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John GRIVAS | Nicole LETCH

PSYCHOLOGY

VCE UNITS 3 AND 4

SEVENTH EDITION

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A Wiley Brand

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John GRIVAS

Nicole LETCH

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PREFACE

Overview of this textbook

The seventh edition of *Psychology VCE Units 3 and 4* comprehensively addresses all the Units 3 and 4 areas of study, outcomes, key knowledge and key science skills specified in the VCE Psychology Study Design (updated June 2017) accredited for the period 1 January 2017 to 31 December 2021.

A key goal of this new edition was to ensure accord with the updated Study Design and the associated VCAA Advice for teachers. Key knowledge amendments to the initially published VCE Psychology Study Design include:

- grammatical, spelling and conceptual corrections that clarify key knowledge dot points
- the term 'dopamine' has replaced the term 'GABA' in Unit 3, Area of Study 1, p.24 (therefore GABA is not accepted in relation to Parkinson's disease after the 2017 exam)
- the examples of 'narcolepsy' as a dyssomnia and 'sleep apnoea' as a parasomnia have been removed in Unit 4, Area of Study 1, p.29 (therefore limiting the scope of content specified for study in relation to 'Effects of sleep disturbances and possible treatments').

In the preparation of this edition, I appreciate the valuable feedback of teachers to fine tune some of the conceptual content and to enhance the number and diversity of learning activities, particularly through additional ideas for practical activities and media analysis/response.

The revised edition also addresses teacher feedback through the inclusion of more explicit links to the Study Design (such as page references), more questions assessing research methodology in more chapters and chapter tests, and more detail within the chapter review aids.

In revising the content, I have also taken account of the initial exam paper and examination report for the Study Design following the first year of implementation of Units 3 and 4 in 2017. The descriptions and explanations of various concepts have been clarified and streamlined or further exemplified where appropriate. All suggested answers and assessment guides for learning activity questions and chapter test short-answer questions in the eGuidePLUS have also been reviewed to ensure better accord with the Study Design and question styles in the exam.

Beyond changes to the content, a new layout gives the text a distinctive and even more engaging look. Specifically, the learning pathway is improved through more prominent headers and additional sub headers, there are distinctive colours for key features, and images are larger.

As in the sixth edition, boxes, colour photographs, diagrams, flow charts and other graphic material are distributed throughout each chapter. These have been updated where appropriate and complemented with references to useful websites, Ted Talks, You Tube videos, online articles and animations. Direct links are provided in the free eBookPLUS supplied with the text, accessed using the code on the inside cover. Additional links to information which should first be previewed by the teacher are provided exclusively in the teacher eGuidePLUS.

The structure, organisation and format of the sixth edition have been retained for each chapter. Information that is likely to be examined, or that closely relates to examinable content, is presented in the central text. Review questions and other learning activities are strategically placed throughout each chapter.

A range of challenging learning activities is presented for each area of study, enabling students to demonstrate their progress in relation to the outcomes. Not all learning activities need to be completed. Teachers can choose those activities (or parts of activities) best suited to their courses and students.

The learning activities involving evaluation of research and data analysis have been enhanced where appropriate. These will be invaluable in preparing students for assessment tasks in school-assessed coursework and the research methods questions in exams. Practical activities and research investigations also serve this function.

The teacher eGuidePLUS includes answers for all learning activity review questions. These answers are not directly available to students. This arrangement complies with teacher requests that access should be quarantined.

In revising the book to meet the Study Design specifications, I have endeavoured to ensure the text is accessible to all students, regardless of specific needs, interests, abilities and socio-cultural backgrounds, but without compromising the required

Units 3 and 4 standards. However, the eBookPLUS enables the teacher to access and customise text content where required. It may also be used to create Powerpoints and other teaching and learning aids (and student presentations).

I hope you have as much satisfaction using this edition of the text as I had in revising the content.

Research methods and other key science skills

The first chapter of the book covers the key science skills, including research methodologies and ethical principles and guidelines, specified in the new Study Design as applying across both Units 3 and 4. Prescribed sciences skills and relevant research methods are explained in detail and supported with examples and graphics that elucidate key concepts and enhance understanding. The first chapter also includes useful information and guidelines for ethically planning, conducting and reporting practical activities and research investigations using reporting conventions as per the American Psychological Association (APA) format. VCAA provides templates for the poster report.

Although research methods content is primarily organised in a discrete chapter, it is not intended to promote the study of all research methods and other science skills as a 'block', in isolation from relevant psychological contexts. Best practice teaching and learning suggests that the key science skills should be 'broken up' and integrated at appropriate points throughout the course.

Chapter tests and answers

At the end of each chapter is a chapter test, comprising multiple-choice and short-answer questions like those in the end-of-year VCE exam. Most of these tests have been expanded, particularly with short-answer questions.

The chapter tests are collectively designed to assess students on key knowledge and science skills covered by the exam. In addition, students can practise answering questions like those in the VCE Psychology exam.

Answers for the multiple-choice questions in the chapter tests are included on page 700. Answers for the short-answer questions can be directly accessed through the free eBookPLUS supplied with the text. Answers to short-answer questions have been designed to support self-assessments.

Glossary

An important feature of the book is the comprehensive glossary. All psychological terms, which appear in the text in bold print, are listed in the glossary along with a definition or explanation of the term as it is used in Psychology. The glossary is a useful compendium for students when studying for tests and the end-of-year exam. The glossary in this revised edition has been enhanced by inclusion of a page number reference for each term to its within-text source. The detailed index will also help students efficiently locate specific information when required.

References

The comprehensive list of references used in preparing the text is also retained. This provides numerous examples of APA conventions for referencing different types of source materials (although digital object identifiers [DOIs] have been omitted).

studyON VCE Psychology

The publisher has included links to the separate and complementary resource *studyON Psychology VCE Units 3 and 4* at its discretion to support student exam study and revision. All studyON content is based on the Study Design and has been developed by other authors independently of this text and has not involved my input.

John Grivas
July 2018

Overview of VCE Psychology

Course outline

Psychology in the Victorian Certificate of Education is offered as a science study. Consequently, there is an emphasis on key science skills and scientific research methodologies in all units.

VCE Psychology is made up of four units. Each unit deals with specific content contained in areas of study and is designed to enable students to achieve the outcomes for that unit. Each outcome is described in terms of key knowledge. Key science skills have also been specified as a core component of all units and apply across all areas of study. These skills include research methodologies and ethical principles. The science skills may be taught separately and/or integrated in the areas of study.

This textbook aims to cover all the Victorian Curriculum and Assessment Authority specifications for Units 3 and 4. The areas of study of these two units are:

Unit 3: How does experience affect behaviour and mental processes?

1. How does the nervous system enable psychological functioning?
2. How do people learn and remember?

Unit 4: How is wellbeing developed and maintained?

1. How do levels of consciousness affect mental processes and behaviour?
2. What influences mental wellbeing?
3. Practical investigation

The areas of study in each unit can be taught in any order. Similarly, within each area of study, the content, including key science skills, can be covered in any order.

The practical investigation specified for Unit 4 is assessed in Unit 4 but may be undertaken in either Unit 3 or 4, or across both Units 3 and 4.

Assessment

Each unit has a set of outcomes that students are required to achieve in order to satisfactorily complete the unit. Each outcome is described in terms of key knowledge, complemented by key science skills. Unit 3 has two outcomes and Unit 4 has three outcomes.

An outcome is a statement of what a student should know and/or be able to do on completion of a unit. Students complete various learning activities throughout each unit to develop the key knowledge and key science skills to achieve each outcome.

The student's level of achievement (e.g. grade) for each unit is determined by school-assessed coursework throughout each unit and a written exam at the end of the year. School-assessed coursework involves completion of a variety of assessment tasks specified by the Victorian Curriculum and Assessment Authority.

The final assessment for VCE Psychology Units 3 and 4 is made up in the following way:

- Unit 3 school-assessed coursework: 16%
- Unit 4 school-assessed coursework: 24%
- End-of-year examination: 60%

For each unit, teachers are required to assess each student's achievement of the outcomes on the basis of overall performance on assessment tasks designated for the unit. Assessment tasks used must be completed mainly in class and within a limited timeframe.

Performance on each assessment task will be determined through advice on the assessment tasks and their assessment given by the Victorian Curriculum and Assessment Authority.

As shown in the following tables, the assessment task(s) associated with each outcome has a specified number of marks allocated towards an overall score for school-assessed coursework. At the end of each unit, the teacher will calculate an overall score on school-assessed coursework and submit this score to the Victorian Curriculum and Assessment Authority.

UNIT 3: How does experience affect behaviour and mental processes?

Outcomes	Marks allocated*	Assessment tasks
Outcome 1 Explain how the structure and function of the human nervous system enables a person to interact with the external world and analyse the different ways in which stress can affect nervous system functioning.	**50**	At least one task selected from: • annotations of at least two practical activities from a practical logbook • evaluation of research • a report of a student investigation • an analysis of data including generalisations and conclusions • a visual presentation • media analysis/response • a response to a set of structured questions • a reflective blog/learning journal related to selected activities or in response to an issue • a test (approximately 50 minutes or not exceeding 1000 words for each task)
Outcome 2 Apply biological and psychological explanations for how new information can be learnt and stored in memory, and provide biological, psychological and social explanations of a person's inability to remember information.	**50**	At least one task (which is different from the type of task/s for Outcome 1) selected from: • annotations of at least two practical activities from a practical logbook • evaluation of research • a report of a student investigation • analysis of data including generalisations and conclusions • a flow chart • media analysis/response • a response to a set of structured questions • a reflective blog/learning journal related to selected activities or in response to an issue • a test (approximately 50 minutes or not exceeding 1000 words for each task)
Total marks	**100**	

*School-assessed Coursework for Unit 3 contributes 16 per cent.

Source: © VCAA, VCE Psychology Study Design (June 2017 update), p. 27.

Note: The VCE Psychology Study Design (June 2017 update) is available on the VCAA website at www.vcaa.vic.edu.au. Teachers are advised to check the *VCAA Bulletin* for updates.

UNIT 4: How is wellbeing developed and maintained?

Outcomes	Marks allocated*	Assessment tasks
Outcome 1 Explain consciousness as a continuum, compare theories about the purpose and nature of sleep, and elaborate on the effects of sleep disruption on a person's functioning.	**30**	Analysis and evaluation of stimulus material using at least one task selected from: • annotations of at least two practical activities from a practical work folio • comparison of different states of consciousness • a report of a student investigation • analysis of data including generalisations and conclusions • media analysis/response • a response to a set of structured questions • a reflective learning journal/blog related to selected activities or in response to an issue • a test (approximately 50 minutes or not exceeding 1000 words for each task)
Outcome 2 Explain the concepts of mental health and mental illness including influences of risk and protective factors, apply a biopsychosocial approach to explain the development and management of specific phobia, and explain the psychological basis of strategies that contribute to mental wellbeing.	**30**	Application of a biopsychosocial approach using at least one task (which is different from the type of task/s for Outcome 1) selected from: • annotations of at least two practical activities from a practical work folio • analysis of the development of specific phobia or the maintenance of mental health • a report of a student investigation • analysis of data including generalisations and conclusions • media analysis/response • a response to a set of structured questions • a reflective learning journal/blog related to selected activities or in response to an issue • a test (approximately 50 minutes or not exceeding 1000 words for each task)
Outcome 3 Design and undertake a practical investigation related to mental processes and psychological functioning, and present methodologies, findings and conclusions in a scientific poster.	**30**	A structured scientific poster according to the VCAA template (not exceeding 1000 words)
Total marks	**90**	

*School-assessed Coursework for Unit 4 contributes 24 per cent.

Source: © VCAA, VCE Psychology Study Design (June 2017 update), p. 33.

Note: The VCE Psychology Study Design (June 2017 update) is available on the VCAA website at www.vcaa.vic.edu.au. Teachers are advised to check the ***VCAA Bulletin*** for updates.

CONTENTS MATRIX

Chapter coverage of the study design

Units 3 & 4: Key science skills

CHAPTER 1 **Research methods in psychology**	*Develop aims and questions, formulate hypotheses and make predictions* • determine aims, research hypotheses, questions and predictions that can be tested • identify and operationalise independent and dependent variables *Plan and undertake investigations* • determine appropriate type of investigation: experiments (including use of control and experimental groups); case studies; observational studies; self-reports; questionnaires; interviews; rating scales; access secondary data, including data sourced through the internet that would otherwise be difficult to source as raw or primary data through fieldwork, a laboratory or a classroom • use an appropriate experimental research design including independent groups, matched participants, repeated measures and cross-sectional studies • select and use equipment, materials and procedures appropriate to the investigation • minimise confounding and extraneous variables by considering type of sampling procedures, type of experiment, counterbalancing, single and double blind procedures, placebos, and standardised instructions and procedures • select appropriate sampling procedures for selection and allocation of participants including random sampling, stratified sampling, convenience sampling and random allocation of participants to groups *Comply with safety and ethical guidelines* • understand the role of ethics committees in approving research • apply ethical principles when undertaking and reporting investigations, including consideration of the role of the experimenter, protection and security of participants' information, confidentiality, voluntary participation, withdrawal rights, informed consent procedures, use of deception in research, debriefing and use of animals in research • apply relevant occupational health and safety guidelines while undertaking practical investigations *Conduct investigations to collect and record data* • work independently and collaboratively as appropriate and within identified research constraints • systematically generate, collect, record and summarise both qualitative and quantitative data *Analyse and evaluate data, methods and scientific models* • process quantitative data using appropriate mathematical relationships and units • organise, present and interpret data using tables, bar charts, line graphs, percentages, calculations of mean as a measure of central tendency and understanding of standard deviation as a measure of variation around the mean • recognise the difference between statistics that describe a specific sample and the use of statistics to make inferences about the population from which the data were drawn • use basic principles of reliability and validity in evaluating research investigations undertaken • explain the merit of replicating procedures and the effects of sample sizes in obtaining reliable data • evaluate investigative procedures and possible sources of bias, and suggest improvements, with reference to identification of potential extraneous and confounding variables including individual participant differences, non-standardised instructions and procedures, order effects, experimenter effect and placebo effects • explain how models are used to organise and understand observed phenomena and concepts related to psychology, identifying limitations of the models • distinguish between scientific and non-scientific ideas

CHAPTER 1 **Research methods in psychology**	*Draw evidence-based conclusions* • determine to what extent evidence from an investigation supports the purpose of the investigation, and make recommendations, as appropriate, for modifying or extending the investigation • draw conclusions consistent with evidence and relevant to the question under investigation • identify, describe and explain the limitations of conclusions, including identification of further evidence required • critically evaluate various types of information related to psychology from journal articles, mass media and opinions presented in the public domain • discuss the implications of research findings and proposals *Communicate and explain scientific ideas* • use appropriate psychological terminology, representations and conventions for reporting research, including standard abbreviations, graphing conventions and the components of a scientific report with reference to inclusion of an abstract, an introduction and sections for method, results and discussion • discuss relevant psychological information, ideas, concepts, theories and models and the connections between them • identify and explain formal psychological terminology about investigations and concepts • use clear, coherent and concise expression • acknowledge sources of information and use standard scientific referencing conventions

Source: © VCAA, VCE Psychology Study Design (June 2017 update).

Unit 3: Key knowledge

CHAPTER 2 **Nervous system functioning**	• the roles of different divisions of the nervous system (central and peripheral nervous systems and their associated sub-divisions) in responding to, and integrating and coordinating with, sensory stimuli received by the body • the distinction between conscious and unconscious responses by the nervous system to sensory stimuli, including the role of the spinal reflex • the role of the neuron (dendrites, axon, myelin and axon terminals) as the primary cell involved in the reception and transmission of information across the synapse (excluding details related to signal transduction) • the role of neurotransmitters in the transmission of neural information between neurons (lock-and-key process) to produce excitatory effects (as with glutamate) or inhibitory effects (as with gamma-amino butyric acid [GABA]) • the effects of chronic changes to the functioning of the nervous system due to interference to neurotransmitter function, as illustrated by the role of dopamine in Parkinson's disease.
CHAPTER 3 **Stress as a psychobiological process**	• sources of stress (eustress and distress) including daily pressures, life events, acculturative stress, major stress and catastrophes that disrupt whole communities • models of stress as a biological process, with reference to Selye's General Adaptation Syndrome of alarm reaction (shock/counter shock), resistance and exhaustion, including the 'fight–flight–freeze' response and the role of cortisol • models of stress as a psychological process, with reference to Richard Lazarus and Susan Folkman's Transactional Model of Stress and Coping (stages of primary and secondary appraisal) • context-specific effectiveness, coping flexibility and use of particular strategies (exercise and approach and avoidance strategies) for coping with stress.
CHAPTER 4 **Neural basis of learning and memory**	• neural plasticity and changes to connections between neurons (including long-term potentiation and long-term depression) as the fundamental mechanisms of memory formation that leads to learning • the role of neurotransmitters and neurohormones in the neural basis of memory and learning (including the role of glutamate in synaptic plasticity and the role of adrenaline in the consolidation of emotionally arousing experiences).
CHAPTER 5 **Models to explain learning**	• classical conditioning as a three-phase process (before conditioning, during conditioning and after conditioning) that results in the involuntary association between a neutral stimulus and unconditioned stimulus to produce a conditioned response, including stimulus generalisation, stimulus discrimination, extinction and spontaneous recovery • operant conditioning as a three-phase model (antecedent, behaviour, consequence) involving reinforcers (positive and negative) and punishment (including response cost) that can be used to change voluntary behaviours, including stimulus generalisation, stimulus discrimination and spontaneous recovery (excluding schedules of reinforcement)

Unit 3: Key knowledge *(continued)*

CHAPTER 5 **Models to explain learning**	• observational learning as a method of social learning, particularly in children, involving attention, retention, reproduction, motivation and reinforcement • the 'Little Albert' experiment as illustrating how classical conditioning can be used to condition an emotional response, including ethical implications of the experiment.
CHAPTER 6 **Process of memory**	• the multi-store model of memory (Atkinson-Shiffrin) with reference to the function, capacity and duration of sensory, short-term and long-term memory • interactions between specific regions of the brain (cerebral cortex, hippocampus, amygdala and cerebellum) in the storage of long-term memories, including implicit and explicit memories.
CHAPTER 7 **Reliability of memory**	• methods to retrieve information from memory or demonstrate the existence of information in memory, including recall, recognition, relearning and reconstruction • the effects of brain trauma on areas of the brain associated with memory and neurodegenerative diseases, including brain surgery, anterograde amnesia and Alzheimer's disease • the factors influencing a person's ability and inability to remember information, including context and state dependent cues, maintenance and elaborative rehearsal and serial position effect • the reconstruction of memories as evidence for the fallibility of memory, with reference to Loftus' research into the effect of leading questions on eyewitness testimonies.

Source: © VCAA, VCE Psychology Study Design (June 2017 update).

Unit 4: Key knowledge

CHAPTER 8 **Nature of consciousness**	• consciousness as a psychological construct that varies along a continuum, broadly categorised into normal waking consciousness and altered states of consciousness (naturally occurring and induced) • the measurement of physiological responses to indicate different states of consciousness, including electroencephalograph (EEG), electromyograph (EMG), electro-oculograph (EOG) and other techniques to investigate consciousness (measurement of speed and accuracy on cognitive tasks, subjective reporting of consciousness, including sleep diaries, and video monitoring) • changes in a person's psychological state due to levels of awareness, controlled and automatic processes, content limitations, perceptual and cognitive distortions, emotional awareness, self-control and time orientation • changes in levels of alertness as indicated by brain waves patterns (beta, alpha, theta, delta) due to drug-induced altered states of consciousness (stimulants and depressants) • the effects on consciousness (cognition, concentration and mood) of one night of full sleep deprivation as a comparison with effects of legal blood-alcohol concentrations.
CHAPTER 9 **Sleep**	• sleep as a regular and naturally occurring altered state of consciousness that follows a circadian rhythm and involves the ultradian rhythms of REM and NREM Stages 1–4 sleep, excluding corresponding brain wave patterns and physiological responses for each stage • theories of the purpose and function of sleep (REM and NREM) including restoration theory and evolutionary (circadian) theory • the differences in sleep across the lifespan and how these can be explained with reference to the total amount of sleep and changes in a typical pattern of sleep (proportion of REM and NREM).
CHAPTER 10 **Sleep disturbances**	• changes to a person's sleep-wake cycle and susceptibility to experiencing a circadian phase disorder, including sleep-wake shifts in adolescence, shift work and jet lag • the effects of partial sleep deprivation (inadequate sleep either in quantity or quality) on a person's affective (amplified emotional responses), behavioural and cognitive functioning • the distinction between dyssomnias (including sleep-onset insomnia) and parasomnias (including sleep walking) with reference to the effects on a person's sleep-wake cycle • the interventions to treat sleep disorders including cognitive behavioural therapy (with reference to insomnia) and bright light therapy (with reference to circadian phase disorders).
CHAPTER 11 **Mental health**	• mental health as a continuum (mentally healthy, mental health problems, mental disorders) influenced by internal and external factors that can fluctuate over time • the typical characteristics of a mentally healthy person, including high levels of functioning, social and emotional well-being and resilience to life stressors • ethical implications in the study of, and research into, mental health, including informed consent and use of placebo treatments.

CHAPTER 12 **Mental disorder**	• the distinction between predisposing risk factors (increase susceptibility), precipitating risk factors (increase susceptibility and contribute to occurrence), perpetuating risk factors (inhibit recovery) and protective factors (prevent occurrence or re-occurrence) • the influence of biological risk factors including genetic vulnerability to specific disorders, poor response to medication due to genetic factors, poor sleep and substance use • the influence of psychological risk factors including rumination, impaired reasoning and memory, stress and poor self-efficacy • the influence of social risk factors including disorganised attachment, loss of a significant relationship and the role of stigma as a barrier to accessing treatment • the concept of cumulative risk.
CHAPTER 13 **Specific phobia**	• the distinctions between stress, phobia and anxiety; variation for individuals with stress, phobia and anxiety on a mental health continuum • the relative influences of contributing factors to the development of specific phobia with reference to: gamma-amino butyric acid (GABA) dysfunction, the role of stress response and long-term potentiation (biological); behavioural models involving precipitation by classical conditioning and perpetuation by operant conditioning, cognitive bias including memory bias and catastrophic thinking (psychological); specific environmental triggers and stigma around seeking treatment (social) • evidence-based interventions and their use for specific phobia with reference to: the use of short-acting anti-anxiety benzodiazepine agents (gamma-amino butyric acid [GABA] agonists) in the management of phobic anxiety and relaxation techniques including breathing retraining and exercise (biological); the use of cognitive behavioural therapy (CBT) and systematic desensitisation as psychotherapeutic treatments of phobia (psychological); psychoeducation for families/supporters with reference to challenging unrealistic or anxious thoughts and not encouraging avoidance behaviours (social).
CHAPTER 14 **Maintenance of mental health**	• resilience as a positive adaptation to adversity including the relative influence of protective factors with reference to: adequate diet and sleep (biological); cognitive behavioural strategies (psychological); support from family, friends and community (social) • models of behaviour change with reference to the transtheoretical model including the stages of pre-contemplation, contemplation, preparation, action and maintenance/relapse.

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Psychology — research methods

What research methods and key science skills are used in VCE Psychology?

CHAPTER 1 Research methods in psychology

1 RESEARCH METHODS IN PSYCHOLOGY

KEY SCIENCE SKILLS

- Develop aims and questions, formulate hypotheses and make predictions
- Plan and undertake investigations
- Comply with safety and ethical guidelines
- Conduct investigations to collect and record data
- Analyse and evaluate data, methods and scientific models
- Draw evidence-based conclusions
- Communicate and explain scientific ideas

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The VCE Psychology study design prescribes a set of key science skills that is a core part of the study of psychology and applies across all areas of study in all units. These skills primarily involve research methods that may be used to undertake investigations and to evaluate the research of others. This chapter focuses on the research methods and the underlying attitudes and principles specified within the key science skills. We start with a brief description of the nature of contemporary psychology to clarify its subject matter and the overall context of VCE Psychology, its aims, areas of study, learning outcomes, key knowledge and key science skills.

DEFINING PSYCHOLOGY AND ITS SUBJECT MATTER

The term psychology originates from two Greek words: *psyche*, meaning soul or mind, and *logos*, which loosely translated means study or knowledge. Therefore, by its original definition, psychology was initially described as 'the study of the soul or mind'. By the late 19th century, when psychology became a distinguishable scientific discipline, it was commonly described as 'the science of mental life'. At this time, 'psychologists' studied the mind by asking their research participants to describe their mental experiences, using questions such as 'What are you thinking?' and 'What are you feeling?'

During the early 20th century, many psychologists adopted the view that a true science can study only overt behaviour. *Overt behaviour* is any action or response made by an organism (person or animal) that is clearly visible and therefore directly observable and readily measured. They rejected the study of mental experiences, as these are *covert*; that is, internal and hidden from view and therefore not directly observable or readily measured. This led many psychologists to change direction from studying mental experiences, such as aggression or forgetting, to studying the outward expressions of these experiences through observable behaviour, such as displays of anger or performance on a memory test. Consequently, in the 1920s, psychology was commonly defined as 'the scientific study of behaviour' (Sdorow, 1995).

This view was dominant until the 1970s, when interest in studying the mind returned, primarily as a result of the development of new technologies such as scanning devices that could capture images of the active human brain while participants engaged in various experimental tasks. This enabled psychologists to more effectively observe and measure the previously 'hidden' activity of the brain. As the new technologies were refined and the discipline of psychology matured, it became increasingly clear to most psychologists that they could not fully understand overt human behaviour without also understanding the mental and biological activity and processes underlying and sustaining externally expressed behaviour.

Currently, definitions of psychology refer to the discipline as involving the systematic study of mental processes and behaviour. This is also the definition adopted for VCE Psychology. However, in VCE Psychology, psychology is defined more precisely as the scientific study of human thoughts, feelings and behaviour. Note the key parts of the definition in Figure 1.1.

(a)

(b)

Figure 1.1 (a) Psychology may be defined as the systematic study of mental processes and behaviour. (b) The psychology symbol is a representation of the Greek letter *psi*.

MENTAL PROCESSES AND BEHAVIOUR

Psychologists usually distinguish mental processes from behaviour. The term **mental processes** generally refers to a person's thoughts and feelings, which are personal, or subjective, and cannot be directly observed. What you think about, how you think when problem solving, how you interpret relationships with others, how you learn, your choice of words in a conversation, your perceptions, how you experience happiness or sadness, your dreaming when asleep, your daydreaming when awake, your emotions and moods, and what motivates you to do something are all examples of mental processes.

These are private, internal experiences that cannot be observed by others in the way that we can see externally expressed actions such as smiling and crying. Consequently, psychologists rely on making inferences about mental processes on the basis of observable or measurable behaviour. An *inference* is a logical assumption, judgment or conclusion based on available evidence. For example, learning cannot be directly observed as it is a mental process that occurs within the individual. Instead, psychologists observe (and measure) performance, or what people do. Then, on the basis of what has been observed, they make inferences about the learning that may have taken place. Similarly, happiness, anger and frustration may be studied by analysing behaviour that accompanies them.

The term **behaviour** generally refers to any action a person (or animal) uses to adjust to the environment. Behaviour involves doing something and is therefore an active process. It is the means by which we can physically express our thoughts and feelings when interacting with the environment. It is also the means by which we (and other organisms) adapt to the environment. Talking, touching, running, perspiring, hugging, flirting, texting, Skyping, watching television, sleeping, socialising and reflexive responses such as blinking and automatically withdrawing your hand if you touch a very hot object are all examples of behaviour that is externally expressed and can therefore be directly observed as it occurs.

Human actions, however, are not necessarily limited to directly observable ones. Behaviour also includes actions through which we adjust to the environment but that cannot be readily observed, such as heart beat, breathing and glandular responses. These activities are hidden from view and can only be detected by inference or through the use of specialised devices and procedures. Consequently, behaviour may be referred to as involving either overt or covert actions and some psychologists may therefore also distinguish between *overt behaviour* and *covert behaviour*.

Although the definition of psychology distinguishes between mental processes and behaviour, these do not often occur independently of one another. They are interrelated and constantly interact. For example, how you overtly behave in a particular situation will be accompanied by underlying thoughts and feelings about that situation. Similarly, your thoughts and feelings about a situation can influence how you behave and the extent to which you will sustain that behaviour. For example, if you think you are being 'used' by one of your friends and feel angry about it, you may refuse to give them your class notes the next time they ask for them. Mental processes and behaviour are only considered separately for the purposes of scientific study, in courses such as VCE Psychology, and in textbooks such as this.

Figure 1.2 Psychologists may distinguish behaviour as (a) directly observable and therefore overt or (b) hidden from view and therefore covert.

PSYCHOLOGY AS A SCIENTIFIC STUDY

Psychologists attempt to understand mental processes and behaviour by using the highly disciplined approach and methods of science to systematically collect, analyse and interpret data. This typically involves experimental research using carefully controlled observations and measurements. The reliance on a scientific approach and use of scientific research methods sets psychology apart from non-scientific disciplines such as history and politics.

Sciences share a common approach to studying their respective subject matter. For example, physics, chemistry, biology, environmental science and psychology differ in what they study, yet each discipline uses a scientific approach and method to achieve common goals of description, explanation, prediction and change, the latter by applying knowledge to prevent an unwanted outcome or bring about a beneficial outcome. While an environmental scientist might pursue these four goals in studying the effects of greenhouse gases on global warming and climate change, a psychologist might pursue them in studying thoughts, feelings and behaviour during sleep.

Table 1.1 shows the key science skills specified for study in VCE Psychology. You will be given the opportunity to develop then demonstrate these skills at a progressively higher level throughout Units 3 and 4.

TABLE 1.1 VCE Psychology Units 1–4 key science skills

Key science skill	VCE Psychology Units 1–4 skills
Develop aims and questions, formulate hypotheses and make predictions	• determine aims, research hypotheses, questions and predictions that can be tested • identify and operationalise independent and dependent variables
Plan and undertake investigations	• determine appropriate type of investigation: experiments (including use of control and experimental groups); case studies; observational studies; self-reports; questionnaires; interviews; rating scales; access secondary data, including data sourced through the internet that would otherwise be difficult to source as raw or primary data through fieldwork, a laboratory or a classroom • use an appropriate experimental research design including independent groups, matched participants, repeated measures and cross-sectional studies • select and use equipment, materials and procedures appropriate to the investigation • minimise confounding and extraneous variables by considering type of sampling procedures, type of experiment, counterbalancing, single and double blind procedures, placebos, and standardised instructions and procedures • select appropriate sampling procedures for selection and allocation of participants including random sampling, stratified sampling, convenience sampling and random allocation of participants to groups
Comply with safety and ethical guidelines	• understand the role of ethics committees in approving research • apply ethical principles when undertaking and reporting investigations, including consideration of the role of the experimenter, protection and security of participants' information, confidentiality, voluntary participation, withdrawal rights, informed consent procedures, use of deception in research, debriefing and use of animals in research • apply relevant occupational health and safety guidelines while undertaking practical investigations
Conduct investigations to collect and record data	• work independently and collaboratively as appropriate and within identified research constraints • systematically generate, collect, record and summarise both qualitative and quantitative data
Analyse and evaluate data, methods and scientific models	• process quantitative data using appropriate mathematical relationships and units • organise, present and interpret data using tables, bar charts, line graphs, percentages, calculations of mean as a measure of central tendency and understanding of standard deviation as a measure of variation around the mean • recognise the difference between statistics that describe a specific sample and the use of statistics to make inferences about the population from which the data were drawn • use basic principles of reliability and validity in evaluating research investigations undertaken • explain the merit of replicating procedures and the effects of sample sizes in obtaining reliable data • evaluate investigative procedures and possible sources of bias, and suggest improvements, with reference to identification of potential extraneous and confounding variables including individual participant differences, non-standardised instructions and procedures, order effects, experimenter effect and placebo effects • explain how models are used to organise and understand observed phenomena and concepts related to psychology, identifying limitations of the models • distinguish between scientific and non-scientific ideas

Key science skill	VCE Psychology Units 1–4 skills
Draw evidence-based conclusions	• determine to what extent evidence from an investigation supports the purpose of the investigation, and make recommendations, as appropriate, for modifying or extending the investigation • draw conclusions consistent with evidence and relevant to the question under investigation • identify, describe and explain the limitations of conclusions, including identification of further evidence required • critically evaluate various types of information related to psychology from journal articles, mass media and opinions presented in the public domain • discuss the implications of research findings and proposals
Communicate and explain scientific ideas	• use appropriate psychological terminology, representations and conventions for reporting research, including standard abbreviations, graphing conventions and the components of a scientific report with reference to inclusion of an abstract, an introduction and sections for method, results and discussion • discuss relevant psychological information, ideas, concepts, theories and models and the connections between them • identify and explain formal psychological terminology about investigations and concepts • use clear, coherent and concise expression • acknowledge sources of information and use standard scientific referencing conventions

Source: © VCAA, *VCE Psychology Study Design* (June 2017 update), pp. 11–12.

STEPS IN PSYCHOLOGICAL RESEARCH

Most of what psychologists know about mental processes and behaviour comes from psychological research studies ('investigations') that have been conducted in a scientific way.

Scientific research involves using an appropriate research method to collect data ('evidence') relating to a question of interest, then analysing the data and drawing valid conclusions from the results in relation to the hypothesis that was tested. The research is based on scientific assumptions, principles and procedures, and is planned, conducted and reported in a systematic way. This approach is also called *scientific method*.

Generally, a systematic, step-by-step procedure is followed when undertaking scientific research. There is not a single, unique set of steps or sequence that everyone follows. Although there are variations to the names of the steps and the order in which they may be followed, most are like those described below and summarised in Figure 1.5 on page 11. The steps do not guarantee accurate and justifiable conclusions, but they help ensure appropriate data are collected and minimise the chance for bias, errors or faulty results and conclusions that cannot be tested through replication of the research.

Step 1 Identify the research topic

The first step involves identifying the specific topic of research interest. The topic that is identified is often called the research 'question' or 'problem'. For example, a researcher might be interested in ways of improving memory. To do this, they may conduct a 'literature review' to find reports of research already conducted on their topic. For example, research studies on memory improvement may include reports on experiments that have:

- tested specific techniques for improving memory (called 'mnemonics') such as 'narrative chaining' and 'acrostics'
- compared 'maintenance rehearsal' involving simple, continuous repetition of the information to be remembered with 'elaborative rehearsal', which involves linking new information with information already in memory.

A literature review enables the researcher to become more familiar with their topic of interest, to refine their ideas and to propose a relevant research question that will provide an aim and therefore help focus their research activities. For example, the researcher might decide to investigate the question 'Is narrative chaining a more effective technique for improving memory than acrostics?'

Step 2 Formulate the research hypothesis

When the topic has been identified and refined to the level of a question, the next step involves construction ('formulation') of an appropriate hypothesis for the research. This is essentially a thoughtfully considered prediction about the outcome when the hypothesis is tested; for example, in a memory improvement study, a prediction about whether the use of a specific memory improvement technique when learning new information will lead to an improvement in memory of that information (when measured using a test of recall).

The research hypothesis is formulated before the study is conducted. It must be testable and written

as a very specific statement. For example, a research hypothesis for the memory improvement study could be 'students who use narrative chaining to learn new information will have a better memory of that information than students who learn the information using acrostics'. Note that within the hypothesis is a possible explanation of the outcome — why some students will have a better memory of what they learn.

There are several other important characteristics of the research hypothesis. These are described on page 15.

Step 3 Design the research

The next step involves determining the type of evidence required to test the hypothesis then devising a plan on how this is best achieved. The overall plan or 'blueprint' that is formulated to collect relevant data is commonly referred to as the *research design*. Generally, the research design will address how, when and where the required data will be collected and analysed.

When designing the research, the researcher must select the most appropriate type of research method (such as an experiment) for testing their hypothesis, and devise the specific procedures that will be used to collect the required data. The researcher must take account of their hypothesis, identify relevant variables and how they will be measured, decide which participants will be studied, how many there will be and how they will be selected and allocated to different groups that may be used in the study. The participants' responses provide the data that become the results for the research.

For the memory improvement study, the researcher may decide to conduct an experiment using Year 6 students from a nearby primary school as participants. For example, if the researcher uses a type of experimental research design called 'independent groups', one-third of the participants could be taught the narrative chaining technique, then they would use it to learn new information (such as a shopping list); one-third would be taught to use acrostics; and the other third would be used for comparison and would therefore not be taught or use narrative chaining or acrostics. Narrative chaining involves story creation using key words and acrostics involve sentence creation using the first letters of key words. The two groups who use a technique for improving memory would be called 'experimental groups', and the comparison group would be called the 'control group'.

There are also organisational matters to attend to; for example, preparation of participant information and consent forms, ensuring availability of participants and a suitable venue at specific times, preparation of instructional and test materials, and submission of the research proposal for review and approval by a human research ethics committee.

When designing the research, it is vital that relevant ethical standards and guidelines that regulate psychological research are considered to help ensure the rights and wellbeing of all participants are protected. These apply to all stages of the research (including the report) and are described on pages 110–16. For example, since children will be used in the memory improvement experiment, the researcher will be required to obtain informed written consent from the parent(s) or guardian(s) of all children who will be selected as participants.

Figure 1.3 An experimental research design may use primary school students to investigate the effectiveness of different memory improvement techniques.

Step 4 Collect the data

The fourth step involves actually collecting the required data in order to determine the results and conclusions that can be drawn. Data may be 'primary' or 'secondary' and 'quantitative' or 'qualitative'. In the memory improvement experiment, the data will be primary (collected 'first hand') and quantitative (in the form of 'numbers' such as test scores). These different types of data are described on pages 89–91.

It is vital that data collection and all other aspects of the research are conducted in an objective way. *Objectivity* involves taking steps to prevent personal factors from influencing any aspect of the research (or its reporting). It requires that data are collected and recorded free of bias, prejudice and other personal factors that may distort it in an inappropriate way. For example, an objective description of an event would simply describe what happened. The description might offer suggestions or beliefs about the motives or emotions of the people involved, but these would be considered *subjective* (or 'personal interpretations'), rather than objective observations.

Step 5 Analyse the data

The data collected by the researcher are initially referred to as *raw data* because they have not been processed or analysed. The next step is therefore to objectively summarise, organise and represent the raw data in a logical and meaningful way to help determine whether the hypothesis is supported and to draw other conclusions.

This usually involves breaking down a large set of numbers into smaller sets (e.g. raw data summarised as percentages in a table or graph), or even down to a single number or two (e.g. a mean score or standard deviation). The researcher is then better able to consider the data when determining whether the hypothesis is supported based on the results obtained. For example, examination ('analysis') of the data may identify patterns, trends, or relationships that support interpretation and evaluation of the results and may subsequently also help explain the results.

Step 6 Interpret and evaluate the results

Once the data have been analysed, they need to be interpreted and critically evaluated. This includes drawing a conclusion(s) about what the results mean and identifying, describing and explaining limitations such as possible bias, errors and uncertainties in procedures and results.

The data may be considered as evidence and all conclusions must be evidence-based. In much the same way as a crime investigator evaluates evidence, the researcher must consider the strengths and potential limitations of their evidence to help ensure their conclusions are justifiable on the basis of evidence and ultimately both valid ('accurate') and reliable ('stable').

One type of conclusion relates directly to the research hypothesis. This involves a judgment on whether or not the results support it. The researcher may also consider how widely the results can be applied. Most psychological research usually involves hypothesis testing with a relatively small number of participants who have been selected from a bigger group of interest; for example, 9 male and 9 female year 6 students from a primary school, rather than all year 6 students at the school or all year 6 students in the area or in general.

Of particular interest to the researcher is whether the findings obtained from a relatively small number of cases, such as the primary school students who were participants in the experiment, can be extended to apply to the bigger group of year 6 students at the school where they were selected, and possibly to other groups and situations; for example, to all years 6 students, to younger and/or older students or people in general.

With reference to the memory improvement experiment, if the results were found to clearly indicate that narrative chaining was a more effective technique than acrostics, then the researcher would interpret the results as supporting the hypothesis. They would conclude that narrative chaining is a more effective strategy for improving memory of new information than acrostics. However, the results might also indicate that using acrostics is also an effective strategy for improving memory (when compared with using no strategy). If so, the researcher would make this conclusion as well.

When drawing conclusions, the researcher examines patterns and trends in the data and bases their judgments strictly on what the results show. Statistical techniques are used to support the process. Their conclusions are restricted to the available data. They would also seek to identify, comment on and take account of any limitations of their study when drawing conclusions. For example, limitations might include:

- participant characteristics (including abilities) or events during the experiment that may have influenced the results in an unwanted way
- that the results may apply only to specific kinds of information (e.g. grocery lists, word lists)
- that mnemonic devices may be more or less suitable for other age, social or cultural groups.

They would also seek to identify further evidence that may be required, including how this could be obtained if the study were to be replicated.

Step 7 Report the research and findings

The final step involves preparation of a report for others who may be interested in the research, its results and findings. Typically, psychological researchers prepare a detailed written report which they seek to get published in a professional journal. Each of these journals has reviewers who critically evaluate the research. It is only on the basis of these 'peer reviews' that the research may be accepted for publication. In addition, a poster report may also be prepared for display and discussion at a conference or meeting with other researchers.

The report prepared for publication in a journal follows a strict format and typically describes in detail all aspects of the research, including relevant background information, how the research was conducted, the results and findings, possible explanations of what was studied and the results obtained, any limitations which may have impacted on the results, comments on the validity and reliability of the research and its data (including reference to their repeatability and/or reproducibility), and a list of references used in preparing for the research and writing the report. A poster report has a format more suited to display and is less detailed.

Reporting the research and its findings is a very important part of the research process. It is the way other researchers find out about research which has been conducted in areas of common interest and the way scientific progress is achieved. It also enables the general public to benefit from the findings of research.

Additionally, the reporting process places the specific study and its research procedures under the critical eye of other psychologists and researchers; for example, to check the accuracy of the results and to consider alternative conclusions that may be valid. It also enables replication by other researchers.

Replication refers to the reproducibility and repeatability of research and its results. This helps ensure the research procedures can be 'reproduced'

(a)

Examples of journals with research reports

- *American Journal of Psychology*
- *American Psychologist*
- *Behavioral and Brain Sciences*
- *Behavioral Neuroscience*
- *Brain Research*
- *British Journal of Psychology*
- *Developmental Psychology*
- *Health Psychology*
- *Journal of Abnormal Psychology*
- *Journal of Adolescence*
- *Journal of Affective Disorders*
- *Journal of Applied Psychology*
- *Journal of Comparative Psychology*
- *Journal of Consulting and Clinical Psychology*
- *Journal of Cross-Cultural Psychology*
- *Journal of Educational Psychology*
- *Journal of Experimental Psychology*
- *Journal of Personality*
- *Journal of Sleep Research*
- *Legal and Criminological Psychology*
- *Neuropathology and Applied Neurobiology*
- *Organizational Psychology*
- *Psychological Bulletin*
- *Psychological Science*
- *Psychotherapy*
- *Schizophrenia Bulletin*

(b)

Figure 1.4 (a) Some of the international journals in which psychological researchers from throughout the world seek to publish their research reports. Note that many are based on sub-disciplines or topic areas of Psychology. (b) One of the Australian journals in which psychologists may publish their research reports.

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Weblinks
View examples of journal articles

under different conditions and that the data and conclusions are not one-off but are 'repeatable' if the research is conducted again under the same conditions (including the type of research method or design, the specific procedures, measures, materials and so on). When replicated, there should be close agreement with the original results. Replication also enables researchers to test the applicability or relevance of the research or results to other groups or situations. Overall, replication is an important test of the reliability of research. *Reliability* is examined in more detail on pages 106–9, as are *reproducability* and *repeatability*.

Figure 1.5 Flow chart of steps in psychological research. There are variations of these steps, but all are based on scientific principles and practices. The flow chart summarises the memory improvement study as if it were completed for VCE Psychology.

BOX 1.1 Designing and conducting experimental research for a practical investigation

The Unit 4 practical investigation SAC requires you to design (or adapt an existing design) and conduct your own experimental research on 'mental processes and psychological functioning'. This may be completed during Unit 3, Unit 4 or across both units. Although there is considerable scope for topic choice, you must use an appropriate experimental research design to collect primary data (see pages 58–60) and present the report using the VCAA poster format (see pages 122–3).

The following guidelines for the practical investigation are based on and summarise the 'Steps in psychological research' described previously. They assume you will work independently and can help ensure you successfully plan and conduct your investigation. The rest of this chapter includes detailed data collection and analysis information relevant to these requirements. Your teacher may provide additional and/or alternative advice of importance, including information about the task, the process, authentication and assessment requirements.

Step 1 Identify the research topic
Identify a suitable topic for investigation. It is desirable that the topic be of personal interest as well as relevant. At this stage, the topic may be broad (e.g. memory).

Step 2 Read relevant literature
Review and become familiar with the area of study and topic you intend to investigate. Refer to VCAA specifications and advice for the investigation (e.g. in the Psychology study design and 'Advice for teachers' available online), the relevant chapter(s) in this textbook, other psychology textbooks, your class notes, credible websites or even journal articles from a library or the internet. This will assist you to refine your ideas. It is important that you focus on arriving at a *specific* topic in the form of a relevant research question that can actually be investigated (such as effectiveness of certain mnemonic devices), rather than a general or broad topic (such as memory). It is also important that you be practical and realistic about what is achievable when deciding on your research question.

Step 3 Identify the research question
Formulate a research question that can be investigated through controlled experimental research or a cross-sectional study (which is like an experiment but lacking its control). Note that primary data must be collected.

Step 4 Draft a research proposal
Draw up an initial plan for carrying out your investigation. Consider the following:

- formulation of your research hypothesis and how it could be tested with reference to the specific type of experimental design, the independent and dependent variables, and how these variables will be operationalised
- variables other than the independent and dependent variables that may have an unwanted influence on the results and therefore need to be controlled
- relevant ethical considerations and safety issues
- who the participants will be, their availability, time requirements for key stages and procedures, and materials/equipment requirements
- the type of primary data that will be collected (i.e. quantitative and/or qualitative) and how it will be summarised and interpreted
- any test or other measure used to collect data, e.g. list of words for a test of recall
- potential limitations of the research methodology and data and the extent to which these may impact on the conduct of the investigation and its results.

Submit your proposal to your teacher. Regardless of how careful you are, your teacher may find flaws in the research design and oversights in ethical or safety considerations that you, the original designer (or adapter), being so close to the research, might not notice. Your teacher will also check that the investigation can meet all SAC requirements. Furthermore, according to the VCE Psychology study design (pp. 8–9), your teacher is responsible for ensuring that your research is conducted safely and ethically.

Step 5 Refine the research design
Correct any problems with your initial proposal. Ensure your research hypothesis is clearly stated and testable using your proposed research design. Your choice of sample and the control of variables are important considerations. The sample size should be manageable. Prepare a revised research proposal.

Step 6 Obtain approval to conduct the investigation
Submit your research proposal to your teacher to obtain approval to conduct the investigation.

Step 7 Organise materials and arrangements for the investigation
Ensure compliance with relevant participant consent requirements. Schedule and confirm availability of participants, the research setting or venue, materials, equipment and any other relevant resources.

Step 8 Collect the data
Conduct the investigation to test your hypothesis. Ensure that you collect the data objectively and follow all relevant ethical and safety guidelines.

Step 9 Present the results
Summarise the raw data, organise it and present it in an appropriate form using relevant statistical measures such as percentages and means. Data is usually presented in tables and figures such as graphs and charts.

Step 10 Analyse the results
Evaluate and interpret the summarised data in relation to your research hypothesis. Identify patterns and relationships, including sources of error and limitations of the data, your research design and how you implemented the design.

Step 11 Draw a conclusion(s)
Having interpreted the data, state the major finding(s) of the investigation. Make a statement about whether the results support or do not support your hypothesis. Review your research design and comment on any limitations of the investigation (including potential influences of unwanted extraneous or confounding variables), ways to improve the design and the possible wider application (generalisation) of the results.

Step 12 Present a report
Finally, prepare a report using the poster format described on pages 122–3. Your teacher will advise you about the template that can be used to guide the format and presentation, as well as the degree of detail required. Keep in mind that your report will be assessed, and ensure that your report will meet all the assessment criteria.

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VCAA practical investigation specifications

RESEARCH METHODS

Psychologists can choose from a wide variety of research methods to scientifically collect data in order to test hypotheses and answer questions on topics of interest. A *research method* is a particular way of conducting an investigation to collect accurate and reliable information about mental processes and behaviour. For example, an experiment and an observational study are different research methods, each of which uses a specific set of procedures for data collection. Although they share some procedures, they are clearly distinguishable research methods.

Each type of research method has its specific purposes, procedures, advantages and limitations. The researcher's choice depends on which method is most appropriate for the specific topic of research interest and hypothesis being tested. This is not unlike the choice a carpenter makes of which tool to use. Whether a hammer or drill is selected depends on the work to be done. Each tool has a specific use and way of being used. Similarly, each research method has a particular logic underlying its use and how it is used. In some cases it may be appropriate to use a combination of research methods to investigate and collect data. For example, a researcher conducting an experiment on different memory aids used by VCE students when studying for an exam may also conduct a survey to find out what motivates them to study for an exam, where they study, when they study and how much time they spend.

Sample selection and formulation of a research hypothesis are common to all psychological investigations requiring participants and are undertaken early in the research process. We consider each of these important procedures before examining the research methods prescribed in VCE Psychology and the specific features that distinguish these methods.

Figure 1.6 A carpenter chooses tools depending on the work to be done, just as the researcher chooses the most appropriate research method to conduct an investigation on their topic of research interest.

Sample and population

Psychologists mostly conduct research with people. Participants are the people who take part in the research. The responses (or 'reactions') of the participants provide the data and the results for the research. The participants who are selected and used in the research are said to form the sample. A **sample** is a group of participants that is a subset or part of a larger group chosen to be studied for research purposes.

The term **population** is used in psychological research to describe the larger group from which a sample is selected and to which the researcher will seek to apply (generalise) the results. In scientific research, the term 'population' does not refer to all the people in a particular country or to the whole human race. It refers to a particular group or an entire set of individuals who has one or more characteristics in common; for example, all VCE Psychology students enrolled at a particular school, all VCE students in all schools, all females, all females who have been diagnosed with schizophrenia and are patients in a hospital, all left-handed males, all registered nurses aged 25 to 30 years, all cigarette smokers, all twins, all four-year-old twins, or all four-year-old identical twins born at a particular hospital.

Figure 1.7 A sample is a subset of a population selected as participants for a research study. The population is the entire set of individuals to which generalisations will be made based on the sample.

The population used for research can also be a measurement; for example, all EEG (brain wave) recordings for an individual during a certain period of time, the IQ scores of all students in a particular school, all drug-related deaths reported by the coroner in the previous 12 months, all absences from a workplace in a ten-year period due to a stress-related problem, all the days on which the temperature exceeded 30°C, all the words in the English language, all public hospitals in Victoria providing adolescent mental health services, or all of any other specified data.

A sample is always a part of the population. Therefore, it is always smaller than a population. When studying people, psychologists can rarely be certain about any mental process or behaviour that occurs in a population because they can rarely study all its members — it's usually too large a group. Consequently, researchers draw a sample that is appropriate for testing their hypothesis and attempt to generalise the results obtained for the sample to the population from which it is drawn. This is why it is important that the sample accurately reflect, or be representative of, the entire population of interest, although this is not always possible.

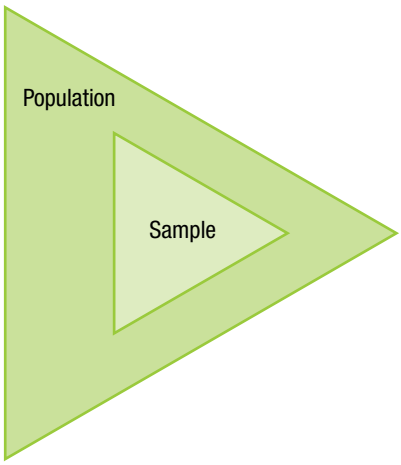

Figure 1.8 If a sample accurately reflects its population, the researcher is more able to generalise the results for the sample to its population.

Research hypothesis

In psychology, as in other sciences, a research study is designed to test one or more hypotheses relevant to the specific topic or question of research interest. A **research hypothesis** is a testable prediction about the relationship between two or more variables (i.e. events or characteristics). It typically states the existence of a relationship between the variables of interest, the expected relationship between them and a possible explanation of the results. For example:

- Watching violent television programs will lead to an increase in aggressive behaviour in young children.
- VCE students perform better on exams when they study on a regular basis.
- Changing channels occurs more frequently when watching television alone than when watching with others.
- Mobile phone conversation while driving, whether hands-on or hands-off, impairs driving performance.

The research hypothesis is often described as an 'educated guess'. This is because it is based on what is already known about relevant behaviour and mental processes; for example, from:

- what has been learnt through prior experience, including observations in everyday life
- reading a psychological theory on the topic and/or
- findings from previous research studies.

The research hypothesis is formulated before the investigation is conducted and provides a very specific focus for the investigation and its report. A useful research hypothesis has the following characteristics:

- refers to events or characteristics that can be observed and measured and is therefore testable (e.g. a hypothesis that people see a bright light when they die is not testable because it is not possible to observe or measure human experiences after death)
- states the existence of a relationship between two or more variables (e.g. a change in one variable is caused by the presence of the other variable)
- states the expected relationship between the variables, sometimes referred to as the 'direction' of the relationship (e.g. how one variable will influence the other)
- explains the prediction or expected results (e.g. an increase in aggressive behaviour will be attributable to watching violent television programs)
- based on observations, a theory, model or research findings
- prepared as a carefully worded written statement (rather than a question)
- expressed clearly and precisely (rather than vaguely and generally)
- written as a single sentence.

In some cases, the research hypothesis may also refer to the specific population from which the sample was drawn and therefore the larger group about which the researcher intends to draw conclusions. The population, however, is most commonly described in the introduction to the report on the investigation.

There is no preferred writing style for a research hypothesis. Different writing styles can be equally valid. For example, some hypotheses use an 'if-then' style, such as '*if* a certain event occurs, *then* it will cause a certain response'. In relation to children's television viewing, this may be stated as: 'If children watch violent programs on television, then they will behave more aggressively'.

It is not always possible to be entirely certain about the accuracy of the prediction within a hypothesis, which is why it is often described as a *tentative* prediction or statement. This is mainly because the researcher does not necessarily know or can control the influence of the many different variables that may affect a person at any given time. Nonetheless, most researchers would probably consider it pointless to conduct an investigation when the outcome is certain.

Scientific predictions tend to be more accurate about a large group or people in general than about a specific person. For example, a car insurance company can more accurately predict the percentage of people in a particular age group who are likely to be involved in road accidents this year than it can predict whether any particular individual in that age group will have an accident. Similarly, a psychologist may be able to correctly predict that cigarette smokers will be more *likely* to suffer a heart attack, but they cannot predict with certainty whether a particular cigarette smoker will suffer a heart attack.

This situation is no different in other sciences, which can only make predictions with varying degrees of probability of being correct. For example, your doctor may prescribe an antibiotic that, based on medical research, is *usually* effective in treating pneumonia. Your doctor, however, cannot guarantee that it will cure *your* pneumonia. Similarly, seismologists know that cities lying along geological faults are more likely to experience earthquakes, but they cannot accurately predict the day, or even the year, when one of these cities will experience its next major earthquake (Sdorow, 1995).

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Figure 1.9 Scientific predictions tend to be more accurate about a large group or people in general than about a specific person. For example, a psychologist may be able to correctly predict that cigarette smokers will be more *likely* to suffer a heart attack, but they cannot predict with certainty whether a particular cigarette smoker will suffer a heart attack.

Theory and model

A research hypothesis is different from a theory and model — it is a specific prediction that guides the collection, analysis, interpretation and evaluation of data to test it. In contrast, a **theory** or **model** is a general explanation of a set of observations or findings about behaviour and/or mental processes that seem to be related. Both are used to organise and understand observed phenomena ('events') and concepts ('ideas') that are relevant to some aspect of psychological functioning.

There are examples of theories and models throughout this text, as they are an important part of your study of psychology. These include:

- models of stress as a biological or psychological process
- models to explain learning
- Atkinson-Shiffrin multi-store model of memory
- theories of the purpose and function of sleep
- 4P factor model of mental health
- biopsychosocial model of mental health
- transtheoretical model of behaviour change.

The term model is used interchangeably with theory although many models tend to focus more on representing *how* some behaviour and/or mental process could, should or does occur. For example, a model is often supported by one or more diagrams with boxes and arrows to organise and show relationships between different concepts.

Theories and models vary in scope, complexity and detail. All have one or more advantages and limitations. Some are essentially a hypothesis that has been restated. Others explain many interrelated research findings and ideas. Along with explaining existing results, a useful theory or model generates new hypotheses and guides further research. Many theories or models of learning, remembering, personality, mental health, stress-related effects, phobia acquisition, child development, problem-solving, creative thinking and so on, are the products of psychological research and have generated valuable new research. In addition, some theories have generated new models and some models have generated new theories.

Whatever their scope — from tiny to vast — theories and models serve a gap-filling function. They explain how findings and ideas fit together and what they mean, thereby making psychology a discipline that does more than report isolated facts.

Psychologists prefer testable theories and models because they can be confirmed, revised or rejected by further scientific research. Therefore, theories and models tend to not be judged in terms of their accuracy, but rather in terms of their usefulness. This means that a theory or model tends not to be considered as either right nor wrong. Instead, it is simply regarded as more or less useful.

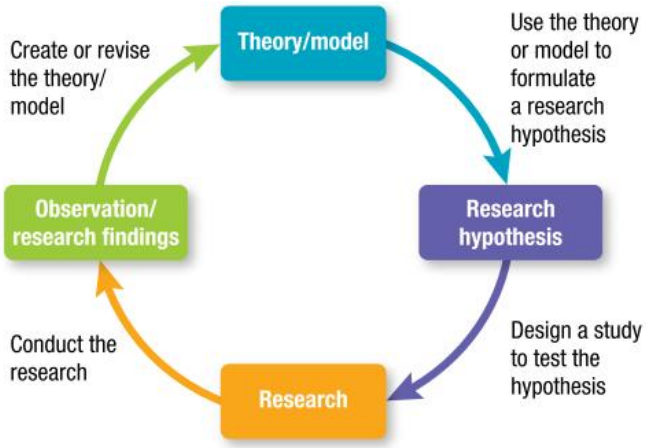

Figure 1.10 Theories and models are expanded and revised to reflect relevant research findings. New or revised theories and models lead to new observations or questions that stimulate new research.

LEARNING ACTIVITY 1.1

Review questions

1. (a) What is the difference between a sample and population in relation to research?
(b) Why is it important that a sample and its population are as alike as possible?

2. (a) Explain the meaning of hypothesis when used in a research study (investigation).
(b) Distinguish between a research hypothesis and a theory or model, with reference to an example of a psychological theory and/or model.
(c) Why can a research hypothesis be described as an 'educated guess'?

3. Construct a two-column table. In one column, list the characteristics of a useful research hypothesis. In the other column, summarise each characteristic using not more than three words.

4. Explain two possible limitations of the following question if it were to be used as a research hypothesis: *Do some people have an extrasensory perceptual ability to send and receive mental messages?*

5. Formulate a research hypothesis for each of the following topics or questions. Two of the hypotheses should be written using the *if-then* style. Note an example of a construction process for if-then hypotheses in the VCE Psychology *Advice for teachers* digital publication.
(a) Lack of attention causes forgetting.
(b) Crowding increases aggression.
(c) Positive thinking leads to success in a job interview.
(d) Does offering an incentive result in greater motivation to succeed?
(e) What is the effect of rote learning of information on a person's ability to recall the information when needed?
(f) Does being permitted to take a bottle of water into an exam improve performance on the exam?

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LEARNING ACTIVITY 1.2

Reflection

Someone has adopted a position that psychology is not a 'real' science like biology or physics. What two or three points could be made in support of psychology being a scientific discipline?

Experimental research

One of the most scientifically rigorous research methods used in psychology, as in other sciences, is the experimental method. This provides a means of collecting evidence to measure the effect of one variable on another. More specifically, an **experiment** is used to test a cause–effect relationship between variables under controlled conditions. For example, an experiment would be used to find out:

- if the variable of anxiety (a possible cause) has an effect on the variable of exam performance
- if the variable of playing music while studying (a possible cause) has an effect on the variable of learning
- if the variable of amount of sleep (a possible cause) has an effect on the variable of memory.

In any of these examples, a researcher (or 'experimenter') could conduct an experiment to find out if there is a causal (i.e. 'cause–effect') relationship between the different variables. When conducting an experiment, the researcher would do so in a planned, systematic way, controlling all variables that can influence the results, not just the independent variable (which is described below) but all other variables too. Generally, to 'control' variables means to regulate or 'keep constant' their influence (ideally minimising or eliminating), except those being systematically varied (i.e. the independent variable(s)).

There are different types of experimental designs that vary in terms of their specific procedures and complexity. All experiments, however, have a number of common features. We consider the essential features of the psychological experiment and why this particular research method can be used to investigate causes of behaviour and links between behaviour and mental processes.

Variables

In research, a **variable** is something that can change ('vary') in amount or type and can be measured. For example, sleep can change in both amount (e.g. number of hours) and type (e.g. with or without rapid eye movements) and is measurable (e.g. through recordings of bodily activities such as eye movements and brain wave patterns).

There is a virtually endless list of variables that may be studied in psychology. Examples include age, sex, intelligence, mood, problem solving, memory, state of consciousness, sociability, use of social media,

diet, exercise, media violence, drug-taking, risk-taking, family environment, religion, culture, work space, crowding, number of errors, and time taken to perform a task.

A variable may be a personal characteristic, either physical or psychological, or an event that can have a specific influence on how an individual may think, feel or behave. Personal characteristics such as biological sex, blood type, genetic make-up and racial or ethnic background are all inborn and therefore 'fixed' and ordinarily unchanging within a person. However, in psychological research they are still considered variables because they can be of different types and are measurable. For example, 'male' and 'female' are two types of biological sex and 'O', 'A', 'B' and 'AB' are four different blood types. Although a researcher cannot actually change a participant's sex or blood type, they can 'manipulate' (or 'change') them by allocating males and females and/or people with different blood types to different groups used in their experiment in order to make comparisons. Similarly, age and intelligence are 'fixed'. However, the researcher can manipulate them by comparing naturally occurring variations; for example, the performance of old and young participants, or, more or less intelligent participants (as indicated by IQ scores).

Independent and dependent variables

Every experiment includes at least one independent variable and one dependent variable. Whatever the type of true experimental design, the independent variable will be manipulated to determine the effect on the dependent variable.

The **independent variable (IV)** is the variable that is systematically manipulated or changed in some way by the researcher in order to measure its effect on the dependent variable. For example, in an experiment on whether watching a violent television program increases aggressive behaviour, the IV will be exposure to a violent television program. Its 'manipulation' will involve exposing or not exposing participants to violence in a television program to observe the consequential changes in the dependent variable (aggressive behaviour). The IV is sometimes referred to as the 'treatment' variable or condition to which participants in an experiment may be exposed. The independent variable is assumed to have a direct effect on the dependent variable so it is also assumed that any measurable change in the dependent variable will be due to the effect of the independent variable.

As indicated in the example above, a 'treatment' may also be withheld; for example, to compare its effect(s) on participants who are exposed to it with those who are not. This is why an IV may also be referred to as having different values (or levels) — the value of the IV is systematically 'manipulated'. In the simplest type of experiment, the IV has two values, such as exposure or non-exposure to violence in a television program.

More complex experiments have three or more values of the IV; for example, non-exposure to a violent TV program, exposure to one violent TV program and exposure to two violent TV programs. In this case, the IV has been manipulated 'quantitatively' by varying its 'amount' — exposure to one or two violent TV programs. Alternatively, the IV may be manipulated 'qualitatively' by varying its 'type'. In this case, the values of the IV may involve exposure or non-exposure to specific types of violent TV programs; for example, to compare the influence of violence by cartoon characters with violence by people in a movie.

An even more complex experiment may compare responses of male and female participants to various types of violent and non-violent male and female characters or people in different types of TV programs (qualitative variables) following different periods of exposure, such as 15 minutes, 30 minutes, 45 minutes, 1 hour, and so on (quantitative variables).

An experiment can also have more than one IV. For example, a researcher might test a hypothesis that a child will behave aggressively after watching a violent TV program only if other children are present. In this case, both the violent TV program and the presence of other children would be IVs. A third IV could be drinking a high sugar content cordial during the program. Of course, one or more of these IVs could also have different values.

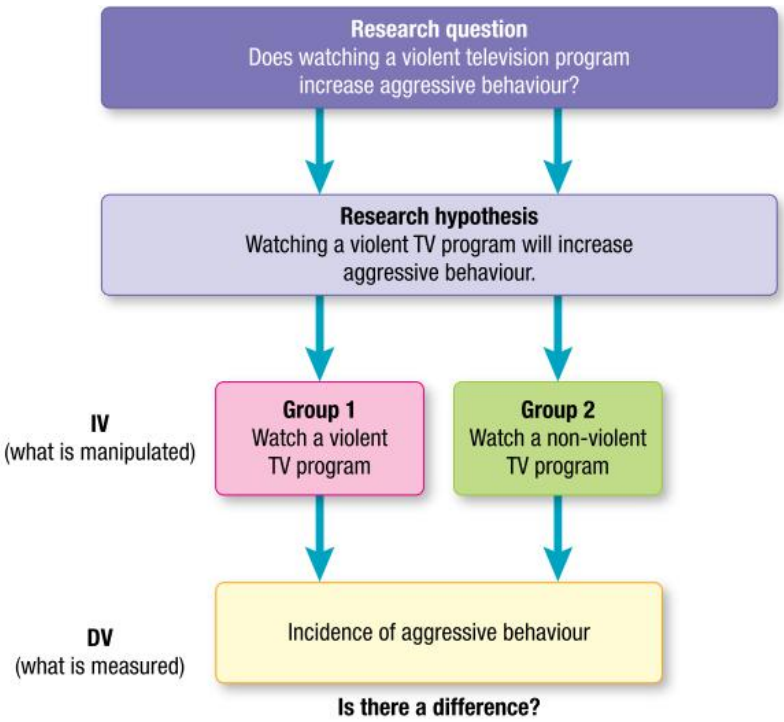

Figure 1.11 The IV and DV in an experiment on whether watching a violent television program increases aggressive behaviour

The **dependent variable (DV)** is the variable that is used to observe and measure the effects of the independent variable. It is the aspect of a participant's behaviour or experience that is assumed and expected to change as a result of the manipulation of the independent variable. The DV is often the responses made by participants and usually has a numerical (quantitative) value. For example, a behaviour such as aggression in young children might be observed and measured by the number of times physical contact is made with another person in a 5-minute period immediately after a child has been exposed to a violent or a non-violent TV program. Aggressive behaviour is the dependent variable, because the participants' responses are believed to be influenced by, or 'dependent on', the effects of the independent variable. It is sometimes referred to as the 'measurement' variable, because it provides a 'measure' of the participants' responses to the independent variable.

In the examples of possible experiments given earlier in this section on page 17, anxiety would be the IV and exam performance the DV; playing music while studying would be the IV and learning the DV; and amount of sleep would be the IV and memory the DV.

In terms of a cause–effect relationship, the independent variable is viewed as the possible *cause*, and change in the dependent variable is the possible *effect*. In experimental research, the research hypothesis states the causal relationship between the independent and dependent variables to be tested; that is, that the IV(s) will cause the DV(s) to change in a particular way. When the results of an experiment are shown on a graph, the IV(s) is plotted on the horizontal axis (e.g. Hours spent studying) and the DV(s) on the vertical axis (e.g. Score on a Psychology Unit Test).

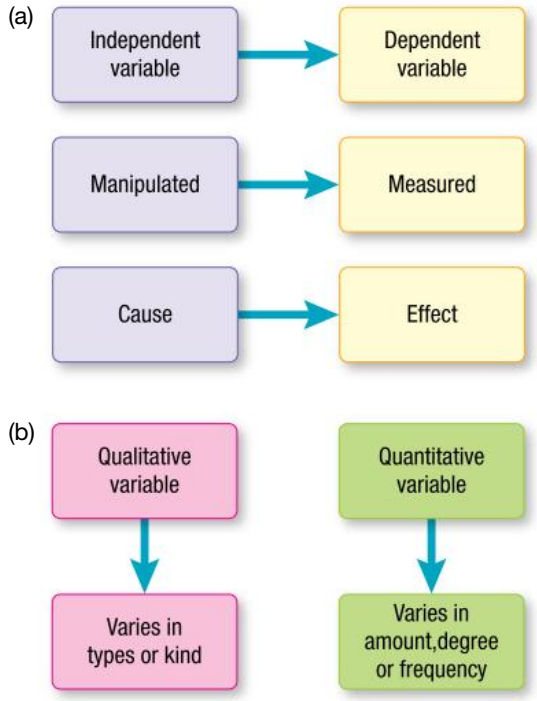

Figure 1.12 Distinguishing between (a) an IV and DV, and (b) a qualitative variable and quantitative variable

LEARNING ACTIVITY 1.3

Review questions

1. What is an experiment?

2. Explain the meaning of control in relation to an experiment.

3. Write a definition of each of the following terms as they apply to an experiment:
- variable
- independent variable
- dependent variable
- quantitative variable
- qualitative variable

4. (a) What do researchers expect to happen to DVs when they manipulate IVs?
(b) What does 'manipulation' of an IV actually involve?
(c) Give an example of how each of the following could be manipulated quantitatively and qualitatively if it is an IV in an experiment:
(i) sleep
(ii) lighting
(iii) room temperature
(iv) a word
(v) body weight

5. Identify the IV and DV in each of the following if experimental research were to be conducted.
(a) Receiving a reward for studying will increase the amount of time students engage in studying.
(b) People who are in love perceive each other more positively than other people perceive them.
(c) Recall of information presented early in a list is better than recall of information presented later in a list.
(d) People react faster to sounds than to visual stimuli.
(e) Using adult language when talking to infants improves their vocabulary.
(f) People change their pitch of voice when lying.
(g) Daydreaming occurs more frequently during simple tasks than during complex tasks.
(h) Workers on an assembly line are more productive when working alone than in a small group.
(i) Heart rate and blood pressure increase when viewing a violent move clip as compared to a non-violent movie clip.
(j) Infants pay attention to a complex stimulus for a longer period of time when compared with a simple stimulus.

LEARNING ACTIVITY 1.4

Identifying IVs and DVs in experiments

A. A laboratory experiment

A researcher noticed that some of her laboratory rats stood on their hind legs for a moment whenever their food was brought into the laboratory. She decided to test whether she could teach the rats to stand on their hind legs when she rang a bell.

First she measured the exact amount of time the rats spent standing when the food was brought in. Then she rang a bell just before each meal. The rats eventually started to stand on their hind legs when they heard the bell.

1. What two IVs are being manipulated in the experiment?
2. What is the DV and how is it measured?
3. Why did the researcher measure the rats' movements before introducing the ringing bell?

B. A field experiment

A researcher observed helping behaviour in a real-world setting. An actor pretending to be either drunk or blind was required to collapse on a Melbourne underground train platform.

Sometimes the actor was an Aboriginal male and sometimes the actor was an Anglo-Saxon male of about the same age.

The researcher then recorded how long it took for help to be given.

1. What is the IV and how many values or levels does it have?
2. How is the IV manipulated?
3. What is the DV and how is it measured?

Operationalising independent and dependent variables

Operationalising the independent and dependent variables involves defining and explaining them in terms of the specific procedures ('operations') used to measure them in a particular experiment. Stating *how* the IV and DV will be defined and measured is an important step because many of the behaviours and mental processes psychologists investigate can have different meanings and can therefore be specifically defined and measured in more than one way.

For example, consider an experiment to investigate whether exercise provides relief from depression. 'Exercise', which is the IV, might be operationalised as 'walking at a particular pace for a specified period of time on an automated treadmill'. 'Depression', which is the DV to be measured, might be operationalised as the number of negative words used in writing a creative story, as it has been found through previous research studies to be related to the severity of depression. Similarly, consider the way in which each of the following potential variables that can have multiple meanings might be operationalised for the purpose of experimental research.

- intelligence — a score on a standardised intelligence test
- memory — a score on a test of free recall
- learning — the reduction in the number of errors when performing an unfamiliar task
- anger — changes in blood pressure, heart rate and respiration rate
- physical attraction — the number of times someone touches another person
- love — the frequency of expressions of affection such as kissing, touching and cuddling

Operationalising the IV(s) and DV(s) ensures that these variables are precisely defined and explained. The resulting definitions are sometimes called *operational definitions* (see Box 1.2 on the next page).

There are several important benefits of variables being defined precisely through operationalisation. These include:

- It helps ensure the independent and dependent variables are testable and therefore that the research hypothesis is testable.
- All researchers involved in conducting the experiment know exactly what is being observed and measured and how this will occur. This helps avoid experimenter biases and differences that can affect the results in an unwanted way.
- When the variables are defined in a very precise way, another researcher interested in the results, or perhaps even doubting them, will be more able to replicate the experiment in order to test ('check') the results obtained for accuracy or for relevance to other groups or situations.

When a study is replicated under the same conditions using a similar sample and similar results are obtained (i.e. the results are 'repeatable'), there is greater confidence in the validity of the results. There is even greater confidence when replication under different conditions achieves very similar results (i.e. the results are 'reproducible'). Alternatively, if replication of a study fails to produce the same basic findings, researchers have less confidence in the findings reported for the original research.

The research hypothesis for an experiment may refer to the operationalised variables (but this is not essential). For example, consider a possible hypothesis for the experiment on exercise and depression:

> *People with depression who exercise regularly will have fewer symptoms of depression than people who do not exercise.*

Note in this research hypothesis that:

- the IV is stated, including both its values i.e. regular exercise and no exercise
- the DV is clear i.e. number of symptoms of depression
- the expected effect of the IV on the DV is also stated, specifically, the direction of the predicted effect — that is, the way in which the two groups (exercise and no exercise) are predicted to differ (not simply that there would be a difference).

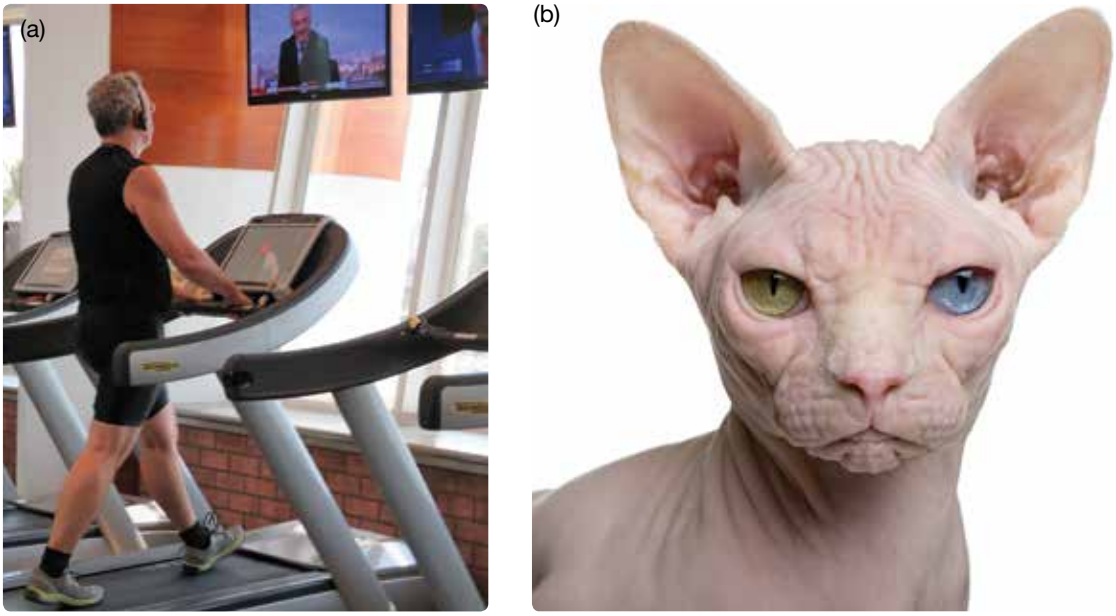

Figure 1.13 (a) Exercise might be defined as walking at 7 km/h for 30 minutes on an automated treadmill. (b) Is this cat attractive? The answer depends on how you operationalise attractive.

BOX 1.2 Operational definitions

In psychology, as in any other science, definitions of the concepts under investigation (and any other descriptions) must be clear and precise. Consider the statement 'the research is about crime'. 'Crime' could refer to riding a bicycle without an approved helmet, parking in front of a fire hydrant, shoplifting, assaulting someone, committing armed robbery, smuggling protected Australian birds out of the country, and so on. Like many of the words that we use in everyday conversation, the term 'crime' covers a broad range of behaviours and is therefore too inexact to use for research purposes.

Similarly, a term such as 'generous', while appropriate to use in everyday conversation, is too imprecise for research purposes because generosity can be demonstrated in many different ways, such as donating money to a charity, volunteering to coach a junior sports team, or spending time with a friend who is unwell or facing difficult times.

Researchers overcome this problem by defining their subject matter in terms of the way they observe or measure it — they define *what* they are measuring by describing precisely *how* they are measuring it.

The resulting definitions are called operational definitions. An *operational definition* is a definition of a variable, condition or some other observable event. It defines an observable event in terms of the specific procedures (or 'operations') used to measure that variable. Operationalisation of the IVs and DVs in an experiment essentially involves stating their operational definitions.

Consider, for example, a researcher who is interested in the conditions under which a rat turns left rather than right in a maze. It may seem relatively simple to determine the direction a rat turns in a maze. But what exactly is a *turn*? What will the researcher *observe*? How will the researcher *measure* the turn of a rat in a maze? Will the rat sticking its nose around the corner be considered a turn? What if it gets most of its body around the corner and then scoots back? Does the rat's tail have to make it all the way around? As basic as it may seem, the researcher would have to operationally define a *turn in a maze* by specifying exactly how it will be measured. For the purposes of this study, the operational definition of a *turn* might be 'when a rat's tail makes it all the way around a corner'. And, for the examples of *crime* and *generous* referred to previously, *crime* might be operationally defined as 'any act listed as a felony by Australian law', and *generous* might be operationally defined as 'donating more than 5% of one's annual salary to charity'.

Figure 1.14 A researcher will operationally define a turn in a maze by specifying exactly how it will be measured.

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LEARNING ACTIVITY 1.5

Review questions

1. What does operationalisation of an experiment's independent and dependent variables involve?
2. List three potential benefits of operationalising variables.
3. Suggest how the IV and DV could be operationalised for an experiment on each of the following research hypotheses.
   (a) Anxiety causes forgetting.
   (b) Crowding increases aggression.
   (c) Relaxation minimises stress.
   (d) Practice assists learning.
   (e) Girls talk more than boys.
4. Suggest an operationalised IV and DV for each of the following research questions.
   (a) Does offering an incentive result in greater motivation to succeed?
   (b) What is the effect of rote learning of information on a person's ability to recall the information when needed?
   (c) Does being permitted to take a bottle of water into an exam improve performance in the exam?
   (d) Does parental attention increase the incidence of tantrum behaviour by toddlers?
   (e) Does sleep deprivation time cause an increase in reaction time when riding a bike?

Experimental groups and control groups

In a relatively simple experiment, the participants selected are allocated to one of two groups. One group of participants, called the **experimental group**, is exposed to the IV (i.e. the 'treatment') under investigation. This group may also be described as being in the **experimental condition**. A second group of participants, called the **control group**, is not exposed to the IV. This group may also be described as being in the **control condition**. This experiment is shown below.

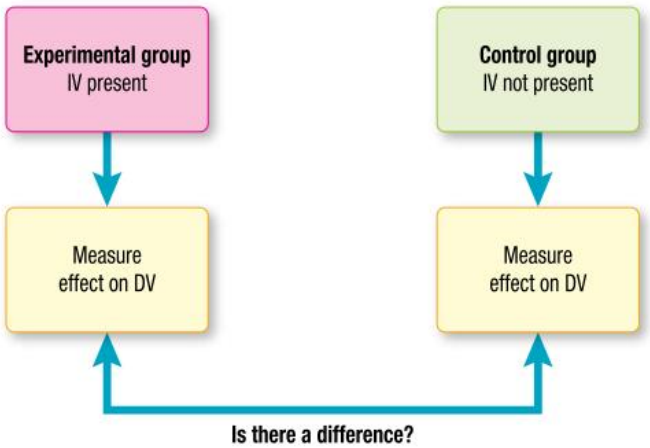

Figure 1.15 A simple experiment

For example, consider an experiment to test whether displaying posters of rock stars wearing a particular brand of jeans increases sales of that brand. The experimental group is exposed to a condition whereby posters showing rock stars wearing the jeans are displayed prominently in a jeans store, while the control group is not exposed to the posters. The DV might be the number of pairs of that brand of jeans sold (this experiment is shown on the next page).

The control group provides a standard or 'baseline' against which the performance of the experimental group can be compared to determine whether the IV has caused some change in, or affected in some way, the behaviour or event being measured (the DV). Without a control condition, it would not be possible to assess the influence of an IV; for example, whether the posters of rock stars wearing the jeans affected the number of pairs of jeans purchased.

If a significantly greater number of these jeans are purchased by participants in the experimental group, the experimenter may assume that the difference between the two groups was caused by the exposure of the experimental group to the posters of rock stars (IV). However, in order to make this assumption, the experimenter must be confident that no variable other than the IV being tested had an excessive influence on the purchase of jeans.

It is important that the experimental group and the control group are as similar as possible in personal characteristics that might cause a change in the DV. For example, one group should not have significantly more participants who have access to more spending money so that this doesn't become a possible reason for the difference in jeans purchased that may be recorded. It is also necessary to treat the two groups the same, except for exposure of the experimental group to the IV. For example, one group should not receive more or better quality customer service than the other. Both of these conditions are necessary so that if a large enough change occurs in the experimental group and does not occur in the control group, the researcher can be more confident in concluding that it was the IV that most likely caused the change and not some other variable.

Some experiments do not have an experimental group and a control group with different participants. Instead, they have one group of participants who are exposed to *both* the control condition and the experimental condition. For example, to study the influence of rock music on people's concentration while driving, a group of participants could have their driving abilities tested in a simulator while no rock music was playing (control condition). The same group would later be tested again in the simulator

while there was rock music playing (experimental condition). The test results of the same group under the two different conditions would then be compared.

Sometimes the experimental condition and control condition are collectively called *experimental conditions*, which literally means 'all the conditions of the experiment'. When this expression is used, the condition in which the IV is present is often referred to as the 'treatment condition' because the IV is the 'treatment' to which the participants are exposed.

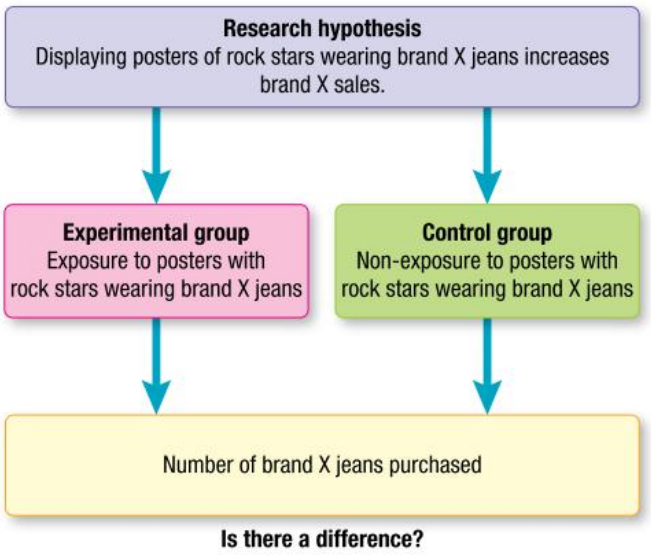

Figure 1.16 Experimental design to test whether displaying posters of rock stars wearing a particular brand of jeans increases sales of that brand

LEARNING ACTIVITY 1.6

Review questions

1. Distinguish between an experimental group and a control group in relation to the IV.
2. What is the purpose of using a control group in an experiment?
3. Why is it important for the experimental and control groups to be as similar as possible in personal characteristics that may affect the DV?
4. (a) In what other way(s) must the experimental and control groups (or conditions) be alike?
   (b) Why?
5. A researcher will conduct an experiment to find out whether people get a better score on a video game when cheered or jeered ('booed') by an audience of peers about the same age rather than when they play the game by themselves.
   (a) Suggest how the IVs and DVs could be operationalised for the experiment.
   (b) What are the experimental and control groups and how are their conditions different?
   (c) Suggest three variables other than the IV that have the potential to influence the DV and would need to be controlled so that the effects of the IV can be isolated.

Extraneous variables

In an experiment, the researcher predicts that manipulating the IV will cause a change in the DV. If a change in the DV is found, the researcher would like to conclude that the change is due *solely* to the influence of the IV. In order to draw such a conclusion, it must be shown that all other variables that could have influenced what is being measured (the DV) have been controlled, minimised or eliminated. Other, or 'extra', variables in an experiment are called extraneous variables.

An **extraneous variable** is any variable other than the IV that can cause a change in the DV and therefore affect the validity ('accuracy') of the results of the experiment in an unwanted way. Extraneous variables are 'unwanted' because they can make it difficult for the researcher to conclude with confidence that any change in the DV was caused solely by the presence of the IV and not because of some other variable.

Although extraneous variables are not intentionally studied (as are the IV and DV), the researcher tries to monitor and control or keep constant the influence of extraneous variables by using procedures that will minimise their influence to an acceptable level. Consequently, the researcher attempts to identify all relevant extraneous variables when designing their experiment. A 'relevant' extraneous variable is one that is believed to have the potential to cause a change in the DV.

For example, suppose a researcher will conduct an experiment to investigate age differences in navigating between different spatial locations. Participants in different age groups ranging from very young to very old will be required to find their way through a series of increasingly complex mazes. The maze navigation tasks will be presented online using a computer so that the time taken to successfully complete each maze can be electronically measured and recorded. The IV is age and the DV is navigational ability. In this study, extraneous variables that could impact on the DV and would therefore need to be controlled or eliminated include:

- biological sex of participants e.g. one sex may have inherently better ability for this kind of spatial task
- prior experience with computers and online task completion e.g. a large number of very young or very old participants may lack computer and online experience which may interfere with maze navigation
- prior experience with maze navigation e.g. to ensure no age group is advantaged
- motivation e.g. to ensure one age group is no more or less motivated to complete the maze tasks than the others

- instructions e.g. to ensure all clearly understand what needs to be done and that no age group is unduly advantaged or disadvantaged by the administration or comprehension of instructions
- test conditions e.g. to ensure they are the same for all participants.

Sometimes, the researcher does not become aware of relevant extraneous variables until after the experiment has commenced; for example, during the experiment or when evaluating the experiment after it has been conducted. In some cases, the researcher remains unaware of relevant extraneous variables until another researcher points them out after reading the report on the experiment.

There are potentially many extraneous variables that can affect the DV of an experiment and it can be difficult for the researcher to predict and control all of them. Consequently, researchers tend to focus on controlling (or at least monitoring) those variables that are likely to have a significant effect on the DV. For example, in an experiment on colour perception or discrimination between different shades of white, it would be very important to control light intensity. However, in an experiment to test the effect of flexibility on performance of some manually performed physical task, light intensity may not be so critical.

Confounding variables

Every experiment used in psychological research is designed to answer the same basic question: *Does the IV cause the predicted change in the DV?* The researcher recognises that there are other variables that can affect participants' responses (i.e. the DV), such as all those variables collectively referred to as extraneous variables.

Extraneous variables are inevitable and do not necessarily pose a problem if controlled in an appropriate way. By strictly controlling their unwanted effects on the DV, the effects of the IV on the DV can be isolated. If there is a measurable change in the DV, then the researcher can confidently conclude that the IV caused the change in the DV. If a variable that can affect the DV is not controlled, then its effect on the DV may not be able to be clearly distinguished from that of the IV. When this happens, the uncontrolled, extraneous variable is commonly referred to as a confounding variable.

A **confounding variable** is a variable other than the IV that has had an unwanted effect on the DV, making it impossible to determine which of the variables has produced the predicted change in the DV. A confounding variable is not manipulated or controlled by the researcher (and therefore not intentionally studied). Nor is it considered to be some kind of 'random error'. It systematically varies together with the IV (or DV) so its effects are 'confounded', confused or mixed up with those of the IV. Because its effects are entangled with and cannot be separated from those of the IV, the researcher cannot conclude with any confidence that the predicted change in the DV was caused by the IV alone.

The presence of one or more confounding variables does not necessarily mean that the IV did *not* cause the change in the DV. However, the presence of a confounding variable suggests that there may be one or more alternative explanations for the results obtained in the experiment. For example, if there is a difference in the results for the experimental and control groups, it could be caused by the IV, the unwanted confounding variable or the combined effects of both. The more alternative explanations there are for the results, the less confident the researcher will be that the IV alone was responsible for the specific outcome.

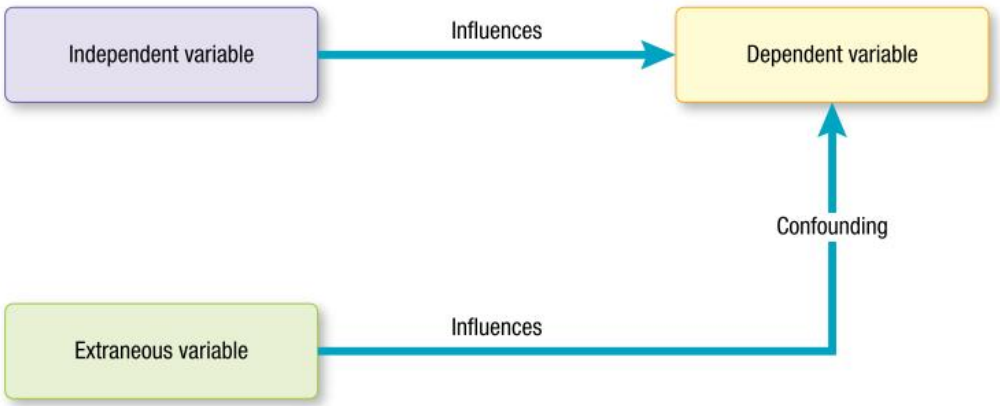

Figure 1.17 Confounding occurs when the effects of the IV on the DV cannot be separated from those of an extraneous variable. The change in the DV is consistent with what was predicted in the hypothesis. When this occurs, the variable will usually be referred to as a confounding variable or simply as a 'confound'. The presence of a confounding variable provides an alternative explanation of the experimental results and thereby also interferes with their validity.

A well-known example of the importance of controlling all variables in an experiment involves a taste test conducted by the Pepsi-Cola Company. Coca-Cola® drinkers were asked to taste two unidentified cola drinks and indicate which of the two they preferred. The drinks were Coca-Cola and Pepsi. The brand of cola was the IV, and the participants' taste preference was the DV. To prevent the participants from knowing which cola they were tasting, they were given Pepsi in a cup labelled 'M' and Coca-Cola in a cup labelled 'Q'. The results showed that most of the participants preferred Pepsi.

The Pepsi-Cola Company proudly advertised this as evidence that even Coca-Cola drinkers preferred Pepsi. But, to test the findings, the Coca-Cola Company replicated the experiment, this time filling both cups with Coca-Cola. The results showed that most of the participants still preferred the cola in the cup labelled 'M'. It seems that the Pepsi taste test had not demonstrated that Coca-Cola drinkers preferred Pepsi. It had demonstrated that Coca-Cola drinkers preferred the letter M to Q. The letters were an uncontrolled variable that had an unwanted effect on the DV (taste preference). Consequently, it remained unclear as to whether the IV (the kind of cola) or the unwanted variable (in this case the confounding variable of the letters) had affected the DV (taste preference).

A confounding variable is often described as a type of extraneous variable. A confounding variable may have its origin as an extraneous variable but there is an important distinction. A confounding variable produces a measurable change in the DV. This change is consistent with what was predicted in the hypothesis, whereas an extraneous variable may or may not affect the DV. What both variables have in common is that they create problems for the researcher in isolating the real effect of the IV, moreso a confounding variable.

An experiment with one or more confounding variables compromises the interpretation of the results and the validity of the experiment, specifically its *internal validity* (which is examined on page 108). The more alternative explanations there might be for an observed result, the less confidence a researcher will have in their research hypothesis, which states that the IV *will* be the cause of a particular result.

Because humans are complex and there are often multiple causes of how they think, feel or behave in any given situation, good experimental design involves anticipating potential extraneous and confounding variables and developing strategies to control and minimise their influence and ensure that extraneous variables do not become confounding variables.

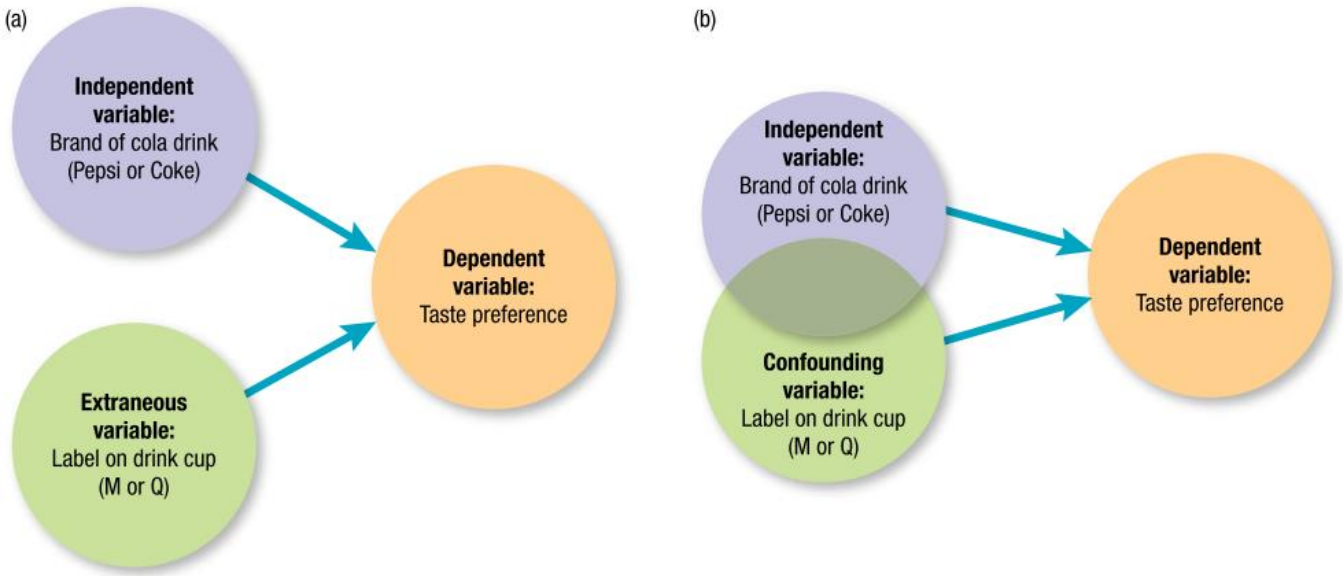

Figure 1.18 (a) In the taste test experiment, the label on the drink cup was an uncontrolled extraneous variable. (b) The effect of the label on the DV (taste preference) could not be isolated from that of the IV (brand of cola drink). The label on the drink cup had therefore become a confounding variable that provided an alternative explanation for the experimental results, making it impossible to be certain that the IV (rather than the confounding variable) caused the DV result.

Figure 1.19 (a) This participant has a high error rate in a driving simulator. (b) Is his poor performance due to his driving ability or because he went out with his friends and stayed up late the night before, slept poorly and felt excessively tired on awakening?

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BOX 1.3 Other types of variables that apply to VCE Psychology

Type of variable	Definitions
Categorical	Categorical variables are qualitative variables that describe a quality or characteristic typically addressing 'what type?' or 'which category?' They are generally represented by non-numeric values and may be further classified as ordinal or nominal. **Ordinal variables** can take values that can be logically ordered or ranked, for example, birth order (1st, 2nd, 3rd), level of stress (low, medium, high) and attitudes (strongly agree, agree, disagree, strongly disagree). **Nominal variables** can take values that cannot be organised in a logical sequence, for example, gender, colour, taste (sweet, sour, bitter, salt, savoury) and type of sleep (REM, NREM). Bar charts and pie graphs are used to graph categorical data.
Numerical	Numerical variables are quantitative variables that describe a measurable quantity as a number, typically addressing 'how many?' or 'how much?' They are further classified as continuous or discrete. **Continuous variables** can take any value between a certain set of real numbers, for example, distance, height (2.85 metres), length of time (12.5 seconds) or temperature (25.4 °C). **Discrete variables** can take a value based on a count from a set of distinct whole values and cannot take the value of a fraction between one value and the next closest value, for example, number of neurons in a brain or number of facts recalled from a list. Scatter plots and line graphs are used to graph numerical data.

Source: VCE Advice for teachers: Psychology (2017). [VCAA digital document]. Retrieved May 2, 2018, from http://www.vcaa.vic.edu.au/Pages/vce/adviceforteachers/psychology/defining_variables.aspx

BOX 1.4 Experimental settings

Experiments can be conducted in a *laboratory setting* (called a *laboratory experiment*) or outside the laboratory in a *field setting* (called a *field experiment*).

A laboratory setting usually enables stricter control of variables but is sometimes criticised because of its artificiality, depending on what is studied. In a field setting, the conditions of the experiment are usually less strictly controlled, but it has the advantage of being able to make observations of participants' behaviour in a real world environment where their behaviour is likely to occur more naturally.

Some experiments conducted in field settings are called natural experiments. A *natural experiment* takes advantage of a naturally occurring event – the independent variable is naturally occurring and is not manipulated by the experimenter, often because it is impossible or unethical to do so. For example, a researcher may study the effect of a catastrophic event such as bushfire or flooding on stress-related ill health. In this case, the IV is a bushfire or flood, a naturally occurring event. However, the IV is not controlled by

the researcher and there may be many uncontrolled extraneous or confounding variables. For example, in a bushfire study, it may be difficult to determine whether stress-related ill health (the DV) is caused by fire, smoke or stress due to loss of one's house.

One of the best-known examples of a natural experiment was conducted by the Nobel Prize-winning American neuropsychologist Roger Sperry (1968) to study the functions of the brain's cerebral hemispheres when surgically separated. His participants were 11 patients who had already undergone 'split-brain surgery' to sever their corpus callosum in order to treat their debilitating epilepsy.

In a true experiment, the researcher can manipulate the IV, so a natural experiment is often described as a *quasi-experiment* because it looks like an experimental design ('quasi' means 'resemble') but the researcher does not actually manipulate anything and it lacks random allocation.

Figure 1.20 (a) A laboratory setting where social behaviour within a group of friends is observed in a controlled situation established by the researcher. (b) A field setting where the social behaviour of interest is observed in the real-world situation of an outdoor café area, but where less control of conditions is possible.

LEARNING ACTIVITY 1.7

Review questions

1. (a) Define the meaning of the terms extraneous variable and confounding variable.
(b) When is the best time to identify these variables?

2. In what way are extraneous and confounding variables similar and different?

3. (a) Give two reasons to explain why it is essential to control extraneous and potential confounding variables in research.
(b) Sometimes researchers refer to the 'presence of a confound' in an experiment. What do you think this means?
(c) Similarly, a researcher may refer to a variable having 'confounded' the results or their interpretation. What do you think this means?

4. For each of the following experiments, identify the IV, DV and three potential extraneous or confounding variables.
(a) The reaction time of 20 people who have just awoken from a night's sleep is compared with that of a group who have just run a kilometre.
(b) The goal shooting accuracy of one group during a 10-minute period is measured when alone and compared with that of another group who goal shoot in the presence of others.
(c) Participants read a description of a person. All read the same description but half are told the person is of the same cultural background as themselves, whereas the other half are told the person has a different cultural background. All participants are then required to select characteristics they believe best describes the person; for example, 'good vs bad', 'warm vs cold' and 'friendly vs unfriendly'.

5. A researcher is planning an experiment to investigate the rate of forgetting (how much time it takes) and amount of forgetting (how much information) that occurs when new information (a list of nonsense 'words' such as qab and jir) is learned.
(a) Identify the operationalised independent and dependent variables.
(b) Suggest two extraneous or potential confounding variables that could affect the DV (in addition to the IV) and therefore need to be controlled.
(c) Suggest a way that each variable referred to in part (b) could be controlled.

6. An experiment was conducted to test whether people make fewer errors in detecting spelling errors in an interesting text than in a boring one. Two groups of randomly selected and allocated participants were used. Group 1 looked for errors in a physics text on string theory (a boring task) and Group 2 looked for errors in the script of a recently released blockbuster movie (an interesting task). The results showed that Group 1 detected significantly fewer spelling errors than did Group 2.
(a) Identify the operationalised independent and dependent variables.
(b) Suggest a potential confounding variable in the experiment. Explain your choice of confounding variable.

Identifying extraneous and potential confounding variables

Researchers have described different types of variables that can be extraneous or potential confounding variables in an experiment. VCE Psychology prescribes the study of individual participant differences, use of non-standardised instructions and procedures, order effects, experimenter effect and placebo effect. We examine each of these in turn and then consider how researchers can minimise their potential influences on a DV.

Individual participant differences

The unique combination of personal characteristics, abilities and backgrounds each participant brings to an experiment (or any other research study) are commonly referred to as **individual participant differences**. These *participant variables*, as they are sometimes called, make one individual different from another, are expected by the researcher and may be biological, psychological or social in nature. They include age, gender, athletic ability, intelligence, personality, memory, educational background, family environment, social relationships, work experience, ethnicity, cultural background, religious beliefs, motivation, emotional state, mood, problem-solving ability, self-esteem, social skills, physical health, mental health, strength, eye–hand coordination, prior experience with materials or tasks to which they will be exposed in the experiment, and so on.

Each of these variables, and many other specific participant characteristics (including abilities) and prior experiences, can affect how participants respond in an experiment. For example, mood may affect participants' responses and make them more or less reactive to the experimental procedures. Some participants may be more or less competitive than others, and some may pay more or less attention to instructions or tasks required of them. Thus, the researcher tries to take into account those participant-related variables that have the potential to impact on the DV (in addition to the IV), and therefore possibly distort the results.

For example, a researcher conducting an experiment on sex differences in aggressive behaviour after playing a violent video game will recognise that participant characteristics such as age, personality, mood, prior experience with violent video games, cultural background, and so on, can also influence aggressive behaviour. Consequently, the researcher will try to ensure that the influence of these other participant variables is controlled or minimised and will do so before the experiment is conducted. How this can be achieved is described in the next section.

Figure 1.21 Even if they have the same cultural background, individual participants will differ in a diverse range of other personal characteristics and abililites. Participant variables arising from such differences are potential extraneous or confounding variables that need to be identfied and controlled, or at least monitored.

BOX 1.5 Participants' roles in experiments

American psychologists Stephen Weber and Thomas Cook (1972) conducted one of the earliest investigations on how being a participant in research can influence attitudes and behaviour. Their investigation led them to identify four distinct roles that some participants may adopt in a laboratory experiment and thereby influence the results in an unwanted way:

- The *'faithful' participant* tries to react to the experimental conditions as naturally as possible, either deliberately or out of disinterest.
- The *cooperative participant* tries to work out the hypothesis being tested in order to help support it.
- The *negativistic participant* tries to work out the hypothesis and what the researcher hopes they will do so that they can do the opposite or give obviously 'silly' replies.
- The *apprehensive participant* believes that the researcher is out to discover some hidden truth about them, and makes every effort to avoid a negative evaluation of themself.

BOX 1.6 The Hawthorne effect

In a series of well-known experiments over a period of five years, American researchers Fritz Roethlisberger and William Dickson (1939) tested different ways of increasing productivity among employees at the Western Electric Company's Hawthorne plant in Chicago.

At various times the employees were subjected to different work conditions such as shorter working periods, longer working periods, long rest breaks, short rest breaks, better lighting conditions, poorer lighting conditions, and work incentives such as bonus payments. Under most of these conditions, it appeared that productivity increased. This observation led to a conclusion called the *Hawthorne effect* — that if participants are aware that they are members of an experimental group, performance may improve simply because of that fact (rather than because of the IV — or experimental treatment — to which they are exposed).

Some psychologists believe that the Hawthorne effect is best described as the *Hawthorne defect*. This is because follow-up research suggests that many of the original Hawthorne experiments did not actually produce the increased productivity reported by the researchers. Reports of the Hawthorne study concentrated on only one of the experiments in which there was a big improvement in productivity. Nonetheless, it is possible that participants' knowledge of being in an experiment may affect the results in an unwanted way, and researchers make every effort to control this unwanted influence.

Figure 1.22 These workers took part in one of the Hawthorne experiments.

LEARNING ACTIVITY 1.8

Review questions

1. In what way can individual participant differences be a source of extraneous or confounding variables? Explain with reference to an example not used in the text.

2. A researcher is planning to conduct an experiment to test the influence on exam performance of the amount of time spent studying.
(a) Formulate a research hypothesis that could be tested.
(b) How will the IV and DV be operationalised?
(c) Identify three participant variables that are potential confounding variables in the experiment and explain your choice of each variable.

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Practical activities on individual differences

Use of non-standardised instructions and procedures

The instructions and procedures used by the researcher can also impact on how participants respond and therefore on the results. This can be a particular concern when research is carried out by multiple research assistants or when large sample sizes require many researchers to complete the project. For example, suppose that the researcher is interested in studying factors influencing the reaction time of helicopter pilots when flying over a hostile war zone at night. The researcher sets up an experiment in which participants perform a task in which they have to detect the blink of a faint red light in a dark room as quickly as possible.

Imagine how the results could be affected if 20 participants received different *instructions* on what the experiment is about, what they are supposed to do, whether they can sit or stand, how much time they have to respond, and so on. What if some participants complete the task early in the morning and others late at night (and may therefore be more or less alert)? Or what if some participants complete the task in a room with 'darker' conditions?

Generally, *procedures* involve everything the researcher does to actually conduct their study, including:

- selection of participants
- instructions for participants in different groups
- interaction with participants
- use of materials or apparatus
- use of rooms or other experimental settings
- observation and measurement of variables
- data-recording techniques.

Procedures not only involve what the researcher does but also how the relevant research activities are conducted, including their sequence. When the research procedures (including instructions) are **non-standardised**, this means that they are not uniform, or the same, for all participants (except for exposure to the IV by participants in the experimental group). Even small variations in procedures may affect participants' responses in unforeseen ways.

An experiment that uses non-standardised instructions and procedures is not strictly controlling all of the variables, and this feature is a source of potential extraneous and confounding variables that can influence the DV and therefore the results.

Figure 1.23 A researcher studying the reaction time of helicopter pilots when flying over a war zone at night may set up an experiment to measure how quickly participants detect the blink of a red light in a dark room.

Order effects

In some experiments, participants are exposed to more than one treatment condition (IV) and they may be required to perform the same type of task twice or even many times under different treatment conditions. For example, in an experiment to determine the effects of alcohol on driving performance, the *same* group of participants may be exposed to one treatment condition (or IV) for which they do not drink any alcohol before a driving test in a simulator (a control condition). After a short break, the participants may then be exposed to another treatment condition (or IV) for which they are given an alcoholic drink before completing the test. The order or sequence in which these conditions are administered can be a problem in an experiment with this type of design (called *repeated measures* and described in detail on pages 56–7).

An **order effect** occurs when performance, as measured by the DV, is influenced by the specific order in which the experimental tasks, treatments or conditions are presented rather than the IV. This essentially means that performing one task affects the performance of the next task. Order effects may change the results so that the impact of the IV may appear to be greater or less than it really is. Two types of order effects that illustrate how this can occur are called practice effects and carry-over effects.

Practice effects are the influence on performance (the DV) that arises from repeating and/or prior experience doing a task. For example, the participants' performance in the alcohol experiment may be influenced or partly determined by practice. Through repeated experience in the driving simulator, participants may get better at the driving task and perform better on the driving test due to greater familiarity with the simulator and its controls, or by anticipating events designed to cause driving errors that were presented during the first driving test.

Participants' responses can also be influenced by other practice effects. For example, performance may get worse as the experiment proceeds due to fatigue or tiredness (sometimes called a *fatigue effect*). Similarly, their performance may be influenced by boredom due to repeating the same task, especially if the task takes a long time, is simple and does not change. Boredom is quite common in experiments in which participants are required to complete multiple trials or tests, especially when task requirements are not particularly interesting.

Carry-over effects are the influences that a particular task has on performance in a task that follows it. They arise simply from experiencing a task. The effect of merely experiencing a task has the potential to 'carry-over' to the next task (or condition), regardless of whether the task is the same or simple. For example, if alcohol was given first in the driving simulator task and the task is then repeated without alcohol (in the control condition), a carry-over effect would occur if insufficient time was allowed for the effects of the alcohol in the first condition to wear off.

As with practice effects, a carry over effect can assist or hinder performance. For example, if a task (such as taking a test in a driving simulator) happens to be very easy, difficult, frustrating or even anxiety-provoking, the feeling may 'carry over', improving or lowering performance the next time the task is completed (driving in the simulator again) depending on the participant's perception or feeling the first time. Either way, this is an unwanted effect as it is a potential confound.

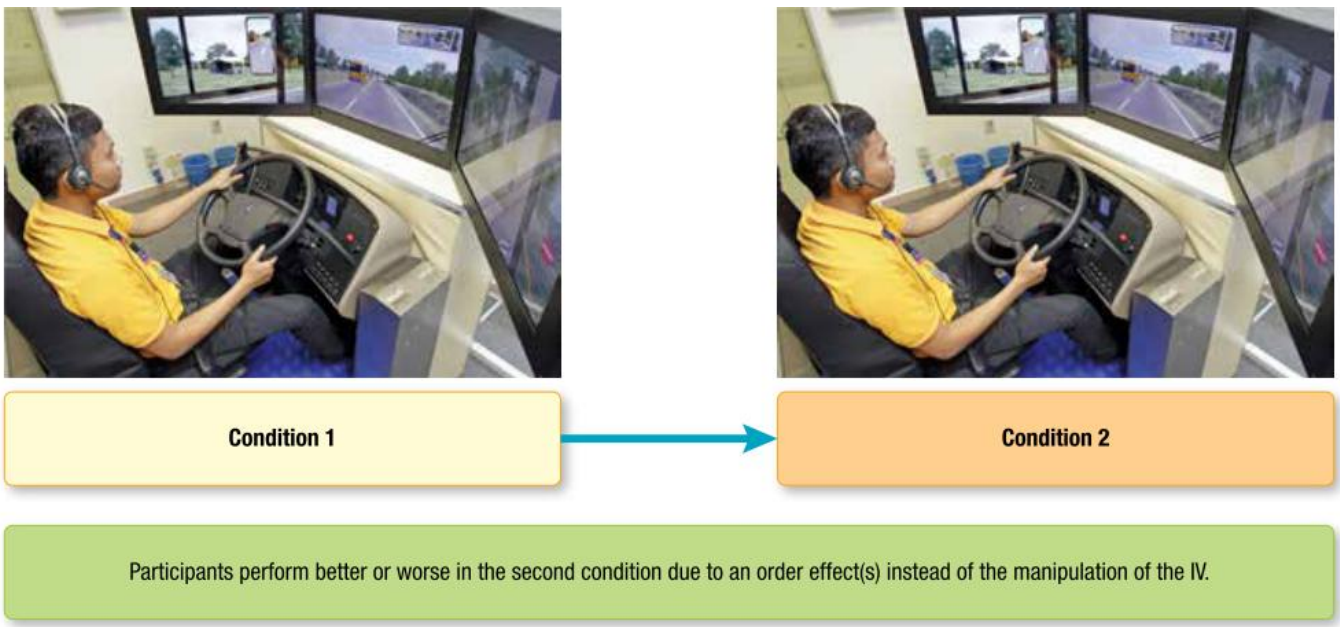

Figure 1.24 Order effect

LEARNING ACTIVITY 1.9

Review questions

1. (a) Explain the meaning of the term non-standardised in relation to research procedures.
(b) Give an example of an instruction to participants and one or more experimental procedures that would be considered to be non-standardised.
(c) Explain why non-standardised instructions and procedures are a source of potential confounding variables.

2. (a) Explain the meaning of order effect.
(b) Distinguish between practice effects and carry-over effects with reference to how these types of order effects can lead to higher or lower scores on a measure of the DV.
(c) Explain why order effects are potential confounding variables.

3. Suggest a possible order effect for each of the following experiments and explain whether it is likely to help or hinder performance. In all examples, there is a minimal rest break between the different experimental conditions.
(a) An experiment is conducted on the effect of the rate of presentation of new information on memory. Participants are exposed to two treatment conditions in which they are presented with a list of words and asked to recall as many words as they can. In condition A, the words are presented at a rate of one word per second. In condition B, a list of similar words ('parallel version') are presented at a rate of two words per second. The number of words correctly recalled is measured for both conditions.
(b) An experiment is conducted to test the effectiveness of a new keyboard design which has a different arrangements of keys. In condition A, participants use a keyboard with a non-standard QWERTY arrangement to type a page of text. In condition B, the same participants use a keyboard with a QWERTY arrangement to type a parallel version of the text. Speed and accuracy is measured for the two different treatment conditions.
(c) An experiment is conducted to test whether listening to music when essay-writing will help students write better. In condition A, participants write a short essay in response to a prompt. In condition B, the same participants listen to music playing through headphones and write another short essay in response to a parallel version of the prompt. The essays are assessed using a standardised set of criteria.

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Practical activity
Order effect

Experimenter effect

Personal characteristics of the experimenter (or any other researcher) and their behaviour during an investigation are also sources of extraneous and confounding variables. The **experimenter effect** is an unwanted influence(s) on participant performance and therefore the results that is produced intentionally or unintentionally by a person carrying out the research. In an experiment, the effect occurs when there is a change in a participant's response because of the experimenter's expectations, biases or actions, rather than the effect of the IV. A common type of experimenter effect is called experimenter expectancy.

Experimenter expectancy, sometimes called an *expectancy effect*, involves cues ('hints') the experimenter provides about the responses participants should make in the experiment. In particular, the experimenter's non-verbal communication ('body language') can produce a *self-fulfilling prophecy* — the experimenter obtains results that they expect to obtain, not simply because they have correctly anticipated a response, but rather because they have helped to shape the response through their expectations (Rosenthal & Rubin, 1978). The results may therefore be attributable to behaviour associated with their expectations rather than the IV. Actions that can promote a self-fulfilling prophecy include:

- facial expressions, such as smiling at participants in the experimental or control group but not at those in another
- mannerisms, such as shaking hands with participants in one group but not with those in another
- tone of voice, such as speaking in a monotone voice to participants in one group and in a more lively way to those in another.

American psychologists Robert Rosenthal and Lenore Jacobson (1966, 1968) demonstrated in a well-known experiment involving teachers and schoolchildren how experimenter expectancy can promote a self-fulfilling prophecy. They found that primary school teachers' expectations of the performance of their students affected how well the children actually performed. Students whose teachers were led to believe that they were 'bloomers' who were showing 'unusual potential for intellectual growth' and were therefore expected to develop rapidly performed better than students whose teachers were led to believe that they were not 'bloomers'. Yet the students hardly differed in their initial intellectual abilities, assessed at the outset of the study using an intelligence ('IQ') test. Teachers were found to have unintentionally influenced the performance of their students, depending on what they had been told by a researcher.

The experimenter effect involves not only the expectations and cues or actions of the researcher that influence participant responses in research settings, but also unintentional biases in the collection and/or treatment of data. This kind of experimenter effect is commonly referred to as *experimenter bias*. Studies have found that when the person measuring the dependent variable is aware of the purpose or hypothesis of the experiment, it is possible on some occasions for them to do such things as misread data, misperceive a rat's reaction in a maze, misinterpret a participant's verbal response, or give unintentional assistance to participants. This is more likely when the researcher wants a particular pattern of data, a particular verbal response from a participant, or a rat to take a particular turn in a maze. These are not examples of intentional dishonesty. They are examples of unintentional or unconscious errors that can be made in collecting and analysing data because of a researcher's close involvement with their study (Gerow, 1995).

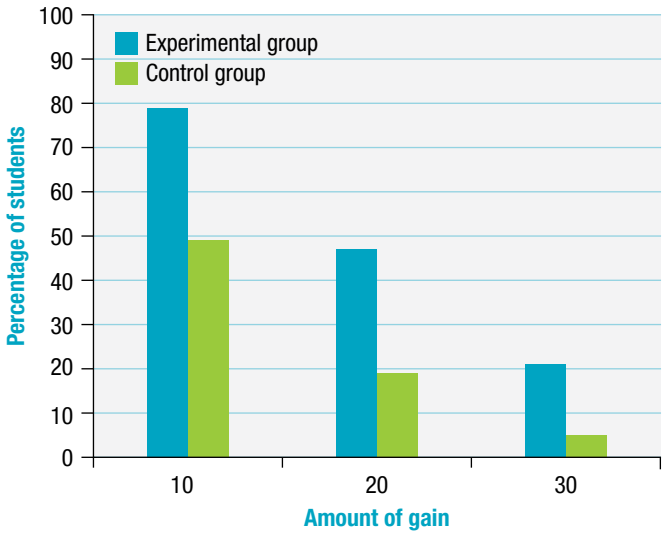

Figure 1.25 IQ score gains by Grades 1 and 2 students in the Rosenthal and Jacobson experiment.

Source: Rosenthal, R., & Jacobson, L. (1966). Teachers' expectancies: Determinates of pupils' IQ gains. *Psychological Reports*, *19,* 115–118.

Figure 1.26 A teacher's expectations of the performance of their students can affect how well the students actually perform.

BOX 1.7 Demand characteristics

Suppose that you are a participant in an experiment being conducted mid-afternoon in a laboratory. The 'laboratory' is a classroom in the psychology department at a university that looks as if most of the furniture has been rearranged or removed. A researcher wearing a lab coat and holding a clipboard and plate of biscuits walks into the room, places the plate on the table in front of you and says, 'Normal people crave biscuits at this time of day, so eat if you want to'. There's a good chance that you'll eat one. Alternatively, suppose that the researcher says, 'Only people who have no self-control eat at this time, but eat if you want to'. There's a good chance that you won't. In any situation, the social and physical surroundings provide cues, or signals, that essentially 'demand' that we behave in a certain way. In research, these cues are called demand characteristics.

A *demand characteristic* is a cue expressed by the researcher or present in some aspect of the research study that communicates the kind of response that is expected from participants and leads them to believe that the research study requires, or 'demands', that they respond in a particular way. In an experiment, demand characteristics guide or bias a participant's behaviour in some way within that setting. Participants rely on demand characteristics to answer such questions as 'What's really going on here?', 'What is this person trying to find out from me?' and 'What am I supposed to do?' Participants don't necessarily respond to demand characteristics intentionally or even consciously. However, demand characteristics typically result in reactions that are not valid or reliable responses to the variables under investigation (Heiman, 2002).

American psychologist Martin Orne (1962) was one of the first researchers to scientifically study demand characteristics and describe the concept as an extraneous variable that can influence the results of a research study, particularly in experimental research. Orne and his research assistants developed a set of tasks which he believed most people would refuse to do, or would do only for a short period of time. According to Orne, 'the tasks were intended to be psychologically noxious, meaningless, or boring, rather than painful or fatiguing'. For example, one task involved additions of rows of random numbers on a sheet of paper. In order to complete just one sheet, participants were required to perform 224 different additions. A stack of about 2000 sheets was presented to each participant, which was clearly an impossible task to complete.

After the instructions were given, the participants' watches were taken away and they were told to continue working until they were told to stop. 'Five and one-half hours later, the experimenter gave up!' (p. 777), amazed that the participants had conscientiously stuck to the task without question. In a variation of the task, which was designed to be 'a more frustrating situation', participants were asked to do the additions on each sheet, then tear up their answer sheet into at least 32 pieces before continuing with the next one, and so on. Again, participants tended to continue for several hours at this completely meaningless task. All persisted without question, complaint or hostility, simply because they were 'in an experiment'.

Orne argued that one reason that participants willingly do things in an experiment/research study which they would not normally do is because of *social desirability*; that is, their desire to provide socially acceptable responses. Essentially, participants 'adjust' their responses so that they aren't embarrassed or so they won't appear strange or abnormal. Similarly, participants tend to do their best to be 'good participants' and not 'upset' the experimenter. But this is not always the case.

Consider a well-known research study that highlights the influence of demand characteristics. German psychologists Fritz Strack, Leonard Martin and Sabine Stepper (1988) tested a hypothesis that the facial muscles used for smiling provide feedback to the brain that actually improves mood. In other words, being happy makes you smile, but then smiling makes you even happier. To test the hypothesis, they measured the dependent variable of mood after participants had held a pen in their mouths, either using their teeth (which mimics smiling) or using their puckered lips (which does not mimic smiling). Imagine that you are in this experiment, sitting in a room with a pen sticking out of your mouth, with a 'psychologist' watching you. What would you be thinking and feeling, and how would that influence what you said and did? Would you really react naturally? If the answer is 'No', then it's because of the experiment's demand characteristics. This variable is one of a number that may account for the inability of many researchers to repeat or reproduce the experiment's results (Heiman, 2002; Reber, 2016; Wagenmakers, 2016).

Figure 1.27 Under 'stage hypnosis', these audience members perform various silly behaviours that they would not ordinarily do in public. Can their behaviour be explained by demand characteristics?

Placebo effect

In medicine, the placebo effect refers to an improvement in health or wellbeing due to an individual's belief that the treatment given to them will be effective. The placebo effect is evident when a patient recovers from an illness or pain after they have been given a substance or a treatment that has no actual medicinal or therapeutic value, such as a 'sugar pill' or fake injection. This inactive substance or fake treatment, which substitutes for the real substance or treatment, is called a **placebo**. The mere suggestion to the patient that they have received, or will receive, some kind of treatment is often sufficient to minimise or eliminate the symptoms. For example, some people begin to feel better if they are put on a waiting list for treatment compared with how they might feel if they were not on a waiting list.

In an experiment, the **placebo effect** occurs when there is a change in the behaviour or responses of participants due to their belief that they are receiving some kind of experimental treatment and they respond in accordance with that belief, rather than to the effect of the IV. Essentially, the participants' behaviour is influenced by their expectations of how they should behave due to their belief that they have received some treatment. There is a change in behaviour in the absence of an experimental manipulation.

For example, consider an experiment on the effects of alcohol on driving performance that uses an experimental and control group, each with different participants. The experimental group would be given an alcoholic drink before a driving test in a simulator. Participants in the control group would not drink any alcohol before completing the test. Suppose that the experimental group makes many more driving errors than the control group. Although the researcher would like to conclude that the difference was due to alcohol consumption impairing performance of the experimental group, this conclusion would not be valid.

The problem is that alcohol consumption may not have been the only variable that adversely affected performance of the experimental group. The act of being given an alcoholic drink by a researcher might have promoted expectations in participants about how they should behave. Experimental group participants might have perceived that they were given alcohol because they were expected to act drunkenly, so they did. Consequently, they may have driven as if they were drunk and made more driving errors. Furthermore, because the experimental group received the alcohol and the control group did not, only the experimental group experienced the placebo effect. This means that a confounding variable is present — the researcher cannot be certain whether it was the effects of alcohol or the placebo effect that caused the performance difference.

Figure 1.28 The placebo effect involves a change in behaviour in the absence of an experimental manipulation. It can be triggered by the belief that a treatment is real, even though it isn't.

BOX 1.8 Experiment on the role of cognition in emotion using a placebo

In the early 1960s American psychologists Stanley Schachter and Jerome Singer (1962) conducted a controversial experiment to investigate the role of psychological factors in human emotion, especially cognitive processes. Their experiment provided evidence for their theory of human emotion in which they proposed that the experience of any emotion arises from a combination of two factors. One factor is our state of physiological arousal which accompanies an emotion and the second factor is our interpretation of the situation in which the arousal is experienced.

The participants were 184 volunteer male students enrolled in an introductory psychology course at the University of Minnesota who consented to an injection of a new medication called 'Supoxrin', which was actually made up of vitamins. They were informed that the purpose of the experiment was to determine the effects of the drug on vision. All received two extra points on their final exam for every hour they served as experimental participants.

There were four conditions in which participants were actually given either an injection of epinephrine (adrenaline) or a placebo. Epinephrine is a hormone that has the effect of arousing the body and producing physiological reactions such as increases in blood pressure and heart rate, rapid breathing, palpitations (trembling), flushing and sweating palms. These changes are also associated with strong emotional states such as excitement, elation and anger. The epinephrine effects usually begin within 3–5 minutes and may last from 10 minutes to an hour or so (depending on dosage and the individual). For most people, the effects wear off within 15–20 minutes after injection.

Although all participants in an experimental group were given the same drug, they were told different information about the effects of the drug that might be expected. Some participants were told a quite accurate account of the possible effects of the drug (the 'informed' group), some participants were told that the drug caused numbness and itching, with no suggestion that there might be excitement or agitation (the 'misinformed' group), and other participants were told nothing of what effects to expect (the 'uninformed' group). There was also a control group of participants who received a placebo injection that had no effect and were given no instructions of what to expect.

After receiving their injections, the participants were asked to wait in a room until the experiment began. In this room was another person who they thought was also a participant. However, the other person (called a 'confederate') was actually a research assistant. All instructions to participants were standardised as much as possible.

Schachter and Singer wanted to observe how the increased arousal level would be interpreted in different situations. They predicted that the 'informed' participants, who knew that the injection caused particular physiological changes, would not experience any strong emotion as they would attribute their arousal to the drug. They also predicted that the 'misinformed' and 'uninformed' participants would attribute their arousal to an emotion that could be associated with the situation they were in.

Two different situations were created using the confederate, who acted in either of two ways. In one situation, the confederate played the clown and acted in a very happy and silly manner. For example, he played with a hula hoop and tossed scrunched-up paper into a bin. In the second situation, the confederate acted as if angry and irritated. The confederate never knew which condition any participant was in.

Emotional responses were measured by researchers, who observed the participants through a one-way mirror. In addition, participants completed a self-report measure — a questionnaire requiring them to rate their feelings in a given situation.

The results showed that participants who waited with the happy confederate tended to interpret their increased arousal level as happiness. Those who waited with the angry confederate tended to interpret their increased arousal as anger. This effect, however, was achieved only with participants who were misinformed or uninformed about the effects of the injection. The informed participants tended to attribute their increased arousal level to the drug.

When there was nothing specific to help explain their physiological arousal (e.g. an injection), participants responded in ways consistent with their interpretation of what was happening in the situation they were in.

Figure 1.29 All participants were given either an injection of epinephrine or a placebo.

Not only did the uninformed participants respond differently in different situations, but they also reported different emotions. Their labelling of how they were feeling (i.e. their emotional state) depended on cognitive factors.

What does this experiment demonstrate? Generally, that physiological arousal affects a person differently, depending on their cognitive interpretation of the situation they are in. When a person cannot explain their physiological arousal, they seek explanations from their environment. In the experiment, the confederate provided cues that helped explain a participant's emotional experience. However, when participants thought that their physiological arousal was caused by an injection, they generally did not attribute their physiological changes to any particular emotion (i.e. happiness or anger). The experiment also demonstrates that physiological arousal is important in emotion because the group who received a placebo would have behaved in the same way as participants in the misinformed groups.

In sum, the Schachter and Singer experiment suggests that physiological arousal and cognition interact to produce emotions. However, their relationship in the experience of emotion is likely to be more complex than proposed by their two-factor theory.

Other psychologists have attempted to replicate this complex experiment in order to test the findings. However, replications of the experiment found differing results. Some have confirmed the findings while others have not. Furthermore, when found, differences in the results between the groups of participants were generally small and not very significant when statistically tested.

LEARNING ACTIVITY 1.10

Review questions

1. (a) Define the meaning of the term experimenter effect.
(b) What is experimenter expectancy and how can it produce
(i) a self-fulfilling prophecy?
(ii) experimenter bias?
(c) Explain why experimenter effects are potential confounding variables.

2. (a) What is a placebo in relation to experimental research?
(b) Define the term placebo effect in relation to experimental research with reference to an example not used in the text.
(c) Explain why the placebo effect is a potential confounding variable.
(d) (i) Sam has the sticker shown at the right on her school diary. Sam's friends notice that her behaviour has changed since the appearance of the sticker. Explain Sam's behaviour change in terms of a placebo effect.
(ii) Give three other everyday life examples of how the placebo effect may influence thinking, feeling or behaviour.

3. Suggest a way of controlling or minimising the influence of
(a) an experimenter effect
(b) a placebo effect.

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Weblinks
- TED-Ed Lesson: The power of the placebo effect 4m 38s
- Theories on how placebos work

LEARNING ACTIVITY 1.11

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Word copy of table

Summarising potential extraneous and confounding variables

Complete the following table.

Variable	Description	Example	Why a potential extraneous or confounding variable?
individual participant differences			
non-standardised instructions and procedures			
order effect			
experimenter effect			
placebo effect			

LEARNING ACTIVITY 1.12

Evaluation of research

Consider the research by Schachter and Singer (1962) on the role of cognition in emotion summarised in Box 1.8 on pages 36–7 and answer the following questions.

1. Formulate a research hypothesis that could have been tested by the procedures used for the experiment.
2. Identify the operationalised independent and dependent variables in the experiment.
3. Identify the characteristics of participants and how they were selected.
4. Explain whether the sample was representative.
5. Suggest an appropriate procedure for assigning participants to different groups and explain your choice.
6. Identify the experimental and control groups used in the experiment and briefly outline the conditions for each group.
7. Describe two strengths and two limitations of the experiment.
8. Explain two significant ethical issues that are relevant to this particular experiment.

LEARNING ACTIVITY 1.13

Reflection

Comment on how accurately the cartoon below depicts a placebo effect.

"If this doesn't help you don't worry, it's a placebo."

eGuide*plus*

Weblinks
Media items on the nocebo effect

Ways of minimising extraneous and confounding variables

When conducting an experiment, a researcher will approach the task in a systematic way, controlling the variables under investigation in order to observe and measure what happens, and to prevent or minimise the influence of variables other than those being tested that might influence the results. The extent to which extraneous and confounding variables are anticipated and controlled determines the quality of an experiment and the validity and reliability of the procedures and results.

Ways of minimising extraneous and confounding variables include use of appropriate sampling procedures for selection and allocation of participants, counterbalancing, single and double blind procedures, placebos, standardised instructions and procedures, and use of an appropriate experimental research design.

Participant selection and allocation

The way participants are selected and how they are allocated to different groups or conditions are very important features of experimental research. Selection and allocation procedures provide the most commonly used means of minimising the influence of extraneous and confounding variables associated with participants.

For example, suppose a psychology lecturer at a university wanted to find out which of two teaching methods is more effective. The lecturer teaches two first-year psychology classes, one that starts at 8 am and one that starts at 4 pm. The lecturer uses one teaching method for the morning class and a different method for the afternoon class. At the end of the semester, the lecturer finds that the final examination scores are higher for the morning class. The researcher concludes that from now on all lecturers will use that particular teaching method for all classes. Is this a valid or legitimate conclusion to draw on the basis of the results obtained from the research?

The problem is that the two groups of participants may not be sufficiently alike in personal characteristics of relevance to the study and which may therefore have influenced the results. For example, people who enrol for lectures that start at 8 am may differ in some ways from those who enrol for a 4 pm lecture. Some people prefer to get up early, while others like to sleep late. Perhaps some students had commitments, such as casual work or other activities scheduled late in the afternoon, that prevented them from enrolling in the 4 pm class.

The likely cause of this problem is that the participant sampling and allocation procedures were inappropriate. Therefore, it cannot be concluded with confidence that the differences in the two groups' examination scores were caused solely by the difference in teaching methods (Carlson & Buskist, 1997).

Given the importance of participant sampling and allocation, we consider different types of procedures that can be used to minimise extraneous and confounding variables relevant to this aspect of the research design.

Participant selection

The process of selecting participants from a population of research interest (the 'target population') is called **sampling**. It is usually undertaken with the goal of being able to use the participants in the sample to draw conclusions about the larger group who form the population. This is not unlike the goal of a medical researcher who analyses a sample of someone's blood to draw one or more conclusions about all of that person's blood.

A sample should be selected in a scientific way so that the results obtained for the sample can be legitimately applied to the population from which it was selected. When sampling, it is important to ensure that the sample lacks bias and is like its population in as many ways as possible so the results can be generalised ('applied') to that population. It must reflect its population in all the personal characteristics of participants that are important in the research study. Participant variables that are considered to be important are those that can influence the results of the study to be conducted. For example, for an experiment on the soft drink and fast food preferences of adolescents, personal characteristics of participants such as their age, sex, income, access to retail outlets and cultural background are among the variables that could be assumed to be important. Variables such as height, hair colour, intelligence and spatial abilities may be assumed to not be important.

When a researcher selects a sample that mirrors or is approximately the same as its population, the sample is called a representative sample. A **representative sample** is a sample that closely matches the population from which it is drawn in every important participant variable. When a sample does not adequately represent the key characteristics of its population it is referred to as a **biased sample**.

Larger samples also tend to minimise the likelihood of an unexpected 'sampling error' resulting in a sample which does not represent its population well and would therefore make it difficult to apply the results to that population. For example, some researchers have described the law of large numbers in relation to sampling. The *law of large numbers* states that as sample size increases, the attributes (characteristics) of the sample more closely reflect the attributes of the population from which the sample was drawn. Basically, the more people who are selected, the more likely it is that they will reflect and therefore be representative of the population.

Researchers can use many different procedures to select a sample. Commonly used procedures are called random sampling, stratified sampling and convenience sampling. Convenience sampling is the simplest method but is less likely to achieve a representative sample than the other procedures.

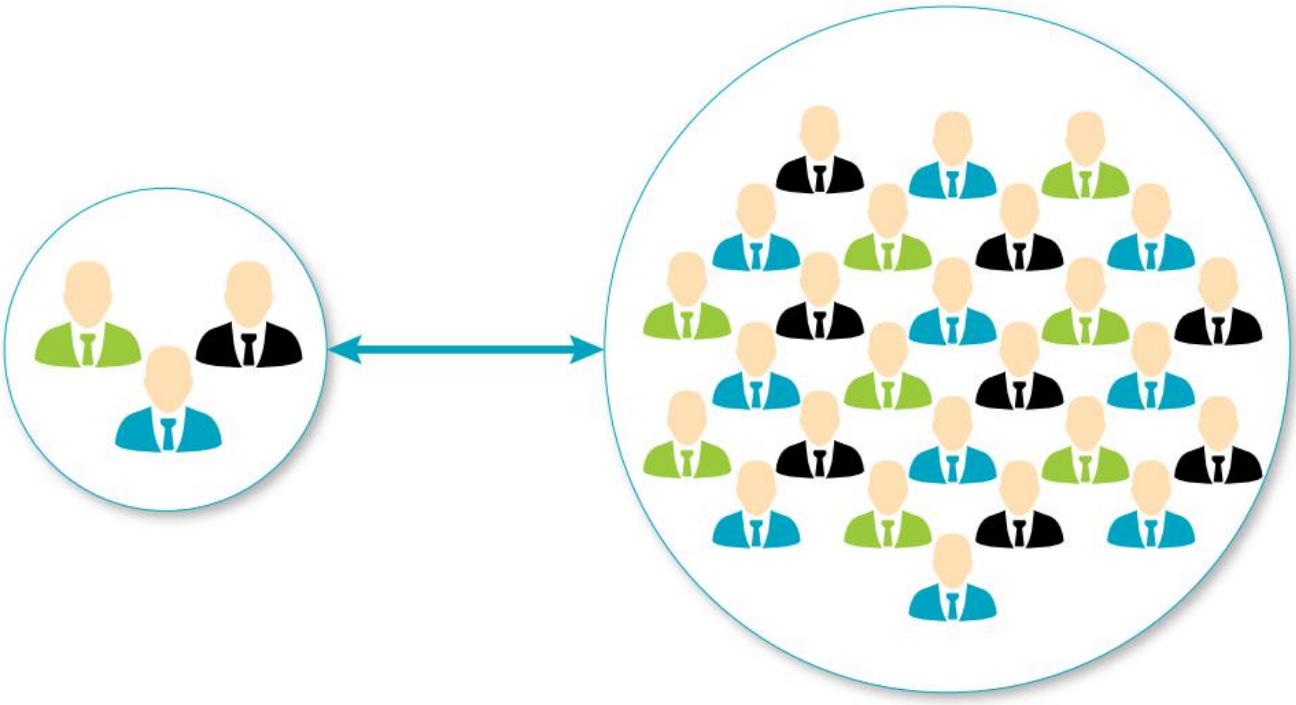

Figure 1.30 A representative sample closely matches the population of research interest in the distribution of key participant characteristics. Generally, the larger the number selected, the more likely it is to be a representative sample rather than a biased sample.

Random sampling

When used in relation to sampling and samples, 'random' does not mean 'haphazard'. In fact, it is anything but haphazard. Nor does random mean selecting participants (or allocating them to experimental or control groups) according to the whims of the researcher. Using a random sampling procedure actually involves a very careful methodical approach or plan.

Random sampling is a sample selection procedure that ensures every member of the population of research interest has a genuinely equal chance of being selected to be part of the sample. This can be achieved in a number of different ways.

One way is to obtain a complete list of all the people in the target population (with appropriate contact information). This source material or list is commonly called a *sampling frame*. For example, an electoral roll may be used as a sampling frame, or the telephone numbers of all the people in a relevant database may be used. If you were conducting a research study in your school, class rolls could be used, but only those with the names of students in the target population. Other sampling frames can include a list of employees in an organisation of research interest, a list of members of an AFL club, patient files in a hospital, and so on. Ideally, the sampling frame will be in an electronic format so that it can be used on a computer or tablet.

After the sampling frame is accessed, the researcher could obtain a random sample using a simple lottery procedure to select the required number of participants. The lottery procedure could involve putting the names or ID numbers of all members of the target population on equal-sized slips of paper, placing the slips in a container and mixing them thoroughly, then drawing out the required number of slips 'blindly', one at a time. As a result of this simple but methodical procedure, the likelihood that the sample is representative of the population is increased, and so is the ability of the researcher to generalise the results to the population. For example, if this procedure was used to select a sample of five students from a small box with the names of all 20 students in a psychology class, any group of five names is equally likely to be selected as any other group of five names.

A commonly used method when a large number of participants is required is to assign a number to each member of the target population, then use a digitally generated list of random numbers to select sample members.

Suppose you are interested in studying some aspect of student behaviour at your school and you want a random sample of 20 students. You would begin with a list of all students currently enrolled at your school. Then, each student is assigned a number. If, for example, there are 1000 students, the first student in the list is assigned number 1 and the last student assigned 1000. A random number generator (available online, in an app or scientific calculator) could then be used to produce 20 numbers that fall between 1 and 1000. The students whose numbers are selected become the sample. For example, if the first random number is 47, then the 47th person in the list is included in the sample; if the second random number is 10, then the 10th person in the list is selected, and so on until the 20th participant has been selected.

This sampling procedure ensures that every student in the school (the relevant population) has an equal chance of being chosen to be part of the sample. Therefore, the likelihood that the sample is representative of the population is increased, and so is the ability of the researcher to generalise the results to the population.

If everyone in a target population does not have an equal chance of being selected as a participant, then *sampling bias* is said to occur. Sampling bias increases the likelihood of a biased sample being obtained. For example, a researcher might conduct a study on stress management strategies used by Victoria Police. A random sample could be obtained by allocating a number to all Victorian police officers and then selecting participants' names using a lottery method. However, sampling police officers 'at random' in a 'hit-or-miss' way in the street or at a nearby police station would achieve a biased sample rather than a truly random sample, because not all Victorian police officers (the target population) will have an equal chance of being selected into the sample at these sampling locations or when the sampling is done.

Sometimes a researcher may not find it necessary or even desirable to use a random sample that is fairly representative of the population of interest. For example, a researcher interested in the language development of children may intentionally undertake a case study of a child raised in a harsh, deprived environment where there is little or no opportunity to learn language, rather than studying a sample of 'average' children from a 'normal' home environment.

An advantage of random sampling is that the sample obtained is not biased in any way by a researcher's behaviour or preferences. In addition, every potential participant has an equal chance of being selected, which helps ensure a highly representative sample, particularly when everyone who has been selected can be contacted and agrees to participate. This allows generalisations that are more likely to be considered to have external validity (as described on page 109). The larger the sample, the more likely it is that the sample will be representative.

However, there is no guarantee all random samples are representative. For example, not all those who have been selected may be contactable, available or agree to participate, which can be a problem when the sample size is small. Others may agree to participate then refuse to do so or withdraw (dropout) after the study commences.

A limitation of random sampling is its need for a complete and up-to-date sampling frame that includes all members of the target population. There may be no single list available with relevant details of all the population. As a result, it may be difficult and time consuming to bring together numerous sub-lists to create a final list from which to select the sample. If available, it may be difficult to gain access. For example, the list may be protected by privacy policies or require a lengthy process for permission to access. If accessed, the process of random selection may be time-consuming.

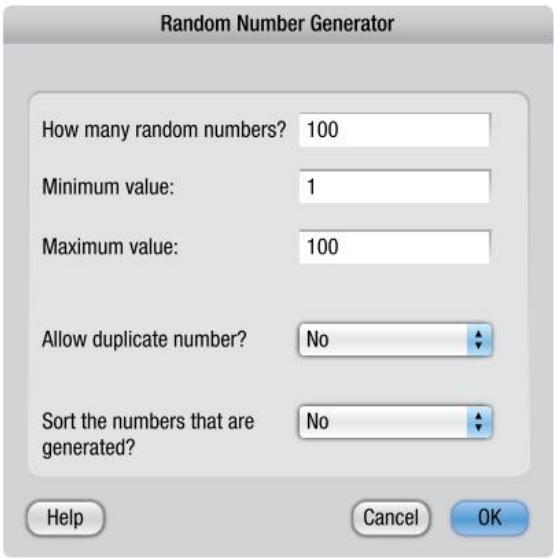

Figure 1.31 One of many random number generators that are freely available online

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Online random number generators

Figure 1.32 A random sampling procedure using a randomly generated number sequence

TABLE 1.2 Example of 100 randomly-generated numbers (unsorted) to select a sample of 20 from a school's student population of 1000. The first participant selected for the sample would be the 47th student in the school list, the second selected would be the 10th in the list, and so on.

47	113	958	780	970	553	464	936	767	23
10	220	410	818	167	792	578	197	935	188
963	389	990	846	10	673	537	790	300	577
323	362	597	32	518	232	665	802	298	103
404	860	252	631	401	191	414	624	770	26
559	193	861	383	917	650	972	997	358	878
120	459	448	472	489	823	703	871	400	671
821	617	883	21	62	130	169	274	746	84
284	981	605	372	393	656	16	516	809	610
451	141	799	687	490	628	90	155	533	912

Stratified sampling

In some research studies it is important to ensure that particular groups in a population of interest are represented in their known proportions in that population. For example, if a psychologist wanted to determine the attitudes of Australian voters to asylum seekers, they could reasonably expect that people's attitudes would differ depending on their age, sex, religion and cultural or ethnic background. Consequently, the psychologist would want to ensure that each of these groups was represented in the final sample in the same proportions that they were known to exist in the voting population. This can be achieved by using a stratified sampling procedure.

Stratified sampling involves dividing the population to be sampled into distinct subgroups (called *strata*), then selecting a separate sample from each subgroup (*stratum*), usually in the same proportions as they occur in the target population. Age, sex, religion, cultural background, residential area, educational qualifications, IQ score, income level and income type (e.g. wages or pension) are examples of characteristics that may be used to divide a population into strata.

The stratified sampling procedure is commonly used to study psychological characteristics or attitudes that vary greatly among different subgroups of a population. For example, suppose you were going to undertake an investigation on behavioural responses of students at your school towards their teachers' use of rewards and punishments in the classroom. You expect that responses may differ among students in different year levels so you want to ensure each year level (stratum) is represented in your sample, more so in about the same proportions as they occur in the school population.

You could first obtain separate lists of the students in each year level and then randomly sample from each list. If, for example, about 10% of all students in your school are enrolled in year 12 and about 15% in year 11, then your sample would consist of about 10% year 12 students and about 15% year 11 students. This would ensure students from each year level are represented in about the same proportions in the sample as they are in the school population. Using this *stratified random sampling* procedure would ensure that the sample is highly representative of the population and therefore not biased in a way you consider to be important. It would also be referred to a type of *quota sampling* because the sample includes a predetermined percentage of each subcategory of the target population.

The most important advantage of stratified sampling is that it enables the researcher to sample specific groups (strata) within populations for comparison purposes; for example, males vs females, or people of different ages and cultural backgrounds who have been diagnosed as having a phobia and will be exposed to a new type of relaxation therapy to help manage their anxiety. In addition, when there is random sampling from appropriately sized proportions of the strata, this helps ensure a high degree of representativeness of all the strata, which means that there can be greater precision in the study and its findings when compared to the standard random sample taken from one larger group.

A major limitation of stratified sampling is that, like random sampling, it can be carried out only if relatively complete lists of the target populations (strata) are available and accessible. If accessed, a representative sample cannot be obtained unless stratified random sampling is used (assuming there is limited missing data). Either way, stratified sampling can be a very time-consuming procedure, more so than standard random sampling.

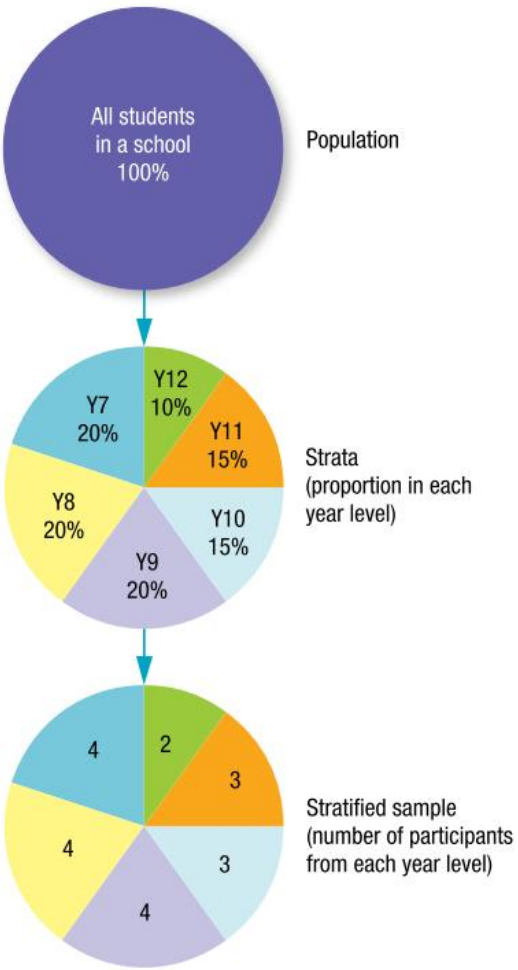

Figure 1.33 An example of stratified sampling for a school-based investigation. Notice how the proportions in the sample match the percentages in the population.

studyon

BOX 1.9 Stratified random sampling

Stratified random sampling involves identifying all of the people within each stratum of research interest, then randomly selecting samples of a set size from within each stratum.

Suppose, for example, you were going to undertake an investigation involving volunteer participants from the VCE population at your school or college. You expect that volunteer rates may differ among students doing maths and science courses, performing arts courses and so on.

You could first make separate lists of the students in each of these courses and then randomly sample from each list. If, for example, 20% of the VCE population is enrolled in a maths and science course and 10% is enrolled in a performing arts course, then the sample should ideally also consist of 20% maths and science students and 10% performing arts students. Students from these courses would be represented in the same proportions in the sample as they are in the population.

An outcome of this sampling procedure is that the sample can be assumed to be truly representative and unbiased. However, obtaining a stratified random sample using set proportions is usually very time-consuming and difficult to achieve so the procedure is not often used.

Figure 1.34 Steps in a stratified random sampling procedure using set proportions.

Convenience sampling

For some research studies it is not convenient, suitable or possible to obtain a representative sample. In such cases, a convenience sample may be used and the researcher may use anyone who is available or present at the time of the study.

Convenience sampling, also called *opportunity sampling* and *accidental sampling*, involves selecting participants who are readily or most easily available. There is no attempt to make the sample representative of a population. For example, a representative sample of illegal drug users or homeless teenagers is not often easily available. Consequently, the researcher may go to locations known to be frequented by the required participants and simply select the first individual they come across who is in the target population and who is willing and available to participate. They may also ask this participant to identify others who would possibly be suitable for the study and agreeable to inclusion (which is called *snowball sampling*).

Similarly, a researcher seeking to conduct a study on drivers who do not obey red traffic lights at a particular intersection at a particular time could use convenience sampling. Participants will be the drivers observed to disobey a red traffic light, and they are simply entered into the study until the desired sample size is reached.

Psychology students often use convenience sampling; for example, when selecting participants they have the opportunity to study such as other students sitting in the library at their school, people walking by in the street, children who happen to be playing in the school yard at a local primary school, friends, parents or relatives.

In most cases, convenience sampling produces a biased sample because only those people present and available at the time and location of the study will have a chance of being included in the sample. If a researcher used convenience sampling at a local shopping centre, they may select only those shoppers who appear cooperative to be in the sample and ignore those who appear uncooperative. Shoppers left out of the sample might think, feel or behave differently from those who are selected in the sample, yet these thoughts, feelings and behaviours will not be represented in the sample.

Since convenience sampling involves sampling bias and the resulting sample is not representative of the target population under investigation, the data obtained can be misleading and the results of the study cannot be legitimately generalised to the entire population.

Despite these limitations, convenience sampling is widely used in psychology. Participants are readily available, so it tends to be quick (time-efficient), simple and inexpensive compared to other sampling procedures. Sometimes it is the only way to access participants to conduct a study. Convenience sampling can also be of considerable value to identify possible trends or patterns in results or when conducting

research to pilot, or 'test', procedures or to gain a preliminary indication of possible responses before conducting the actual study.

Many researchers regard convenience sampling as an adequate sampling procedure when investigating aspects of mental processes or behaviour that are assumed to be similar in all 'normal' individuals, despite individual differences. For example, all 'normal' adults are capable of reflecting on their personal experiences and using language to communicate what they think or feel. Similarly, all normal adults are capable of seeing, hearing and responding reflexively.

Figure 1.35 Convenience sampling involves selecting participants who are readily available. For example, a researcher may be interested in strategies of buskers that are more or less likely to promote audience donations, such as eye contact, verbal interaction, and involvement of audience members as active participants. Different buskers at known locations may simply be entered into the sample and observed.

Research on hair pulling

Do you pull out your hair to the point of causing unintended hair loss?

Do you find your hair pulling difficult to control?

Does your hair pulling interfere with your life or cause you emotional distress?

Psychology researchers at Swinburne University (Melbourne, Australia) are currently developing a measure of thoughts and beliefs associated with **Trichotillomania** (aka **Hair Pulling Disorder**). It is hoped that the final measure can be used across Australia and internationally to improve our understanding of this disorder so we can develop more comprehensive, effective, and targeted treatments.

If you think you might have this problem and are aged 18 or older, we need your help!

In order to help us develop this measure you will be required to:

1. participate in a 30-minute interview about your hair pulling with a student investigator. Interviews can be conducted via Skype for interstate and international participants.
2. complete a series of online questionnaires about hair pulling, related thoughts and feelings, and other psychological symptoms.

If you think you can participate in this research or would like more information, please do not hesitate to contact either:

Dr M.N., Principal Investigator, ph. (03) 1234 5678, email: mn@email.edu.au

A.R., Student Investigator, ph. (03) 1234 6789, email: ar@email.edu.au

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Advertisements for research participants

Figure 1.36 A commonly used means of accessing participants in a population of research interest is to advertise. These participants are volunteers who 'self-select' to be in the sample but they are not necessarily included. They may be in a predefined group but may not meet the researcher's criteria to be in the sample. Nonetheless, using a *volunteer sample* or *self-selected sample* as it is also called, despite the likelihood of bias, is a convenient way to find willing participants.

LEARNING ACTIVITY 1.14

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Review questions

1. What does sampling involve?
2. Explain whether the sample is considered to be all those selected for participation in research or the group who actually participate.
3. Explain the difference between a biased and representative sample with reference to an example of how each sample type is achieved.
4. What are two potential limitations of a small sample size?
5. Why is convenience sampling often described as 'opportunity sampling'?
6. Explain how the type of sampling procedure used can either reduce or increase the likelihood of an extraneous or confounding variable influencing research results in an unwanted way.
7. Complete the table below to summarise key features of three sampling procedures.
8. Suppose that you are required to determine the typical amount of nightly sleep of students at your school or college.
   (a) Briefly describe a convenience sampling, random sampling and stratified sampling procedure for selecting research participants.
   (b) Explain which of the three sampling procedures would result in the most highly representative sample.
9. You want to compare the lifestyles of VCE students in Melbourne and Mildura.
   (a) Define your population.
   (b) How could you obtain a random sample from each of these populations?
10. You want to test short-term memory capacity in preschool children, teenagers and people aged over 65 years.
    (a) Define your population.
    (b) How could you obtain a random sample from each of these populations?

Sampling procedure	Description	Example	Advantages	Limitations
random sampling				
stratified sampling				
convenience sampling				

LEARNING ACTIVITY 1.15

Evaluation of samples and sampling procedures

1. (a) A researcher investigating variables that influence consumer decision-making will conduct a brief, 3-item survey outside a Myer store in a shopping mall on a Friday evening. The researcher will toss a 20 cent coin when ready to interview someone. If the coin shows heads, the person exiting the store will be interviewed. If the coin shows tails, the person will not be interviewed.

Explain whether the researcher will obtain a random sample.

(b) Another researcher will conduct the same survey at the same location but will vary the sampling technique. Instead of tossing a coin, the researcher will interview every 20th person who exits the store.

Explain whether the researcher will obtain a random sample.

2. Explain why each of the following research studies is likely to have sample bias.

(a) a survey on binge-drinking behaviour in a popular teenager's magazine

(b) a television or radio call-in survey

(c) a telephone survey at 6 pm on weeknights using landlines to people's homes

(d) a survey based on the number of 'likes' for a Facebook post

(e) a psychologist working at a rehabilitation centre for people with a brain injury accesses some of their relatives for a study on their coping strategies

(f) a researcher interested in the age and sex of gamblers who play the pokies interviews people entering a local gaming venue during a 4-hour period on a weekday afternoon

3. To which type of sampling procedure is the cartoon below most likely referring? Explain your choice.

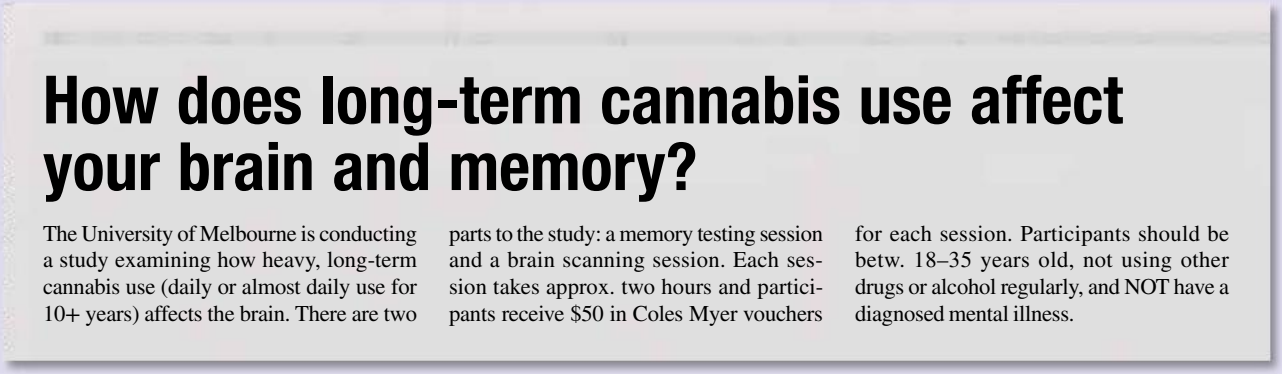
"How would you like me to answer that question? As a member of my ethnic group, educational class, income group, or religious category?"

4. The rating of a TV show is determined by the size of the audience who watches it. The rating is based on data from an electronic recording device attached to a TV set in a viewer's home. The device automatically records which TV show is being watched and for how long. Viewers also indicate who in the household is watching. Suppose you are responsible for determining the TV ratings of the viewing audience in Melbourne (or a regional town) for a one-week period.

(a) Briefly describe the sampling procedure you could use to select the participants who will receive a recording device.

(b) Explain how your procedure would ensure a representative sample of the viewing population.

5. Consider the newspaper advertisement below, then answer the following questions.



How does long-term cannabis use affect your brain and memory?

The University of Melbourne is conducting a study examining how heavy, long-term cannabis use (daily or almost daily use for 10+ years) affects the brain. There are two parts to the study: a memory testing session and a brain scanning session. Each session takes approx. two hours and participants receive $50 in Coles Myer vouchers for each session. Participants should be betw. 18–35 years old, not using other drugs or alcohol regularly, and NOT have a diagnosed mental illness.

(a) Identify the target population for the sample.
(b) Is this sampling procedure better described as convenience sampling or random sampling? Explain your choice.
(c) A sample obtained through an advertisement is sometimes called a 'self-selected' sample. In what way is this type of sample self-selecting?
(d) Will advertising for research participants and using a gift voucher or incentive payment result in sample bias? Explain your answer.
(e) Will exclusion of some respondents from the sample result in sample bias? Explain your answer.
(f) How representative is the sample obtained using the advertisement likely to be?
(g) Will the researcher be able to generalise their results from the study described in the advertisement? Explain your answer.

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Practical activity
Testing different sampling techniques

Participant allocation

After participants have been selected, they have to be assigned to the different groups required for the experiment. This must be completed as systematically as the selection process so that personal characteristics of participants are distributed relatively evenly across the different groups (and therefore within the conditions of the experiment). In this way, participant variables that may become confounding variables are controlled. This type of control through random allocation is an *essential* characteristic of experimental research and also distinguishes it from other research methods.

Random allocation

It is to be expected that individual participants will have different abilities and other personal characteristics or backgrounds that may affect the outcome of an experiment. One way of minimising differences in the composition of the control and experimental groups is to randomly allocate, or assign, participants to the groups.

Random allocation, also called *random assignment*, is a procedure used to place participants in groups or conditions so that they are as likely to be in one group as the other. This means that every participant has an equal chance of being selected for any of the groups to be used.

As with random selection, random allocation can be achieved using a lottery method in which chance alone will determine the group to which each participant is assigned. For example, drawing 'names out of a hat' or tossing a coin are also appropriate ways of randomly allocating participants to groups.

With a sufficiently large number of participants, it is reasonable to assume that each group will end up with the same kind of spread of participant characteristics, abilities and backgrounds that may affect the DV and therefore the results. For example, consider the experiment on alcohol consumption and driving ability described previously. If the experimental group has a larger proportion of 'bad' drivers than the control group and the experimental group makes significantly more driving errors in the driving simulator, it will be difficult for the researcher to isolate the effect of alcohol (the IV) on driving ability (the DV).

The problem is that the participants in the experimental group may make more driving errors than the control group even when *not* under the influence of alcohol. Through random allocation of participants to the experimental and control groups, each group would be expected to end up with relatively even numbers of participants who are 'good' and 'bad' drivers.

The purpose of random allocation of participants is to obtain groups that are as alike as possible in terms of participant variables *before* introducing the IV. With random allocation of participants to the experimental and control groups, researchers can more confidently conclude that if two groups responded differently in the experiment in terms of the number of driving errors, then it most likely had something to do with the effect of the IV. Consequently, random allocation is an important means of experimental control.

For a classroom experiment, placing all males in one group and all females in the other group would *not* be a random allocation procedure. Similarly, assigning the people seated in the front half of the room to one group and the people seated in the back half to the other group is not random allocation. There could be a difference in one or more personal characteristics of people who prefer to sit at the front or back of the classroom.

Random allocation does not guarantee that participants in the different groups or conditions are entirely equivalent before the experiment begins. However, it does reduce the likelihood of differences being present due to 'chance' factors, which helps rule out possible alternative explanations of the change measured in the DV. The likelihood of chance differences in participant variables between or even within groups tends to be reduced further as the sample size of each group increases.

Random allocation is different from random sampling. Random allocation is used to place participants in groups whereas random sampling is one of the procedures which can be used to select participants for an experiment. Random sampling, however, is based on the same principle of 'equal opportunity for all participants'.

Random sampling and random allocation can also be distinguished in relation to the validity of the experiment (or any other research study). Since random sampling involves selection of participants from a target population, it is crucial for the generalisability of the results and therefore *external validity*. After all, random sampling is used so that the participants will better represent the population from which they are drawn — the goal being to generalise the results for the sample to its population.

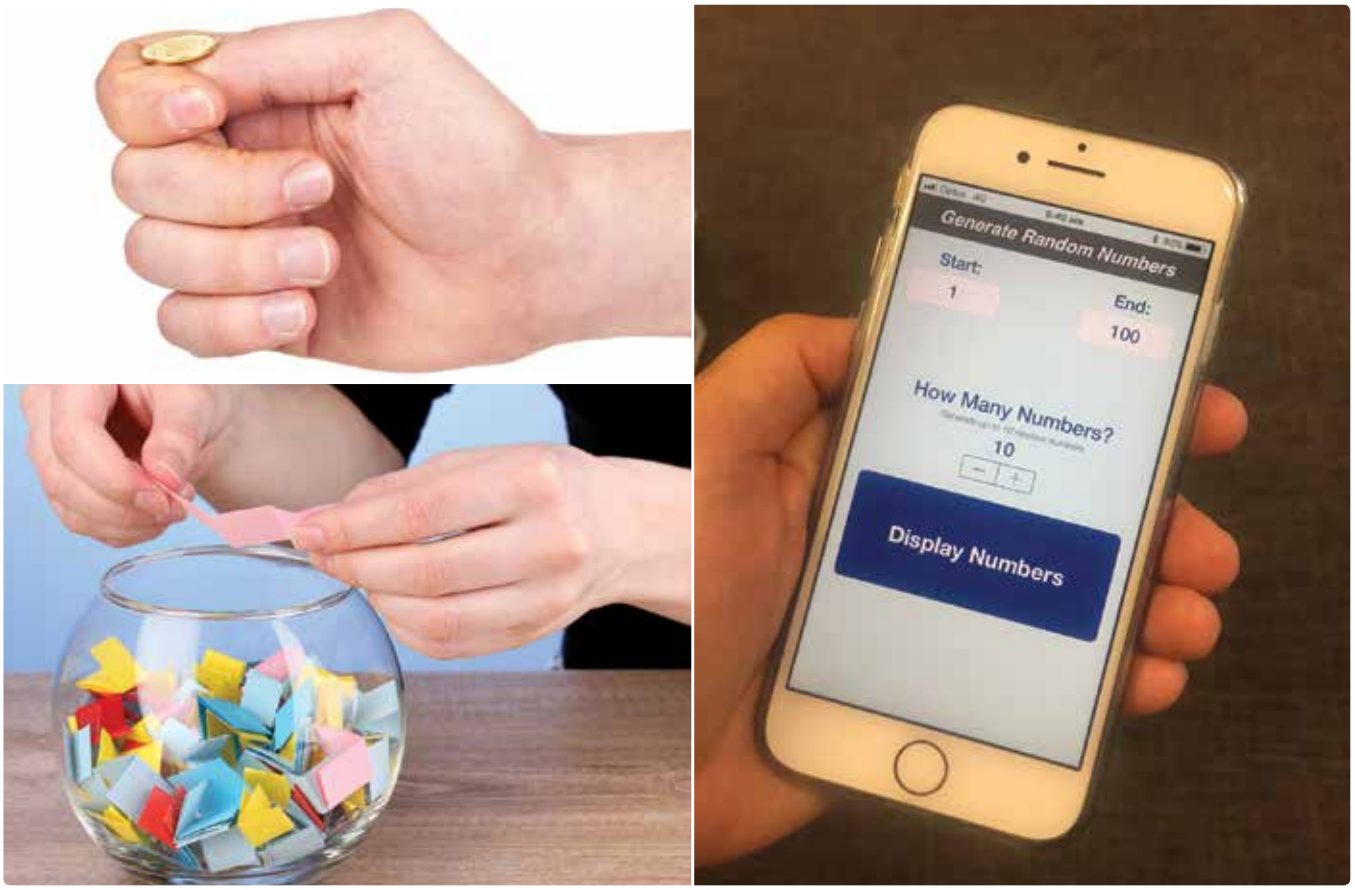

Figure 1.37 Coin tossing, drawing names from a container and a digital random number generator can be used for random allocation to groups.

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Practical activities on random allocation

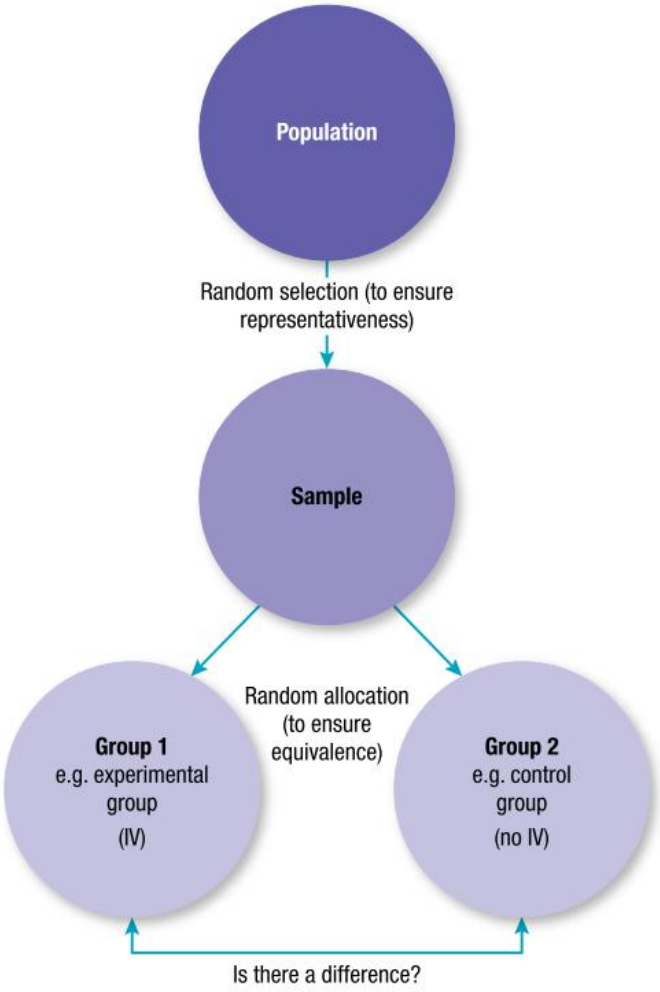

Figure 1.38 A simple experimental design using random sampling to select participants and random allocation to assign them to either condition

In contrast, random allocation is most related to the research design. It is used with the goal of being able to draw conclusions about the causal effect of the IV on the DV. After all, participants are randomly allocated in order to help ensure that the experimental and control groups are as similar to each other as possible (i.e. equivalent) prior to manipulation of the IV. Non-random allocation usually leads to non-equivalent groups, meaning that any change in the DV might be due to the groups being different in participant variables rather than the IV alone. Therefore, random allocation is most related to *internal validity*.

The consequences of random selection and random allocation are clearly very different, and a good research design will use both whenever possible to help ensure both internal and external validity (see pages 108–9).

LEARNING ACTIVITY 1.16

Review questions

1. What is the main difference between participant selection and participant allocation?
2. What is random allocation?
3. What does random allocation achieve?
4. Why is random allocation considered to be a crucial feature of a psychological experiment?
5. How are random sampling and random allocation different?
6. How do random sampling and random allocation relate to the validity of an experiment?

LEARNING ACTIVITY 1.17

Evaluation of research

A VCE Psychologist wanted to investigate what effect, if any, a reward of money would have on doing a simple motor task. The student therefore devised the task of having participants put together small nuts and bolts. The 'score' consisted of the number of nuts and bolts put together in a three-minute period. The student non-randomly allocated a large number of conveniently-sampled, volunteer individuals into two groups, ensuring the groups were equivalent in size. The sample is shown in Table 1 below.

TABLE 1

Group	Males	Females	Total
A	22	18	40
B	15	25	40

The student researcher explained to the participants what to do. Then the student had Group A assemble the nuts and bolts, which were placed in separate containers next to each participant. At the end of the three-minute period, the student counted the number of units assembled by each participant. Next, the student repeated the same instructions to Group B, except Group B members were offered 50 cents for each completed unit. The results are shown in Table 2 below.

TABLE 2

Group	Mean number of units assembled
A	37
B	52

1. Identify the operationalised independent and dependent variables.
2. What conclusion do the results suggest about the effect of the IV?
3. Suggest two potential confounding variables and therefore alternative explanations of the results. Ensure that you clearly explain your choice of confounds.

Counterbalancing

A counterbalancing procedure is commonly used to control or minimise order effects such as practice and carry-over. **Counterbalancing** involves systematically changing the order of treatments or tasks for participants in a 'balanced' way to 'counter' the unwanted effects on performance of any one order. By counterbalancing, the researcher recognises that an order effect is a potential confounding variable and cannot be controlled or eliminated through other means. Experiments with a repeated measures design are most vulnerable to order effects (see page 56).

There are different types of counterbalancing procedures that vary in complexity. The simplest and most commonly used is called between-participants counterbalancing.

The *between-participants counterbalancing* procedure involves alternating the order in which the experimental and control groups are exposed to each condition of the experiment. Each group is exposed to each condition in a different order.

For example, suppose a researcher will conduct an experiment in which all participants first learn a list of words when rap music is playing and then learn a list of similar words when there is no music. It is possible that the participants may demonstrate better learning in the no music condition because of a practice effect. To address this order effect, the researcher could split the sample into two groups — A and B. Group A could learn words in the rap music condition first, then learn words in the no music condition. Group B would learn words in the no music condition, followed by the rap music condition. Participants would also be randomly allocated to each group to experience either condition first or second. The procedure is shown in Figure 1.39 below.

The results for all participants are then combined across the entire experiment to achieve counterbalancing. In this way, whatever order effects impact on learning the words are controlled. Although an order effect may have occurred for each participant, because they occurred equally in both groups, they have balanced each other out in the results.

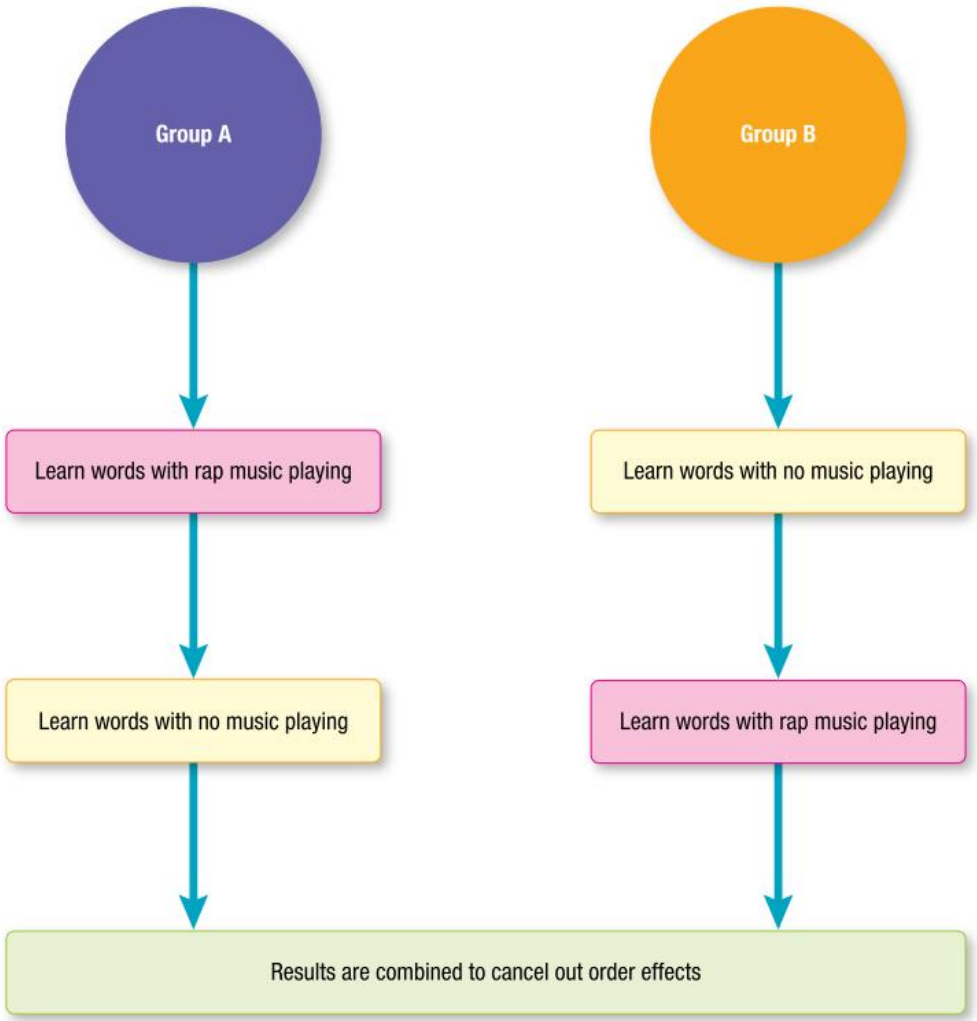

Figure 1.39 A simple counterbalancing procedure for the learning and rap music experiment. Table 1.3 on the next page and Table 1.4 on page 57 show other examples of counterbalancing.

BOX 1.10 Within-participants counterbalancing

The *within-participants counterbalancing* procedure requires each participant to be exposed to the same combination of conditions. That is, each participant is exposed to the treatment conditions in one order and then again in the reverse order.

The within-participants counterbalancing procedure called *ABBA counterbalancing* can be used when there are only two experimental conditions. In this form of counterbalancing, participants receive condition A first and then condition B, followed by condition B and then condition A. If more trials are desired, then this sequence is repeated.

For example, in the Pepsi and Coke taste-testing study described earlier on page 25, participants would rate one cola first followed by the second cola, then the second cola again followed by the first cola. In this way, any order effects are held constant so that their impact is balanced out over the entire experiment.

TABLE 1.3 An example of a within-participants counterbalancing procedure for a taste-testing experiment

Condition A (Pepsi)	Condition B (Coke)	Condition B (Coke)	Condition A (Pepsi)
P_1	P_1	P_1	P_1
P_2	P_2	P_2	P_2
P_3	P_3	P_3	P_3
P_4	P_4	P_4	P_4
P_5	P_5	P_5	P_5
P_6	P_6	P_6	P_6
P_7	P_7	P_7	P_7
P_8	P_8	P_8	P_8
P_9	P_9	P_9	P_9
P_{10}	P_{10}	P_{10}	P_{10}

Note: P = participant

Single and double blind procedures

Participant beliefs and expectations (including the placebo effect) can influence the results of any investigation, so it is important that participants do not know whether they are in an experimental or a control group. In this case, the experiment is said to be using a single blind procedure. It is called a **single blind procedure** because the participants are not aware of (are 'blind' to) the condition of the experiment to which they have been allocated and therefore the experimental treatment (the IV). Note, however, that single blind is not always possible. For example, in an experiment assessing which type of psychotherapy is most effective, it would be impossible to keep participants unaware of whether or not they actually received some type of therapy.

To control possible experimenter effects, while also controlling participant expectations, researchers may use a procedure in which neither the participant nor the researcher interacting with the participants knows which participants are in the experimental or control conditions. This is called the **double blind procedure** because the participants *and* the researcher (or research assistant) directly involved with the participants are unaware of (are 'blind' to) the conditions to which the participants have been allocated. Only the researcher(s) removed from the actual research situation knows which participants are in which condition (or groups).

The double blind procedure has obvious value in experiments in which knowledge of the conditions might affect the behaviour of the researcher as well as the participants; for example, when testing the effects of a drug. In drug testing studies, called 'clinical trials', use of double blind is a standard procedure. However, as with single blind, double blind is not always possible.

In some experiments the participants may know which condition they are in and one or more researchers do not. For example, a researcher conducting a vital data collection, recording or assessment procedure may intentionally be kept unaware of the condition to which participants are allocated in order to avoid bias or some other 'experimenter effect' on participant performance or results. In such cases, the researcher is said to have been 'blinded' or 'blinded to' the condition, so it is considered that single blind has been used.

Figure 1.40 This 10-year-old boy is a participant in a double blind, oral food trial to test for a food allergy. The boy is required to eat a variety of foods one by one, while being observed for symptoms of an allergic reaction by a doctor. The foods include suspected allergens and placebos. Neither the patient nor the doctor knows which foods are which.

Placebos

In an experiment, participants in the experimental group are exposed to the treatment (the IV) and participants in the control group are not. Because only the experimental group receives the treatment, only the participants in this group may be influenced by their expectations or beliefs about how they should behave. Therefore, there is a potential confounding variable — the experimental group may respond differently to the control group either because of the treatment or because of their expectations of how they should behave.

For example, suppose an experimental group is given an alcoholic drink so that its effects on performance of a task can be observed, whereas the control group receives nothing. Impaired performance observed in the experimental group may be due to the alcohol, or it may have arisen because the act of giving the participants alcohol suggested that they were expected to act drunkenly, so they did.

In order to control this potential confounding variable, control groups can be given a placebo, or fake treatment, so that they form the same expectations and beliefs as the experimental group. Thus, the control group would be given a drink that smells and tastes like alcohol but is not alcohol. The control group would not be informed that their drink is not alcoholic and they would have no way of distinguishing it from a real alcoholic drink.

Using this procedure, both groups will form the same expectations for acting drunkenly, so any differences in performance can be assumed to be due to the real alcohol given to the experimental group. Similarly, when testing other drugs, researchers give placebo pills, substances or even injections to the control group so that all participants experience the same procedure and form the same expectations. And in studies that require the experimental group to perform, for example, a physically or mentally demanding task prior to making a response, the researcher would have the control group perform a similar placebo task to eliminate differences between the groups in terms of motivation or fatigue (Heiman, 2002).

A placebo can be any type of inert (inactive) or fake treatment. It may be a drug or any other type of pill or substance, an edible product such as a food, a special diet, a psychological therapy, a physical therapy, exercise or even surgery (such as an incision and a procedure that is faked so that the participant doesn't know they actually had nothing done).

When a placebo is given to a control group, the group is sometimes referred to as the *placebo control group* or the *placebo condition*. The use of placebo treatments, including ethical considerations, is discussed further in Chapter 11.

Figure 1.41 The inability of many astronauts to sleep well when on space missions led to research designed to test whether they could be helped by taking melatonin, a hormone known to have a role in sleep onset. In one experiment, half the astronauts aboard a space shuttle took a pill containing melatonin, and the other half took a placebo pill that looked the same but did not contain any active ingredient. All astronauts were blind as to which experimental condition they were in — they did not know whether they had taken the melatonin or placebo. This photo shows space shuttle astronauts in their sleeping bags. Their arms are floating free but their bodies are restrained and kept in place.

Standardised instructions and procedures

The instructions and procedures used by the researcher are a source of extraneous or confounding variables so their potential unwanted influences must be minimised. More specifically, the goal is to minimise any differences among participants that might occur within the experiment itself.

This is achieved by standardisation ('uniformity') across the different conditions. Using standardised instructions and procedures means that instructions and procedures are the same for all participants (except for variations required for experimental group participants exposed to the IV).

The use of **standardised instructions** means that the directions and explanations given to all participants in each condition are predetermined and identical in terms of what they state and how they are administered. They should be clear and avoid jargon, and there should be no ambiguities or variations for individual participants. Generally, the researcher should describe the sequence of events, identify the stimuli participants should attend to and explain how to respond. Questions by participants should be anticipated and the specific answers or type of response to be given by the researcher should be predetermined.

The use of standardised instructions starts with participant contact and includes the consent form. To reliably present instructions during an experiment, researchers usually read from a pre-prepared script in a 'neutral' voice. The script typically contains all the information about what the researcher says and does during the experiment, beginning with greeting the participants and ending with the debriefing.

A key purpose of using standardised instructions is to have all participants perform the intended task in the same way to avoid introducing potential extraneous variables that make the task inconsistent or different for different participants. For example, if the researcher must stop during testing to further explain a task or correct a behaviour, the researcher's actions can become an inconsistency.

It is also essential that all participants are exposed to the same environment and procedures, with the only exception being exposure to the independent variable. Therefore, it is also necessary to use **standardised procedures** — the techniques used for making observations and measuring and recording responses should be identical for all individual participants. All participants should be treated in the same way, as appropriate to the experimental condition to which they have been assigned

Figure 1.42 A researcher conducting a study on food cravings during pregnancy. The participants are shown sampling foods from a selection on a table, and notes are being made by a researcher (upper left) of what they choose to eat. The researcher's use of standardised instructions and procedures minimises the influence of unwanted participant variables and experimenter effects.

(e.g. experimental or control group). For example, using standardised procedures often means that:

- all participants will be organised and brought together in the same way
- all participants would interact with the same researcher in the same environment
- the experiment would be run at the same time of day for all participants
- all participants would have the same amount of time, learn the same amount of information and complete the same activities (except for variations required for IV exposure)
- all researchers will treat each participant in the same way when conducting the study (except for IV manipulation).

How the researcher presents a stimulus to initiate a response of interest and record the resulting physical reaction or a score during DV measurement can often be controlled through automation by using electronic or mechanical devices. Electronic timers, data projectors, video and audio recorders, computers, tablets and other digital technologies can help ensure controlled and consistent stimulus presentations (such as an image on a monitor to measure reaction time). Automating data collection ensures that the response recording and scoring systems are consistently and accurately applied. It can also provide for sensitive measurement of responses (such as the keystroke or screen tap used to measure reaction time to a stimulus).

The use of standardised instructions and procedures can help control unwanted participant variables and the placebo effect, because all participants will have the same experience. It can also help control any experimenter effect, as all the researchers involved will follow the same procedures. Consequently, when the results for experimental and control groups are compared, significant differences can be said to be due to the IV with confidence.

LEARNING ACTIVITY 1.18

Review questions

1. Explain what the counterbalancing procedure is and which potential problem(s) it attempts to control.

2. (a) A researcher believes that the biological sex of participants is a potential confounding variable. Explain how counterbalancing could be used to control this variable.

(b) The researcher will use a number of research assistants to conduct the study and also believes that their sex is a potential confounding variable. Explain how counterbalancing could be used to control this variable.

3. Suggest a randomisation or random allocation procedure that could be used to counterbalance order effects in an experiment.

4. (a) In what way is the single blind procedure similar and different to the double blind procedure?

(b) Which of the two procedures gives more control? Explain your answer.

(c) Give an example of when it would be essential for participants *and* a researcher to be blinded to the condition to which participants are allocated.

5. Explain how a placebo can be used to control or minimise the influence of expectations or beliefs associated with the specific treatment received by participants in experimental and control groups.

6. (a) What are standardised instructions and procedures? Explain with reference to relevant examples.

(b) Explain how standardised instructions and procedures can be used to control or minimise the influence of participant variables and experimenter effects.

LEARNING ACTIVITY 1.19

Evaluation of research

Mardi conducts an experiment to find out if colour preference can be influenced by associating a colour with a pleasant experience such as eating. She delivers a supply of red, orange, yellow, green and blue feeding bottles to some mothers of newborn infants and the regular transparent feeding bottles to the mothers of other newborn infants in the sample. The mothers have consented to let their infants be participants in Mardi's experiment.

1. What is the IV in Mardi's experiment?

2. How many experimental groups does Mardi have in her experiment?

3. Which participants make up the control group?

4. What is the DV?

5. How could Mardi randomly allocate the participants to different groups?

6. Identify two extraneous or potential confounding variables that should be controlled and explain why.

Source: Adapted from Sugar, J., & Offir, C. (1990). *Student resource manual* (3rd ed.). New York: Harper & Row.

LEARNING ACTIVITY 1.20

Reflection

To what extent are non evidence-based 'alternative medicines' (such as faith healing and herbal products) reliant on the placebo effect? Comment with reference to an example.

Use of an appropriate experimental research design

Various experimental research designs can be used to minimise the effects of potential extraneous and confounding variables, particularly variables associated with individual differences of participants. Three of these designs are the independent groups, repeated measures and matched participants designs. The designs primarily differ in how participants are allocated to different groups (or conditions).

Independent groups

In an experiment with an **independent groups** design, each participant is randomly allocated to one of two (or more) entirely separate ('independent') conditions (and therefore 'groups'). This experimental design is also called *independent measures*, *between participants* and *between groups*.

The simplest independent groups design uses two groups — most often one group as the experimental group and the other as the control group. The experimental group is exposed to the IV (some kind of change) and the control group is not. For example, suppose a researcher is interested in investigating the effects of loud music (an IV) on problem solving (a DV). The experimental group could be given a problem-solving task to complete while loud music is playing and the control group would be given the task to complete without any music playing. Performance of participants under each condition would then be compared with reference to scores achieved on the problem-solving task. For example, a mean score could be calculated for each group to enable a quick comparison.

Random allocation is an essential feature of the independent groups design in order to control the influence of individual participant differences. This procedure is used after participants have been selected for the experiment, but before the experiment begins. Depending on the number of participants and groups, the random allocation procedure may involve tossing a coin to decide which participant goes into each group. Alternatively, a simple lottery method can be used. For example, participants may be asked to draw a number from a container holding as many different numbers as there are participants. Those who draw odd numbers are then allocated to one group, and those who draw even numbers are allocated to another group.

Using an appropriate random allocation procedure is likely to result in two groups that are well matched on participant characteristics and therefore fairly equivalent. However, this may not necessarily be the case if there are a very small number of participants. The bigger the groups, the more likely it is that a uniform spread of characteristics and abilities will be achieved. Although random allocation does not guarantee that different conditions are entirely equivalent in the spread of participant variables, it does greatly reduce the likelihood of differences so that the effect(s) of the IV on the DV can be isolated.

The independent groups design is very common in experimental research. A significant practical advantage is that the experiment can usually be completed on one occasion, which also helps ensure participant attrition (loss) is negligible. Unlike the repeated measures design, there is not often a need to spread out the time period between the different conditions. Another advantage of the independent groups design is there are no order effects between conditions to control.

However, there is often a need for a larger number of participants to help ensure the spread of participant variables within the sample will match the distribution within the population. In addition, there is less control over participant variables than in the repeated measures and matched participants designs, especially when a small sample is used.

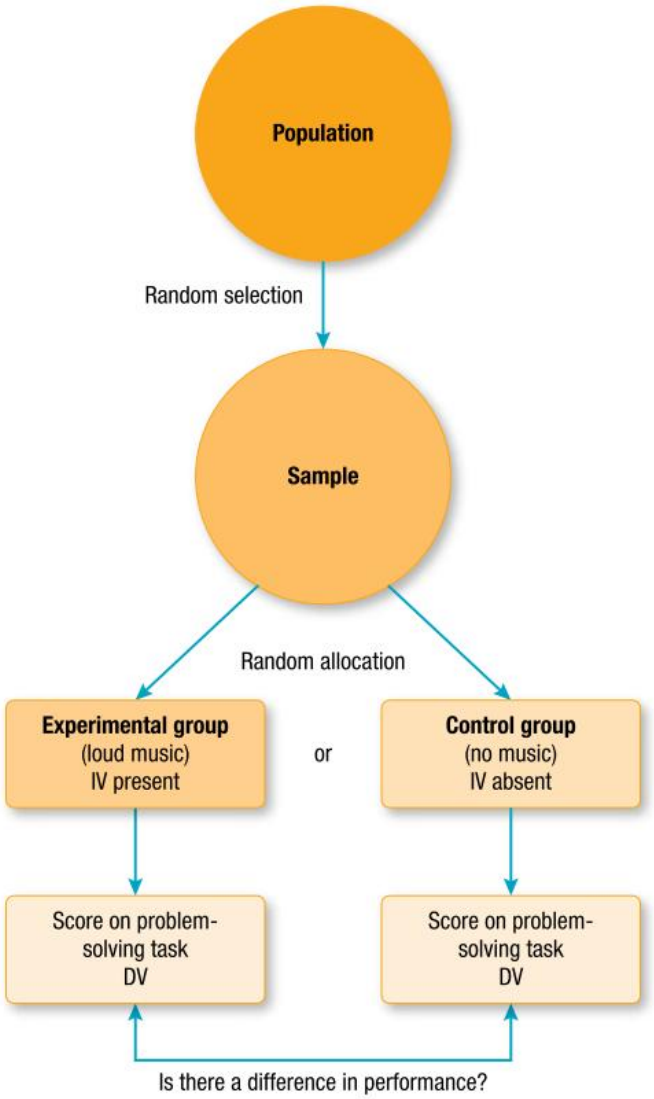

Figure 1.43 In an experiment with an independent groups design, participants are randomly allocated to the different groups (conditions) to ensure participant variables that can cause a change in the DV are uniformly distributed across the groups.

Repeated measures

Another way of controlling the influence of individual differences of participants is to design an experiment that uses the *same* participants in the experimental and control conditions. This is what happens in a repeated measures experiment, which is also called *within participants* and *within groups*.

In an experiment with a **repeated measures** design, each participant is in both the experimental and control groups (and therefore all conditions). The groups are identical so individual participant differences that may impact on the DV are controlled.

For example, consider the researcher interested in loud music and problem solving. Using the repeated measures design, a group of participants would be given a problem-solving task to complete while loud music was playing, and the same group would then be tested on a similar, equally difficult, problem-solving task but without any music playing. This means each participant would experience both the loud music and no music conditions while solving similar problems. How well all participants solved problems would be measured twice, once after each condition of loud music and no music respectively (hence the term 'repeated measures').

Using this design would give the researcher strict control over all relevant participant variables that can influence the results, such as individual differences in problem-solving abilities and levels of motivation. Any participant differences that may not have been identified by the researcher as potential confounding variables have also been controlled as the participants in both conditions are identical in every respect.

When planning a repeated measures experiment, the researcher has to consider order effects that may arise from the design; for example, whether a problem-solving task is performed first or second. Performance on a problem-solving task that is completed second may be better because of the experience gained in completing the first task. Participants may perform better in the second condition because they have practised the task or have gained other useful knowledge about the task or the experiment. Alternatively, participants' performance may be impaired by effects such as fatigue or boredom, and they may not perform as well on the second occasion. In either case, the order effect is a potential confounding variable because the researcher cannot be confident about whether the IV or order effect caused the change that was measured in the DV.

One way of dealing with order effects such as practice, fatigue and boredom is to increase the time between measuring the DV in each condition (in this case, completion of the problem-solving tasks). For example, participants might be in the experimental group one day, then return a week later for the control condition. When this procedure is inappropriate, inconvenient or impractical, the researcher should ensure that the order in which the problem-solving tasks are performed is counterbalanced across the participants. For example, half the participants would follow one order (solving a problem in the experimental condition first, then solving a problem in the control condition). The other half would follow the reverse order (solving the problem in the control condition first, then solving the problem in the experimental condition).

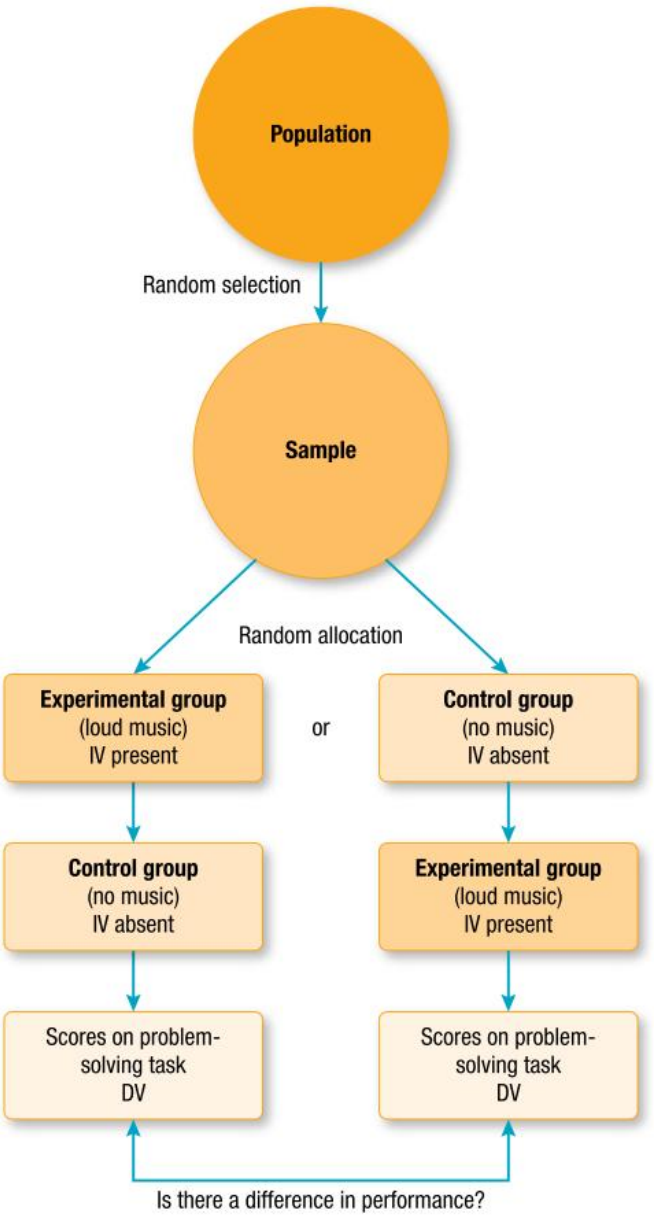

Figure 1.44 In an experiment with a repeated measures design, the same participants are in both the experimental and the control groups and are therefore exposed to all conditions.

Even stricter counterbalancing control of order effects may be achieved by using a random allocation procedure to determine the order in which each participant will be exposed to each condition. These procedures usually ensure that order effects are balanced out over the entire experiment, but there

is no guarantee that this will occur. Table 1.4 below shows a counterbalancing arrangement whereby individual participants are randomly allocated to the different conditions (also see Figure 1.39 on page 50).

TABLE 1.4 Counterbalancing for a repeated measures experiment

Participant	Experimental condition	Control condition
1	first	second
2	second	first
3	first	second
4	second	first
5	second	first
6	first	second

The main advantage of the repeated measures design is that it can effectively control potential confounding variables arising from individual participant differences. The researcher can assume that any difference in performance on the DV in each condition of the experiment should not be due to differences produced by any extraneous variable associated with individual participant differences because each participant, with the same personal characteristics (including abilities), is in every condition. Another advantage is that this design also tends to require a relatively smaller number of participants when compared with other experimental designs because the same participants are in all conditions.

However, the repeated measures design has several limitations. Although this design keeps individual participant differences constant, it does not necessarily control all participant variables that can influence the results. For example, some participants may guess what the experiment is about as they compare the two conditions, creating expectations and beliefs that lead to unnatural responses.

The repeated measures design can also result in unwanted participant loss before the experiment is completed. It is most common when the repeated measurement of the DV requires a considerable amount of time per participant, so that, to reduce fatigue or overload, the researcher spreads out the time between the different conditions over several days. Then, participants show up for the first session but do not return for the second one. It is also possible for some participants to find the first condition boring and not attend the second simply because they don't want to.

Another limitation is that order effects are more likely with the repeated measures design and can become a confounding variable if uncontrolled. However, the researcher can use counterbalancing to control any order effect.

Matched participants

In a **matched participants** design, also called *matched groups,* each participant in one condition 'matches' a participant in the other condition(s) on one or more participant variables of relevance to the experiment. This type of experiment usually involves selection of pairs of participants who are very similar in one or more personal characteristics that can influence the DV, then allocating each member of the pair to an experimental or control group. When pairs of participants are matched, the design is often called *matched pairs*. However, the matched participant design is not limited to pairs of participants. Several well-known experiments have used matched 'trios' (or 'triplets'). One of the best known is a series of experiments by Albert Bandura to investigate observational learning of aggression by young children (see pages 318–19). An experiment may also use matched quads and so on, if required.

The use of a matching process in terms of one or more relevant participant variables (such as intelligence, creativity, sex, age) is reflected in the name of the experimental design. Randomly allocating one member of each matched group to a different condition ensures that each experimental and control group is fairly equivalent in terms of the spread of participant characteristics that can cause a change in the DV.

Sets of identical twins are best for matching participants when pairs are used. They have the same genetic make-up, are identical in age and sex and tend to be very similar (but not identical) in socio-cultural background, mental abilities, temperament and various other personal characteristics (but not all). In a matched participants experiment, one member of each pair of twins would be allocated to the experimental group and the other would be allocated to the control group. In this way, both groups would be considered fairly equivalent, thereby minimising extraneous and confounding variables. However, identical twins are often not available.

In the loud music and problem-solving experiment, the intellectual ability of each participant could be reasonably assumed as being likely to affect their problem-solving ability. Suppose that the experimental group (loud music condition) performed poorly on the problem-solving task, as compared to the control group (no music condition). The researcher would want to be in a position to conclude that this difference in performance was due solely to the IV (loud music). If the experimental group had all the participants who were least intellectually able and the control group had all the participants who were most intellectually able, the experimenter would not know whether it was the loud music or the problem-solving ability of participants that caused the poor performance.

In order to avoid this problem, the researcher could administer an intelligence test to each participant after they had been selected for the experiment,

but before the experiment began. This pre-testing would provide an IQ score for each participant. Each participant would then be paired with someone else with a similar IQ score until all the participants had been matched on intelligence. The participants would then be allocated to a group (experimental or control condition) on the basis of their IQ scores.

For example, in allocating participants to groups in the loud music and problem-solving experiment, the two participants with the highest IQ scores would be randomly allocated to the loud music and no music groups respectively. Then the two participants with the next highest IQ scores would be randomly allocated to the two groups, and so on. In this way, the two groups in the experiment would be *matched* in terms of intellectual ability, thereby controlling the influence of this potential confounding variable.

The loud music and problem-solving experiment could also have three groups — a control group who will not be exposed to any music, an experimental group who will be exposed to loud music and an experimental group who will be exposed to soft music. For this specific design, participants would be organised into groups of three based on IQ score matching, then each member would be allocated to one of the three experimental conditions.

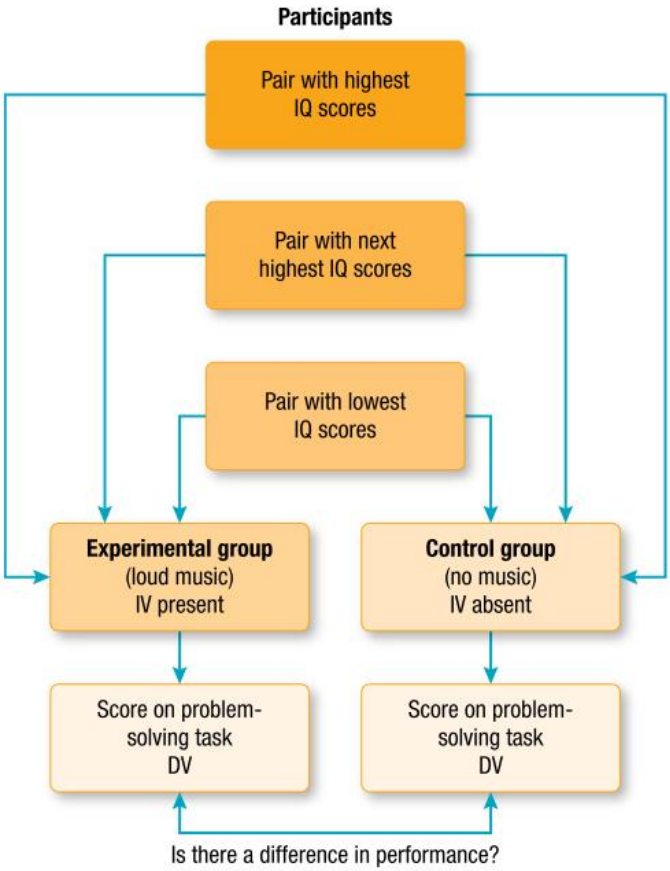

Figure 1.45 Matched participants design for the experiment on loud music and problem-solving

The main advantage of matching participants is that it ensures that in every condition there is a participant with very similar or identical scores on the variable(s) the researcher seeks to control. This means that these variables are constant across the conditions, thereby eliminating them as potential confounding variables. In addition, like the independent groups design, the experiment can usually be completed on one occasion. Furthermore, unlike the repeated measures design, there are no order effects between conditions to control. Participant loss is also less common than with the repeated measures design and there is not often a need to spread out the time period between the different conditions.

There are, however, limitations to the matched participants design. One potential problem is the difficulty of knowing which specific participant variables should be matched. Even if the researcher can identify the variable(s) that is likely to most influence performance on the DV, it is often difficult and time-consuming to actually recruit participants who are sufficiently alike in the variable. There are also other practical problems. For example, to find matching participants, the researcher often has to pre-test many individuals and/or settle for a very small number of participants. And the more matching variables that are specified, the more difficult and time-consuming it is to match.

As well as being time-consuming, pre-testing can create order effects. And the loss of one participant through attrition means the loss of a whole pair, trio and so on. Pre-testing is usually not required for the repeated measures design and is only used in an independent groups design if the researcher elects to do so.

Use of the matched participants design is often not necessary in experimental research. Random allocation is usually sufficient to control individual differences of participants as it ensures equivalence of the experimental and control groups. Consequently, the matched participants design is not commonly used.

TABLE 1.5 Three experimental designs

Experimental design	Feature
independent groups	Each participant is randomly allocated to either the experimental or control group and is in one group (condition) only.
repeated measures	Each participant is involved in both the experimental and control groups i.e. all conditions.
matched participants	Each participant in one group (or condition) 'matches' a participant in the other group(s) on one or more participant variables relevant to the experiment.

Advantages and limitations of experimental research

A key feature of an experiment is the researcher's attempts to control the conditions in which a behaviour of interest or other event occurs, whether the experiment occurs in a laboratory setting or in a real-life, field setting. As well as controlling the IV, the researcher also attempts to minimise or eliminate the influence of unwanted extraneous or confounding variables to concentrate entirely on the effect the IV has on the DV. Elimination of all unwanted and irrelevant variables is not always possible, but their control is usually greater than in other research methods, especially if the experiment is conducted in a laboratory setting. Therefore, the ability to control variables, often in a very precise way, is an important advantage of an experiment when compared to other research methods.

Another important advantage of the experiment is that the IV can be manipulated in order to observe and measure the effect on the DV, therefore making it possible to test if there is a cause and effect relationship between the IV and DV. In this way, experimental research has the principal advantage of enabling conclusions about cause-and-effect relationships between variables. Furthermore, because controlled conditions are known conditions, the experimenter can set up the experiment a second time and repeat it to test the results.

Alternatively, the experimenter can report the conditions of an experiment in such a precise way that others can replicate it and test the results. Replication is very important because when a study is repeated and similar results are obtained, there can be greater confidence in the reliability and validity of the research and its results.

Despite its precision, there are several limitations of the experiment. Although a 'field experiment' occurs in a real-life setting and therefore has a relationship to the real world, it is often difficult to strictly control all variables because of the unpredictability of real-life settings. The ability to more strictly control variables is an advantage of the laboratory setting; however, this type of setting is often artificial and too dissimilar to real life. For example, bringing someone into the unfamiliar environment of a psychology laboratory can change their behaviour to the point where it is not appropriate to generalise or apply the observed behaviour to situations outside the laboratory (see Box 1.11 on the next page).

Furthermore, some things cannot be measured in a laboratory. The researcher cannot break up families, for example, to measure the effects of family separation. It is not possible because of practical realities and ethical concerns. Nor would the laboratory be the best setting for testing variables such as grief, hate or love. It may be difficult for participants to express these emotions naturally or very realistically in a laboratory setting.

Figure 1.46 Would practical realities and/or ethical concerns limit an experimental research study of responses to an emergency situation by an audience in a real-life setting? If so, how could these limitations be overcome?

BOX 1.11 Artificiality and ecological validity of laboratory experiments in psychological research

Psychologists often conduct experiments in laboratory settings, usually located at a university, so that the environment and procedures can be controlled and the participants' responses to the IV can be carefully observed. Volunteer participants of any age may be brought into a research laboratory to study virtually any aspect of human thinking, feeling and behaviour.

Some laboratories are quite elaborate. For example, a sleep laboratory has a diverse range of technical equipment that enables researchers to monitor a participant's eye movements and brain wave patterns, record the exact time they fall asleep and get dream reports the moment they awaken. Similarly, a laboratory for studying infant–parent social interactions may be set up as a special playroom equipped with hand-picked toys, two-way mirrors, and a hidden camera and microphone so that researchers can record every word that is spoken and analyse every little detail of each participant's behaviour.

Thus, in order to make certain observations, psychologists often find it necessary to simulate situations or events in a laboratory. However, the laboratory is an artificial setting. It is a humanmade, 'non-natural' setting used for research purposes (but can be basic as a classroom or lecture theatre).

This type of environment can produce responses that are distorted or do not adequately resemble how people would 'naturally' think, feel or behave when in the 'field' or real-life settings. For example, can someone sleep normally in a strange bed with metal electrodes pasted to their scalp? Will a parent and child interact in the playroom the way they do at home (Kassin, 1995)?

Laboratory-based research in psychology is often criticised because of its *artificiality* — its lack of realism and differences to real-life settings. The artificiality of the environment in which a study takes place can produce cues called *demand characteristics* that cause participants to react unnaturally. For example, participants sometimes use such things as random noises, changes in lighting or a broken pencil point as cues to work out what is being studied and how they should respond. More often than not, the conclusions drawn by participants are misleading or wrong (see Box 1.7 on page 34). Furthermore, artificiality can limit the generalisability of the results from the laboratory setting to real-life contexts. This means that a study conducted in a laboratory setting may be lacking in ecological validity and therefore external validity. *Ecological validity* is the extent to which an experiment's results (or any research findings) can be generalised to everyday, common real-life behaviours and natural situations.

However, too much emphasis may be placed on the setting in which a study is conducted. Many variables are impossible to study in the field or a real-world context for ethical and practical reasons. For example, Stanley Milgram's controversial studies in the 1960s on obedience to authority were criticised on the basis that they were conducted in a laboratory-based environment at a university. Participants knew they were in an experiment and, due to the artificial nature of the environment, may have responded differently to how they would have acted in similar circumstances in real life. For example, they may not have administered electrical shocks at deadly levels, if at all. Milgram recognised the limitation of his university laboratory setting by conducting further studies in a more realistic setting (a shopfront location in the community outside the university). He subsequently obtained a similar overall pattern of results to those observed in the 'artificial' laboratory setting. Such a study would be virtually impossible to conduct in a truly real-life context, and although the study was ethically questionable, it was better to examine the type of obedience involved in a controlled environment.

Figure 1.47 Stanley Milgram's controversial studies on obedience to authority were criticised on the basis of their artificiality as they were conducted in a laboratory-based environment. The photo shows an obedient research participant administering a shock he believes is potentially lethal.

BOX 1.12 Correlational research

In an experiment, the researcher manipulates one or more IV(s) in order to establish whether a change in the IV(s) brings about a change in the DV(s). If strict experimental control is maintained, a cause–effect relationship between an IV(s) and DV(s) can usually be established. Sometimes, however, using the experimental method is impractical or inappropriate.

Suppose a researcher wanted to find out how a severe emotional trauma in childhood affects school performance. It would be unethical to set up two similar groups of participants and expose one of these groups to the harmful experimental condition of the particular severe emotional trauma. In such cases, the researcher may choose to use existing information in order to assess the relationship, or correlation, between the variables of interest.

Correlational research is used to identify and describe the 'co-relationship' between two (or more) variables of interest. No attempt is made to manipulate any variable, as in experimental research. Nor is there any random allocation to conditions. The researcher merely assesses the type and strength of relationship between the variables.

The term *correlation* is a statistical one — a measure that indicates how variables are 'co-related'; for example, the relationship between stress and cancer, between level of anxiety and incidence of bedwetting, or between personality test scores and birth order. Correlation does not indicate that one variable (such as stress) causes another (such as cancer). Rather, it indicates whether a relationship exists, the strength of the relationship and the direction of the relationship (e.g. as one variable increases, is the other likely to increase or decrease?).

Direction of correlation

For any two variables measured in a correlational study there are three possible relationships between them: positive, negative and zero (no relationship).

A *positive correlation* means that the variables vary (change) in the same direction — as the value of one variable increases, the value of the other variable also tends to increase. For example, as job satisfaction increases, work productivity tends to increase (and vice versa). Similarly, as one variable decreases, so does the other.

A *negative correlation* means that the variables vary in opposite directions — as the value of one variable increases, the value of the other variable tends to decrease (and vice versa). The variables change like a seesaw, rather than in tandem. For example, as the amount of alcohol in the blood increases, reaction time tends to decrease (and vice versa). And, as the number of cigarettes smoked daily increases, the number of years of life decreases.

It is said that there is a *zero correlation* or little or no relationship between two variables if the way that they vary is totally independent of each other. For example, there is no relationship between height and VCE grades or the amount of coffee drunk and IQ score.

A correlation is usually described by a number known as a correlation coefficient. A *correlation coefficient* is expressed as a decimal number, which can range from +1.00 to –1.00.

The plus or minus sign describes the *direction* of the relationship between the two variables; that is, positive or negative.

A correlation coefficient preceded by a plus sign indicates a positive correlation. This means that high scores for one variable tend to go with high scores on the other, middle scores with middle scores, and low scores with low. For example, if there is a high positive correlation (e.g. +0.75) between the rate of pupil dilation and problem-solving ability, then people with rapid pupil dilation should tend to be good problem-solvers (e.g. they would solve many problems in a 20-minute period). People with slow dilation would tend to be poor problem solvers (e.g. they would solve fewer problems in a 20-minute period).

A correlation coefficient preceded by a minus sign indicates a negative correlation. This means that when a score on one variable is high, the score on the other tends to be low, and middle scores tend to go with middle scores. For example, if there is a high negative correlation (e.g. –0.75) between the rate of pupil dilation and problem-solving ability, then people with rapid pupil dilation would tend to be poor problem solvers and those with slow dilation would tend to be good problem solvers.

When reporting correlation coefficients for positive correlations, researchers usually omit the plus sign from the front of the score. However the minus sign is always included for a negative correlation.

Strength of correlation

The decimal number of the correlation coefficient describes the *strength* of the relationship between the sets of scores for the variables; that is, whether the relationship is strong, moderate or weak. A correlation coefficient that is close to +1.00 indicates a high positive correlation (i.e. very strong relationship) between the variables. A correlation coefficient that is close to –1.00 indicates a high negative correlation (i.e. very strong relationship) between the variables. Correlation coefficients of +1.00 and –1.00 indicate perfect correlations, but these very rarely occur.

A correlation coefficient that is close to zero indicates little or no relationship between the variable. For example, 0.12 and –0.12 would be considered a weak positive and negative correlation respectively.

Correlation and causation

Correlations show the existence and extent of relationships between variables but they do not necessarily indicate a cause–effect relationship (that one variable causes the other); for example, as the world rotates on its axis, people get older.

(continued)

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Figure 1.48 Sleeping with shoes on and waking up with a headache have a strong positive correlation. Does this mean that sleeping with shoes on causes a headache? Of course not. Both variables also correlate with and are affected by a third variable — going to bed after drinking too much alcohol.

There is an extremely strong correlation between these two variables but it would be faulty to assume that the Earth's rotation causes people to age or that people's ageing causes the Earth to rotate. Although scientists know that the two variables correlate, they have not been inclined to discover a way of stopping the Earth's rotation so that we stop getting older!

There are also many instances when high correlations suggest a logical cause–effect relationship, and sometimes correlations really do represent causal relationships. The amount of ink left in a pen is closely related to the length of time spent using the pen. But a significant correlation doesn't necessarily mean that there is a cause–effect relationship because both variables may be correlated with a third variable. For example, there is high positive correlation between the number of permanent teeth in children and their ability to answer increasingly difficult questions on intelligence tests. It cannot be assumed, however, that having more teeth causes increased cognitive ability. The correlation is high because a third variable — increasing age — accounts for both new teeth and cognitive development.

Similarly, there is a very high correlation between the number of years spent in schooling and income as an adult. Both of these variables, however, have also been found to correlate not *only* with each other but *also* with a third variable — parents' income. When two variables are correlated, this is not accepted by psychologists as proof of causation in the absence of other research evidence. In such cases, researchers will test the possible cause–effect relationship by conducting a carefully controlled experiment.

Scatter plots

Correlational data are often displayed in a scatter plot (also called a *scattergram* or *scatter diagram*). A *scatter plot* is a graph of scores (or other values) on two different variables. The values of one variable are shown on the vertical axis (Y axis) and the values of the other variable on the horizontal axis (X axis). Each pair of scores is plotted as a single point (a dot) in the scatter plot.

The spread of the dots on a scatter plot gives an idea of the *strength* of the correlation — the extent to which the two variables are related. Widely spread dots in the scatter plot in Figure 1.49 on the next page suggest that the two variables, attractiveness and reaction time, are not related. This would be represented by a correlation close to 0 (zero). In a zero correlation, individuals with high scores on one variable may have high, middle or low scores on the other variable. Figure 1.49 shows that participants with high scores on attractiveness have high, medium and low reaction times.

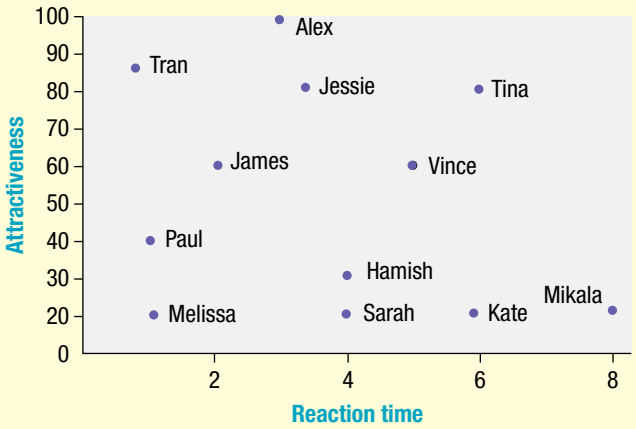

Figure 1.49 Scatter plot showing data for 12 participants obtained from a correlational study that investigated the relationship between physical attractiveness and reaction time

Figures 1.50 and 1.51 below both show a strong correlation as the dots cluster close together in a cigar-shaped pattern. Figure 1.50 shows a strong positive correlation and Figure 1.51 shows a strong negative correlation.

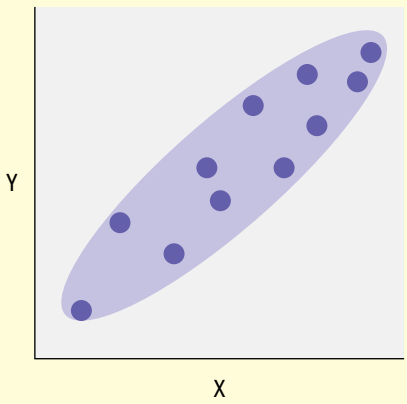

Figure 1.50 Strong positive correlation

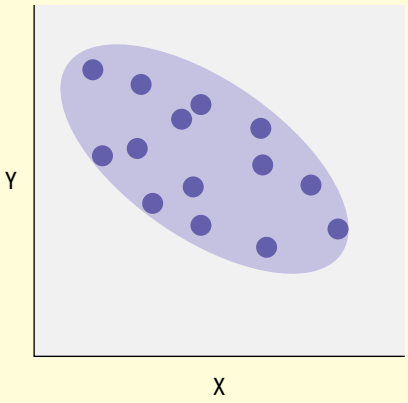

Figure 1.51 Strong negative correlation

The *direction* of the correlation — whether the correlation is positive or negative — is indicated by the slope or 'lean' of the dots, that is, whether they slope upwards or downwards (or neither). For example, in figures 1.52 and 1.53, a line has been drawn through the middle of the dots to help identify the slope. In Figure 1.52, the upward sloping line indicates a positive correlation, whereas the downward sloping line in Figure 1.53 indicates a negative correlation. Note that in both figures 1.52 and 1.53, the dots are closely clustered around each line, indicating a strong positive correlation in Figure 1.52 and a strong negative correlation in 1.53.

Figure 1.52 Strong positive correlation

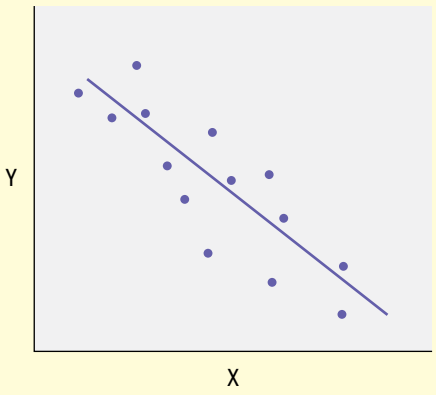

Figure 1.53 Strong negative correlation

eBook*plus*

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TEDx presentation: The danger of mixing up causality and correlation 5m 57s

LEARNING ACTIVITY 1.21

Review questions

1. Make a copy of Table 1.5 on page 58. Add two columns, one headed 'Advantages' and the other 'Limitations'. Complete the table including at least two advantages and two limitations for each experimental design.
2. Explain the meaning of experimental design.
3. Which of the three experimental designs uses each participant as his or her own control?
4. Which of the three experimental designs targets comparison of a participant's behaviour both before and after exposure to a treatment?
5. Which of the three experimental designs exposes all participants to the same IV(s)?
6. Sometimes participants in an experiment may guess what the study is about, thereby producing unnatural responses. Which procedure would be used to control this extraneous variable?
7. Sometimes participants in an independent groups experiment may be naturally better at performing an experimental task. For example, in a study on attention, some people might happen to be better at concentrating than others. Which procedure would be used to control this extraneous variable?
8. For each of the following extraneous or potential confounding variables, rank the three experimental designs from 1 to 3 to indicate the extent to which the design controls the variable, as compared to the other designs. A ranking of 1 indicates greatest control and a ranking of 3 indicates least control. If appropriate, more than one design may be given the same ranking. Explain your choice of rankings.
   (a) individual participant differences
   (b) placebo effect
   (c) order effects
   (d) experimenter effect
9. Suggest two research topics or questions that you believe could not be investigated through experimental research because of ethical or practical concerns and explain each choice.

LEARNING ACTIVITY 1.22

Identifying and analysing experimental designs

1. Read the following summaries of experiments and indicate whether an independent groups, repeated measures or matched participants is used.

Experiment 1

A researcher is interested in the effectiveness of a particular treatment for insomnia. Fifty adult insomnia sufferers are contacted from a newspaper advertisement, and each is given a pill with instructions to take it before going to sleep that night. The pill actually contains milk powder (a placebo). The participants are randomly allocated to receive one of two instructions about the pill: half are told that the pill will make them feel 'sleepy' and the other half are told that the pill will make them feel 'awake and alert'. The next day, all the participants meet with the researcher and are asked how long it took them to fall asleep after taking the pill. The participants who were told the pill would make them feel sleepy reported having fallen asleep significantly faster than the participants who were told the pill would make them feel awake and alert.

Experiment 2

A researcher wants to examine the effects of massed practice versus distributed practice on the learning of nonsense words such as qoh, nal and fub. The researcher randomly allocates first-year university students studying psychology into one of three groups.

- Group 1 is required to learn a list of 20 nonsense words in one 90-minute session on one day.
- Group 2 learns the same list for 45 minutes per day for two successive days.
- Group 3 practises the same list for 30 minutes per day for three successive days.

The researcher assesses each group's performance with a test of free recall of the nonsense words after each group completes the designated number of sessions. The mean recall of the 20 words for Group 1 is 6.2; for Group 2, 11.1; and for Group 3, 14.9. These mean scores are found to be significantly different from one another, and the researcher concludes that distributed practice is more effective than massed practice.

Experiment 3

A researcher conducted an experiment to test a new medication for treating phobias. 347 volunteers ranging in age from 21 to 75 years responded to an advertisement. 24 males and 24 females who best met the selection criteria were included in the sample. The participants were grouped into pairs on the basis of two variables requiring control — sex and age. For example, Pair 1 was two females, both in the age group 21–25 years, Pair 2 was 2 males, both aged 21–25, and so on. Then, within each pair, participants were randomly allocated to either of two conditions — a treatment condition in which they used the medication, or a placebo control condition.

Experiment 4

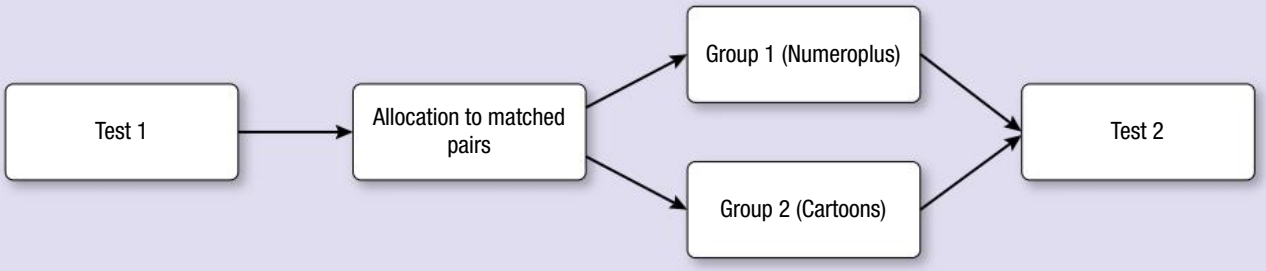
A researcher studied how having previously seen an image of an object may influence the ability to name it again when it reappears later. Participants are first shown pictures of common objects such as a purse, a wristwatch and keys on a computer monitor. The participants then leave and return one week later. At this time, they are shown some of the original pictures they had seen in the first session, some similar but not identical pictures, and some entirely new ones. They are then asked to name the objects as quickly as possible. The researcher found that the original objects were named significantly faster than the new objects, but that the similar objects were named more slowly than the new ones.

2. Read the following summary of an experiment and answer the questions about the design.

A researcher conducted an experiment to test the effectiveness of Numeroplus – a new teaching program for developing numeracy skills in young children. There were 24 Year 2 participants from a local primary school whose parents had given written consent. All completed a numeracy test (Test 1). The results were used to organise participants into 12 matched pairs based on the similarity of their scores. A member of each pair was then allocated to either Group 1 or 2. Each participant had an equal chance of being in Group 1 or 2. Group 1 undertook the Numeroplus program every school day over a two-week period. This was presented through a 20-minute video tutorial on a TV at the front of the classroom. Group 2 watched cartoons on a TV for 20 minutes, every school day for 2 weeks. All participants then completed a second numeracy test (Test 2).

The flow chart shown below summarises the procedure.

(a) Explain why the researcher placed the participants into matched pairs.
(b) What was the purpose of Group 2?
(c) Identify the operationalised independent and dependent variables.
(d) Describe two features of the procedure that identify this study as an experimental design.
(e) What is an advantage of using an experimental design for this investigation?



Source: Adapted from Stangor, C. (1998). *Research methods for the behavioural sciences*. Boston, Massachusetts: Houghton Mifflin.

LEARNING ACTIVITY 1.23

Evaluation of research

An experiment was conducted to compare the effectiveness of learning online and learning from a textbook. The participants were 70 volunteer first-year psychology students. After arriving at the experimental room, each participant was given written instructions describing the task and learning materials. These instructions were identical except for reference to either a computer or text for learning.

Participants were then randomly allocated to either of two groups. Group 1 went to an adjacent computer lab where they were each assigned to a computer in separate learning compartments and worked individually to learn new psychology content that was presented online in 20 screens over a 40-minute period. Group 2 members went to an adjacent classroom, remained together and learnt the same psychology content for the same amount of time. However, the computer screen content was in a hard-copy format, presented as a printed booklet.

Both groups then returned to the experimental room for a test on the content. This was completed using a standard pen and paper format. The results showed that Group 1 performed significantly better than Group 2. The researcher concluded that online learning is more effective than textbook learning.

1. Formulate a research hypothesis that would be supported by the results obtained for the experiment.
2. Give an advantage and a limitation of the sampling technique used for this particular experiment.
3. Identify the experimental design.
4. Identify the operationalised independent and dependent variables in the experiment.
5. Briefly describe the conclusion that was made on the basis of the results that were obtained.
6. Identify a potential confounding variable and explain why it may provide an alternative explanation of the results.

LEARNING ACTIVITY 1.24

Designing an experiment

Choose a specific topic of interest from Unit 3 or 4 and outline an experiment with an independent groups design, an experiment with a repeated measures design and an experiment with a matched participants design that could be conducted on your chosen topic.

Present the experiments using flow charts (see figures 1.43–1.45) so that the three designs can be compared.

Cross-sectional studies

A **cross-sectional study** selects and compares different groups of participants on one or more variables of interest at a single point in time. In this way, it provides a 'snapshot' of mental processes or behaviour in relation to the variables included in the study. A cross-sectional study is often used to study age-related differences. For example, a study might investigate how performance on a memory task can vary according to age. Groups of people selected at 10- or 20-year intervals from 5 to 85 year olds (i.e. a 'cross-section' of ages) could be tested and the results compared.

A cross-sectional study may also be used to study differences between groups in one or more other variables at a particular point in time. For example, a study may compare the recovery of a group of stroke patients who participated in a specific rehabilitation program with a group who did not, or it may be used to study the behaviour of students in three year seven English classes, each of which is taught by a teacher with a different approach to classroom management and discipline. The choice of samples and variables for study is virtually endless. Samples of participants may be selected on the basis of their school type, year level, course, occupation, attitudes, mental health status, mental abilities, sleep habits, exercise habits, parental style, personality, cultural background, social media use, use of a specific medication, and so on. However, the data are collected all at the same time (or within a short time frame).

A cross-sectional study may use an independent groups design and is sometimes called a *quasi-experiment* because of this resemblance to an experiment. However, it is not a true experiment because participants cannot be randomly allocated to experimental and control groups. Instead, a cross-sectional study uses existing, naturally formed or occurring groups. For example, the researcher can select participants from different age groups of interest but cannot randomly assign people to be a particular age. In addition, the researcher measures characteristics or events that already exist or occur naturally in a sample (or population) without directly manipulating any variable(s).

In sum, in a cross-sectional study, the independent variable of interest occurs naturally and the researcher takes advantage of pre-existing variables or conditions such as a participant's age, or an event that the researcher has no control over.

A cross-sectional study may be repeated periodically to study a trend or pattern. It may therefore also involve 'repeated measures', but this does not mean it is the same as a repeated measures experiment.

Advantages and limitations of cross-sectional studies

One advantage of a cross-sectional study is that it can be used to efficiently study change over time. Compared to other research methods, it tends to be simpler to undertake, less time-consuming and less expensive. For example, a researcher can study differences in one or more variables of interest in 5-, 10- and 15-year-olds at one time, over a short period, instead of tracking them over 10 years to complete their investigation. In this way, a snapshot of age-related differences can be obtained without having to wait many years for the results.

Another advantage is that a cross-sectional study provides a means of conducting research on certain topics that are unethical and/or impractical to conduct through experimentation. For example, to study the effects of exposure to a natural disaster on mental health, the researcher could access one or more groups who have been exposed to a specific type of natural disaster and assess their mental health. Similarly, to study maternal risk factors for low birth weight infants, a research team could access mothers who have recently given birth and collect data to compare maternal environments and behaviours. Four groups of mothers could be used, based on World Health Organization definitions of 'birth weight'. For example, 'low birth weight' is defined as a birth weight of a liveborn

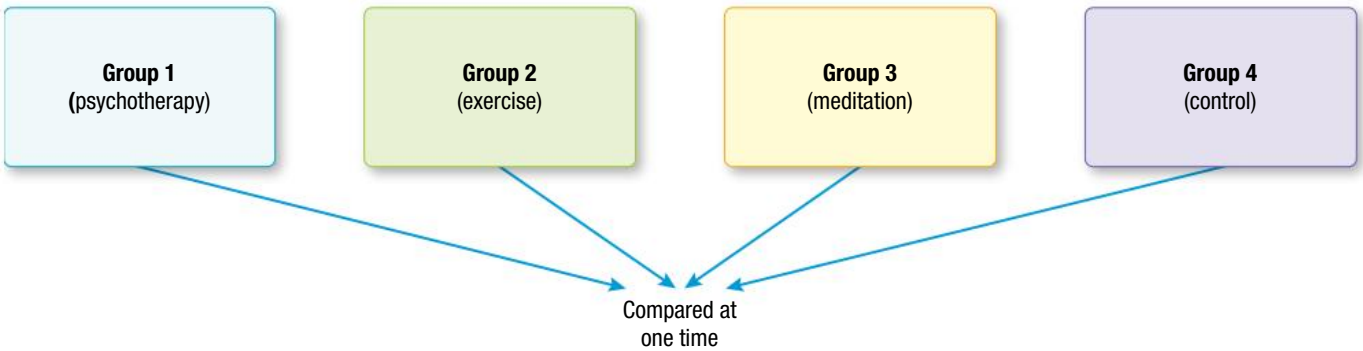


Figure 1.54 An example of a cross-sectional study that uses an independent groups design to enable comparison of one or more variables in existing groups at a single point in time. This study is comparing outcomes associated with three different stress management programs. There is a fourth group who do not engage in any stress management program.

infant of 2499 grams (5 pounds 8 ounces) or less, 'very low birth weight' is less than 1500 grams (3 pounds 5 ounces), and 'extremely low birth weight' is less than 1000 grams (2 pounds 3 ounces). A fourth group could be mothers who gave birth to an infant with a 'normal birth weight', defined as 2500–4200 grams (5 pounds 8 ounces–9 pounds 4 ounces).

Cross-sectional studies also tend to have a relatively low level of participant attrition (especially when compared to repeated measures experiments). Since data are collected all at once, it is less likely that participants will quit the study before all data have been collected. Furthermore, cross-sectional studies tend to have a low level of artificiality and therefore the results may better reflect real-life everyday thoughts, feelings and behaviour (especially when compared with laboratory experiments) (see Box 1.10 on page 51).

A major limitation of cross-sectional studies is that a cause-effect relationship between different variables cannot be tested or determined. For example, in the natural disaster and mental health study, if the results showed that exposure to a natural disaster adversely impacted on mental health, a researcher would not be able to conclude with confidence that exposure to the disaster was the sole cause. Numerous other participant variables can influence mental health and these would not have been subject to the control that occurs in an experiment. Note that this also highlights another limitation of cross-sectional studies — little control over extraneous variables (which may also become confounding variables). However, despite the inability to assess cause–effect, the researcher can still make inferences about possible relationships that may exist at a particular point in time, or collect data that may give direction to further research through true experimental designs.

In addition, when age differences are studied, participant variables other than age can influence the results and therefore be confounding variables. Differences found between age groups may be due to factors other than age, such as the particular backgrounds and life experiences of participants in each age group. For example, genetic makeup, number of siblings, family environment and schooling may account for differences found in a cross-sectional study of language development in young children.

In particular, one variable that cannot be adequately controlled in some cross-sectional studies is called a cohort effect. A **cohort effect** occurs when the researcher measures characteristics in groups of people ('cohorts') born at significantly different times and members of each group share life experiences associated with the social and cultural experiences of the period and/or place in which they grew up. One or more of these experiences can impact on their development and how they think, feel and/or behave. These perceptions, characteristics and other changes are unique to the group in question.

For example, people who are currently in their nineties experienced childhood during the 1930s depression. They may think, feel and behave differently from 30-, 50- or 60-year olds, not only because they differ in age, but because their backgrounds differ in terms of access to nutritional diets and health care, educational backgrounds and other socio-economic circumstances. Similarly, some age groups experienced adolescence during World War II in the 1940s, without television in the 1950s or when disco was popular in the 1970s. People in these groups may have shared experiences that make them different from other age groups. Consider also the fact that the current adolescent 'cohort' has grown up during a period marked by widespread access to the internet, new digital technologies and social media, which collectively provides a different experience from that of their parents and grandparents when they were growing up.

The larger the difference in age between groups in a cross-sectional study investigating age-related differences, the greater the potential for a cohort effect that causes confounding — when age differences are entangled with differences in participants' life experiences that are actually associated with growing up at a particular time, as a member of a particular generation, in a particular historical context.

Figure 1.55 The larger the difference in age between groups in a cross-sectional study investigating age-related differences, the greater the potential for a cohort effect that may cause confounding.

BOX 1.13 Longitudinal studies and cohort sequential designs

A *longitudinal study* tracks the same group (or groups) of people over an extended period of time, observing changes that occur in behaviour and/or mental processes at several points in time. Some longitudinal studies are relatively brief, lasting for one to two years; others can last a lifetime. Usually, the same group(s) of participants is studied and re-studied at regular intervals, thereby involving a non-experimental (i.e. quasi-experimental) repeated measures design.

A longitudinal study is a relatively useful way of examining consistencies and inconsistencies in mental processes or behaviour over time; for example, discovering if intelligence test scores change with age or remain stable, whether memory declines with age, whether regular physical or mental exercise inhibits onset of a dementia such as Alzheimer's disease, how identical twins reared together or apart may differ on a variety of variables, and how symptoms of a mental health disorder may progress over time.

Because longitudinal studies use the same group(s) of participants, they also allow researchers to study ways in which early experience may affect later experience. However, a longitudinal study can be expensive and take a long time to get results. Keeping in touch with the same group over a period of time can also be difficult — participants may lose interest in the study, move to another location where they are unable to be contacted, or even die.

A research study with a *cohort sequential design* combines the cross-sectional and longitudinal methods to investigate change over time. It has some of the advantages of each method and eliminates some of the disadvantages of both.

The cohort sequential method involves two or more groups of participants (i.e. cohorts) who overlap in age. For example, a study might begin with three groups of adolescents aged 14, 16 and 18. Every two years, this group is tested on risk-taking behaviour, the characteristic of research interest, until the 14-year-olds have turned 18. In addition, every two years a new group of 14-year-olds is added to the research study.

In this way the study is longitudinal in that it spans a four-year period. But the study is also cross-sectional in that it provides data from three different groups that can be compared directly. It also provides a comparison of adolescents who were the same age (14, 16 and 18 years) at three different times. This third comparison enables researchers to identify socio-economic and historical factors that may influence age-related differences. Furthermore, even though the study spans only a four-year period, it provides longitudinal data over an eight-year period.

Although studies with a cohort sequential design are not used often, primarily because of the time and cost involved, they enable a comparison of cross-sectional and longitudinal data for the same groups of participants.

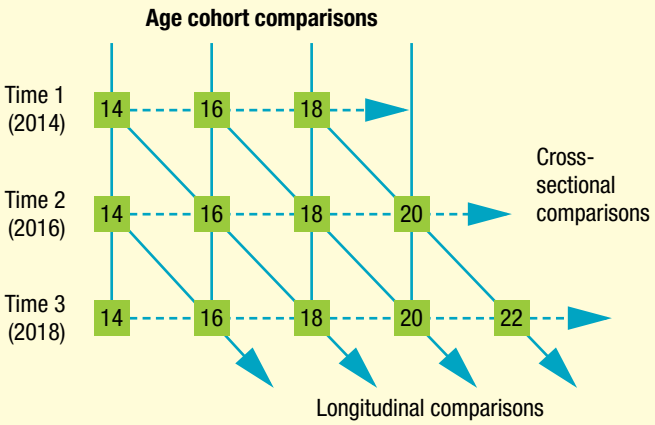


Figure 1.56 Example of a cross-sequential design

LEARNING ACTIVITY 1.25

Review questions

1. (a) Explain what a cross-sectional study is, with reference to an example.
(b) Is a cross-section taken of participants, variables or both?

2. Why may some cross-sectional studies be referred to as quasi-experiments?

3. Which type of experimental design is a cross-sectional study most like?

4. Give two reasons to explain why a cross-sectional study cannot be used to test a cause–effect relationship between the variables of interest.

5. (a) Explain the meaning of cohort effect with reference to an example.
(b) Give an example of when a cohort effect would be considered a confounding variable and explain why it would be considered a confounding variable in relation to your example.

6. (a) Suggest an example of cross-sectional research that could be conducted to investigate whether the duration of a typical night's sleep changes with age.
(b) If age-related differences in total sleep time are found, would your research design enable you to account for or explain the differences? Give a reason for your answer.

7. Suggest an example of cross-sectional research that could be conducted to investigate each of the following.
(a) mental and physical health problems associated with dementia
(b) behaviour management strategies used by student teachers during their training years
(c) problematic mobile phone use in adolescence
(d) quality of life of people who regularly experience panic attacks

8. Which research method is considered better than the cross-sectional study for measuring change over time?

9. What are the main advantages and limitations of the cross-sectional study?

Case studies

Sometimes a researcher will collect detailed information on only a small number of people, perhaps an individual or a small group of two or three. When this is done, the researcher may be conducting a case study.

A **case study** is an intensive, in-depth investigation of some behaviour or event of interest in an individual, group, organisation or situation. Usually, the 'case' that is the subject of 'study' is a person. It may involve the normal or abnormal behaviour or functioning of an individual, over a short period of time or a long period. Sometimes it may involve a specific group or event, such as the decision-making process used by an ethics committee when reviewing a research proposal or by a NASA team when deciding to proceed with or abort a space mission launch.

A case study may also involve an organisation; for example an investigation of a specific issue such as how staff respond to or cope with news of their workplace's relocation, permanent closure or some other significant change.

Sometimes a researcher may conduct multiple case studies on a research question and combine the results to look for trends or patterns that permit tentative conclusions. For example, data collected from case studies of different individuals diagnosed with a particular mental disorder may be combined to better understand one or more factors contributing to its onset, maintenance and/or relapse.

Case studies are most often used when large numbers of participants are not available for study; for example, to study individuals with a relatively rare or unusual disorder, problem, ability or characteristic. The case study may involve a combination of data collection methods. For example, an individual may be interviewed at length. Information may also be collected through interviews of family members, friends, teachers or co-workers. The individual's medical records and school reports may also be considered. Other sources of information can include extensive psychological testing and observations of the person's behaviour. However, a case study is different from a single participant experiment because the method does not actually involve manipulation of any independent variable.

Clinical psychologists who treat people with mental health problems and disorders routinely conduct case studies involving their clients. However, this research is usually for diagnostic and treatment goals (rather than for scientific research purposes). Therefore, when used in a clinical setting for therapeutic purposes, a case study is often referred to as a *case history* or a *clinical observation*.

TABLE 1.6 Examples of case studies

Person	The study of one single individual, generally using several different research methods
Group	The study of a single distinctive set of people, such as a family or small group of friends
Organisation	The study of a single organisation or company and the way that people act within it
Event	The study of a particular social or cultural event and the interpretations of that event by those participating in it
Location	The study of a particular place and the way that it is used or regarded by people

Much of what is known about the role of the brain in behaviour and mental processes has come from case studies of people with a brain injury. Intensive study of individuals with brain damage makes it possible for researchers to gain detailed, valuable information about the roles of the brain in consciousness, speech, memory, perception and so on.

One of the earliest and best-known case studies of an individual with a brain injury is that of Phineas Gage, which was reported by his doctor John Harlow in 1848. Gage was a railway construction supervisor who accidentally exploded gunpowder that sent an iron rod through his skull, causing massive damage to his frontal lobes. No-one expected him to live. Although Gage survived, his temperament (mood), social behaviour and personality changed very noticeably after the accident. The last sentence of his doctor's report reads, 'His mind was radically changed, so decidedly that his friends and acquaintances said that he was "no longer Gage"'. The Gage case study provided one of the earliest detailed insights into the roles of the frontal lobes in mental processes and behaviour research.

Another well-known case is that of Henry Molaison, whose brain injury was intentionally caused through surgery. His case is examined in detail in your study of human memory (pages 388–90).

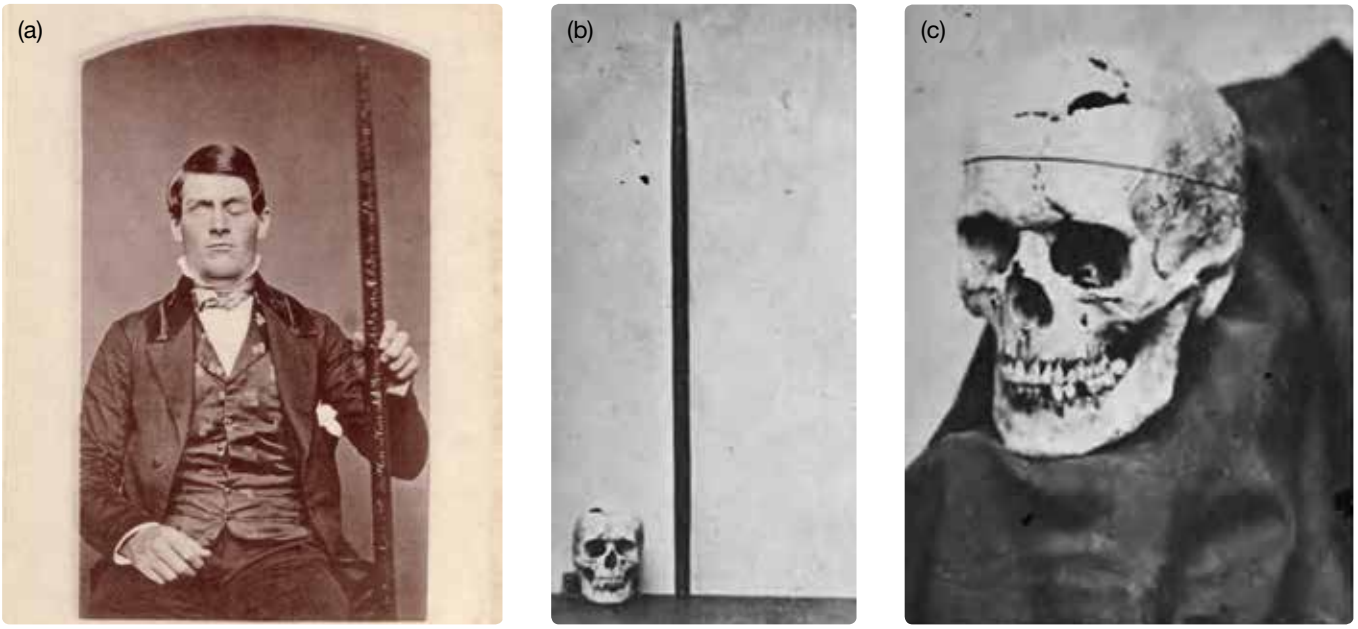


Figure 1.57 Some of the earliest information on the effects of damage to the brain's frontal lobes has come from a case study of the injuries of Phineas Gage in 1848. (a) Gage is shown holding the rod that caused the damage. (b) Gage's skull and the rod. (c) A close-up of Gage's skull.

BOX 1.14 Case study research on Anton's syndrome

Case study research in the late 19th century led to the identification of a rare disorder involving blindness without any awareness of being blind. A common pattern of symptoms emerged and the disorder was subsequently called Anton's syndrome, named after the Austrian neurologist and psychiatrist Gabriel Anton who first reported the disorder in 1893 (Förstl, Owen & David, 1993).

People with *Anton's syndrome* are cortically blind but do not realise that they are blind. Cortical blindness means that they are unable to see because of severe damage to their visual cortex, the part of the brain that initially receives and processes incoming visual sensory information. An unusual aspect of Anton's syndrome is that individuals do not have any damage to their eyes or visual pathways to the brain. However, they believe that they can still see and have an explanation for why they cannot. For example, someone with Anton's syndrome may claim that they can't see because there is insufficient light in the room where they are being examined (Andrewes, 2001).

Each case study published on Anton's syndrome since it was first reported has enhanced understanding of the disorder. For example, a more recent case involved an adult female patient called H. S. to maintain confidentiality.

H. S. was of particular interest to the researchers because her visual cortex was entirely destroyed. Despite all the evidence that H. S. was totally blind, she would deny her blindness and describe her sight as only 'unreliable'. She reported that sometimes things around her would appear very clearly, only to disappear a few minutes later. Sometimes she would reach out for an object, such as a cup, only to find that it was not where she expected it to be (Goldenberg, Mullbacher & Nowak, 1995).

The researchers believed that H. S. might have been mistaking her visual imagery of objects for sight, believing that what she was imagining was what she was actually seeing. They tested their imagery hypothesis by making sounds that related to various objects — for example, the sound of rattling keys or scissors opening and shutting — and then placing the object out of sight. At other times, they let H. S. touch the object and then placed the object out of sight.

Figure 1.58 Gabriel Anton (1858–1933)

Each time they did this, the researchers would ask H. S. whether she saw the object. When not allowed to hear or touch the object, H. S. would say that she couldn't see anything, but she would report seeing the object if the object was within her field of vision.

The following dialogue, in which R. is the researcher and H. S. is the patient, reveals the test. Although by this time H. S. had recovered some of her vision, she still only had a 5° visual window on the right side. Apart from this, she is functionally blind.

R. [Moves bunch of small keys, producing sound.] *I am holding an object. Do you have any idea what it might be?*
H.S. *Could that be a key?*
R. [Silently moves the keys beneath the table. The part of the conversation printed in italics takes place while the keys are hidden from view.] *What does it look like?*
H.S. *On top there is a big ring, and it has a dark key-bit.*
R. *Do you see the key well?*
H.S. *I am seeing the key.*

As can be seen from these notes, the case study of H. S. gives researchers much insight into different aspects of brain function, as well as providing evidence for a number of different aspects of brain function. For example, the visual cortex is shown to have a crucial role in vision, given that H. S.'s was entirely damaged and she consequently had no vision. Despite believing that she could still see objects, as indicated in her conversation above with the researcher, H. S. was blind — her description of the key was incorrect. However, she had excellent visual imagery, despite having no visual cortex. This suggests that visual imagery and visual perception do not necessarily depend on the same brain structures and processes, and that the relationship between visual imagery and visual perception is not as close as some psychologists have proposed. Furthermore, H. S. recovered some of her vision over time (and recovery may continue). This provides evidence for the plasticity of the brain; that is, the capacity of the brain (specifically its neurons) to take over part or all of a function of an area responsible for that function, but which has been damaged (Andrewes, 2001).

Advantages and limitations of case studies

Case studies provide a useful and effective way of obtaining highly detailed information (data and results) on behaviour and mental processes, particularly in relation to rare or unusual disorders or conditions. Their depth of analysis and the richness of the data are commonly described as their main advantage (or 'strength').

With case studies, there is usually no manipulation or control of variables, as with research conducted under strictly controlled experimental conditions (unless an experiment is used to collect some of the case study data). Consequently, case studies can avoid artificiality and provide a 'snapshot' of the actual or real-life experience of one or more individuals at a particular time in a particular situation. Case studies are, however, not only useful for a 'snapshot'. They can be conducted over a prolonged period, even many years where relevant and practical to do so, and may therefore also be useful for tracking and describing experiences and change over time.

Case studies can also provide insights into how others may think, feel or behave under similar circumstances, especially when information from different case studies on the same topic or research question is compiled and knit together to help identify a general pattern or trend in the results. Another advantage of case studies is that they can be a valuable source of hypotheses for further research or for data to support theory building or challenge a theory's assumptions.

A major limitation of case studies is that they cannot test a cause–effect relationship as does an experiment. For example, a case study cannot be considered to be a single participant experiment.

Their small sample size is another limitation. By their very nature, case studies usually focus on rare or unusual individuals, groups or situations. This means that the sample is often a convenience sample (rather than a random sample) and limited to a size of one. The results for such a sample can usually provide only very tentative and limited support for drawing conclusions.

Furthermore, generalising the results to others in a relevant population cannot be done with any certainty. Generalising is a bigger problem when the case study involves a rare or unusual disorder or ability. Because the mental experiences, processes or behaviours of such individuals (or groups) are 'extraordinary', they may not reflect typical ways of thinking, feeling or behaving. Therefore, the researcher can never be fully confident that the conclusions drawn from their study are representative of similar instances within the wider population or apply elsewhere over time. This means that a case study usually has poor external validity. In addition, a case study's use of a rare or unusual sample means that it often cannot be replicated to test the reliability of the results in the way that an experiment can.

Case studies have other limitations. Because of the very detailed and comprehensive data usually obtained, the process of analysing, summarising and reporting these data can be painstaking and time-consuming.

Case studies also have the limitation of being susceptible to biased information from the participants or the researcher. This can influence

the accuracy of the information that is obtained and conclusions that may be drawn. For example, case studies usually rely on the individuals under investigation to provide a great deal of the required information. Some participants may not remember clearly what they actually experienced, or they may intentionally change or omit information that they do not wish to reveal for personal reasons.

Similarly, case studies are usually conducted by one researcher and are vulnerable to experimenter effects. It is possible that the researcher may see or hear what they expect or hope to see or hear. Furthermore, the researcher is also responsible for deciding what to include in their descriptions and what to leave out. In writing a report on the case, the researcher may select information that supports key points or conclusions they wish to make and omit other points that may be just as relevant and could have been included by another researcher interpreting the same information.

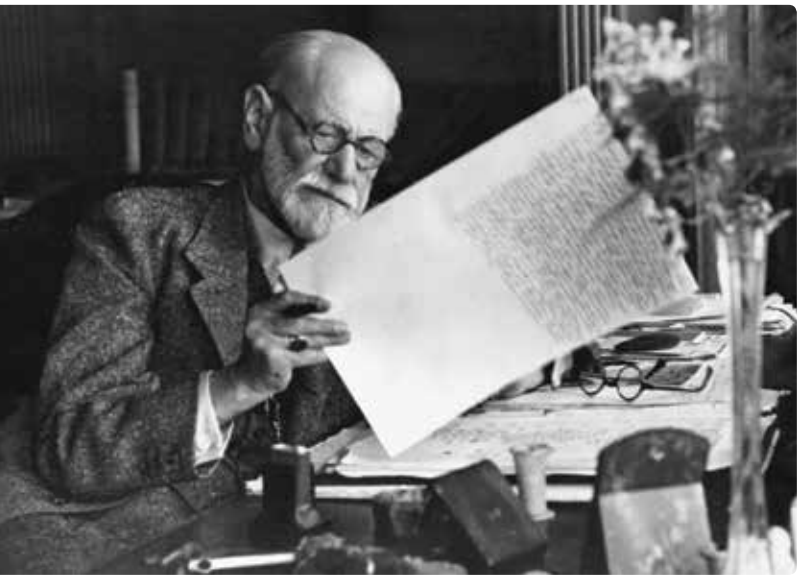


Figure 1.59 Sigmund Freud (1856–1939) developed his psychoanalytic theories mainly from case studies of patients who sought his help with mental health problems they were experiencing.

LEARNING ACTIVITY 1.26

Review questions

1. What is a case study?
2. Give two examples of possible case studies not referred to in the text, one involving an individual and another a small group or organisation.
3. Suggest an example of an experiment that could be conducted as part of a case study.
4. Describe three advantages and three limitations of case studies when used for research purposes.
5. What is a potential limitation of a case study conducted over a prolonged period of time, but other than a limitation referred to in Q4 above.

Observational studies

An **observational study** involves collecting data by carefully watching and recording behaviour as it occurs. Psychologists use observational studies to collect data when the behaviour under investigation is clearly visible and can be easily recorded. Data collection may be:

- *structured* — a pre-prepared system is used to guide and record observations e.g. a checklist of items to precisely guide what to look for and to record or exclude
- *unstructured* — observations are made without a predetermined format
- *semi-structured* — a part of the study involves using a predetermined format.

Most observational studies conducted in psychology are structured and use systematic data-collection techniques, such as the checklist with predetermined criteria shown on the next page. A structured study typically involves operationalising the behaviour of interest and variables that are involved. For example, a researcher observing aggression outside nightclubs in King Street, Melbourne, must define aggression precisely in terms of the variables to be measured and devise a list of the specific behaviours to be observed and recorded. In preparing their observation checklist, the researcher will determine whether, for example, aggression includes shouting or only physical contact and whether an accidental push or shove is to be recorded along with a deliberate push or shove.

One of the difficulties in observing and recording ongoing target behaviour is that there can be so much of it and/or it may be occurring within the context of lots of other behaviour. The researcher must therefore also decide in advance whether to record all occurrences of the behaviour and when observations are actually made during the study. For example, three behaviour sampling decisions for an observational study may involve:

1. *event sampling*: The researcher decides to focus on one or more specific types of behaviour ('events') and record all occurrences. All other types of behaviour are ignored. For example, in a study of bullying in the school grounds, only those acts involving intentional physical contact initiated by the bully. In some studies where relevant, the researcher may also record the antecedent (actions immediately prior to the event) and/or the consequences (what happens immediately after the event).
2. *time sampling*: The researcher decides that observation will take place only during specified time periods (e.g. 1 minute every 5 minutes per hour, or 10 minutes every hour, 1 hour per day) and records the occurrence of the specified behaviour during that period only.

INITIATION OF AGGRESSIVE ACT, SHOWN BY CHILD AND SEX

	#	1	M	#	2	M	#	3	M	#	4	M	#	5	M	#	6	F	#	7	F	#	8	F
Aggressive act against whom (shown by child's assigned number)*	5	6	8				6	7	2	1	3	5	1	6	8	2	2	4				6	3	5
Response:																								
Anger												X		X		X								
Surprise													X			X								X
Hurt, tears		X	X				X	X							X		X					X	X	X
Little or no emotion shown	X								X	X	X													
Help from other children			X				X	X					X									X		
Help from adult supervisor			X					X							X	X								X
Resolution favours:	1	1	8				8	7	3	?	?	5	5	5	8	6	2					8	3	5

*The observer assigned numbers to the children, keyed to clothing. The child in the red sweater was #1, the one in the blue shirt was #2, and so on.

Figure 1.60 An example of a checklist used for an observational study

Source: Wiseman, J.P., & Aron, M.S. (1970). *Field projects for sociology students*. Cambridge, Massachusetts: Schenkman. p.21.

3. *individual sampling*: Rather than trying to record the behaviour of all individuals at once, the researcher decides to focus on observing one individual (or group) at a time while ignoring the behaviour of others during the time period. One individual may be randomly selected to be the focus of an observational period and all others are ignored during that period. Over the entire period of the study, however, each individual may be observed. And, when dealing with a group's behaviour, the researcher might observe the entire group all at once, or only one group member for a certain time, then observe another, and so on.

Observations have become more accurate as new technologies permit increasingly precise measurements. For example, digital video cameras can be used to record then analyse rapidly changing behaviour. Even a single 'frame' within a long action sequence can be analysed. This technology can be used, for example, in studies of the way subtle changes in facial expressions of mothers and their babies become synchronised and similar over time. The miniaturisation and greater portability of recording devices has also enabled observational studies to become less obtrusive where desirable.

Sometimes an observational study might resemble an experiment. For example, to investigate creative problem-solving processes in a group, a researcher might present a friendship group with a problem requiring its members to come up with as many uses for a house brick as they possibly can in 10 minutes. The researcher could then observe and record who suggests answers and how often; who records answers and how the recorder is selected; how correct and incorrect answers are dealt with; whether judgments about answers are immediate or postponed; who gives or doesn't give feedback; who stays on task; who is time-conscious, and so on. The researcher might also observe problem solving in a group comprising strangers in order to make comparisons with the friendship group.

Although a particular observational study might use an independent groups design and all experiments actually involve observation of responses, an observational study using groups is not a true experiment unless random allocation is used. Furthermore, an observational study can reveal a relationship between two variables (e.g. group type and creative problem-solving), but only a true experiment can establish a cause–effect relationship because there is an IV that is manipulated along with the use of random allocation. In an observational study, there may be naturally occurring variables of interest but the researcher does not interfere in the situation — there is no intervention that might disrupt what is occurring naturally.

Natural and contrived settings

Observations may be conducted within a participant's natural environment or in a contrived environment. In both settings, the researchers would wait for the behaviour of interest to occur voluntarily and to unfold as it usually does.

When observations are conducted within the participant's natural environment, the method is commonly called naturalistic observation. In **naturalistic observation**, the researcher views behaviour in the natural, 'real-life' environment where it would ordinarily occur. This is a situation where behaviour in its genuine form would be most likely to be observed. In addition, the researcher conducts their observations in an inconspicuous or 'unnoticeable' manner so that their presence does not influence the behaviour of interest.

For example, in a study on the social behaviour of pre-schoolers, a researcher might observe children at play in a pre-school centre's outside area at lunchtime. They would do so from the 'sidelines' so that the children are not aware that they are being observed to help ensure their presence does not interfere with the naturally occurring, voluntary play behaviour. From the observational records of each child's interactions with others, the researcher will make inferences about children's social behaviour. Similarly, a researcher studying how paramedics respond to traumatic events might observe paramedics in action by riding along with them on duty. In doing so, the researcher would be as unobtrusive as possible, trying to 'shadow' the paramedics as they respond to various types of trauma, communicating with them only when essential.

A *contrived* environment is one that the researcher creates for the specific purpose of conducting an observational study. It is an artificial ('non-naturalistic') environment for the behaviour of interest and is sometimes referred to as a *controlled* or *laboratory* environment because of the degree of control the researcher has over it.

Generally, with this type of observational study, the researcher decides where the observations will take place, at what time, with which participants, in what circumstances, and uses standardised procedures. There may also be observations of different groups for which an IV may be present or absent.

For example, the researcher conducting the study on social behaviour may decide to observe children at play in a room set up for that purpose at a venue away from the pre-school centre. Specific playthings may be made available and strategically located together with a table and chairs. Observations could then be made at pre-determined times from behind a one-way mirror so that multiple the children are not aware that multiple they are being observed. The children's behaviour might also be video recorded so that multiple researchers can also record observations to help ensure reliability of the data. However, despite the use of such control over the environment and observational procedures, the researchers must still wait for the behaviours of interest to occur naturally.

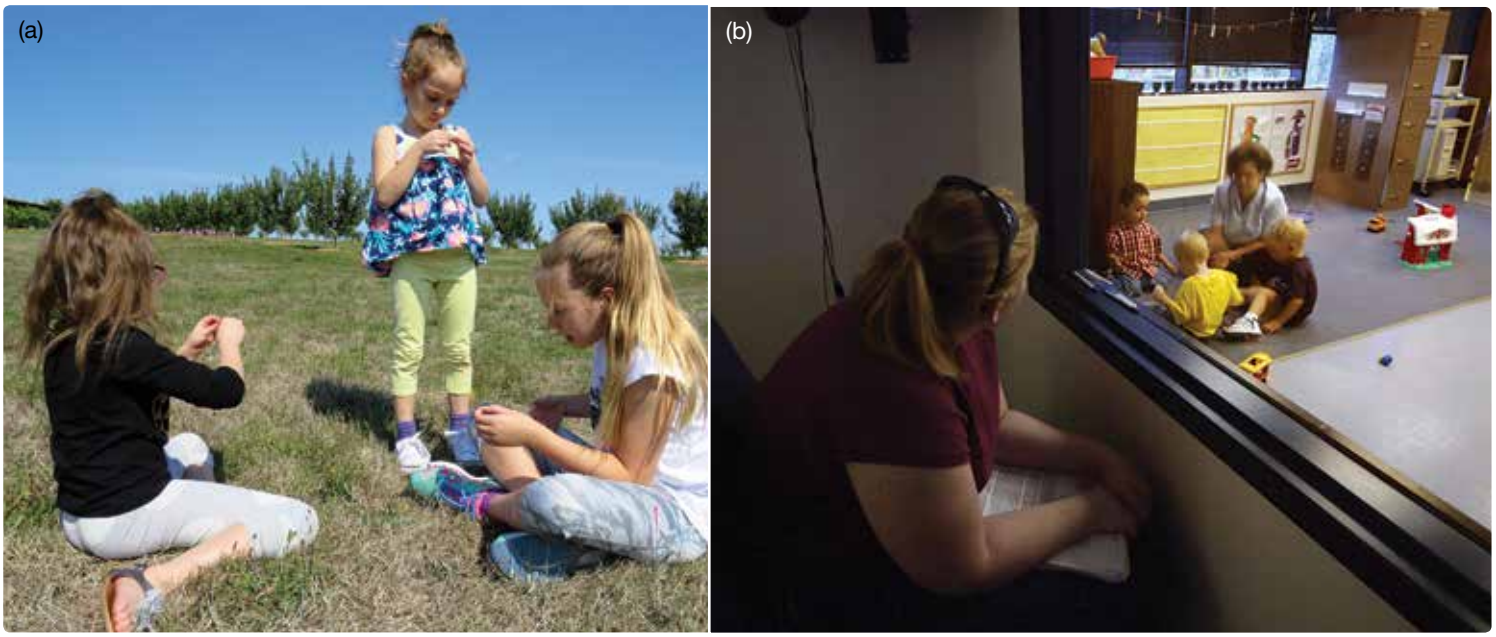


Figure 1.61 (a) An observational study may be conducted in a natural, 'real-life' environment or (b) a formal contrived environment such as a formal laboratory setting.

Participant and non-participant observation

When researchers try to conceal their presence while making observations, it is often called *non-participant observation* (and sometimes *passive participation*). For example, when making naturalistic observations of the use of specific 'body language' in a real-life setting, a researcher might sit on a nearby seat pretending to be absorbed in a book in order to observe the non-verbal interactions of people being met at an airport. They will try to blend in with the crowd and observe from the sidelines, concealing as best as possible their identity and what they are actually doing so that the individual(s) being observed does not alter their actions, as may occur when people know that they are being observed.

Sometimes, the behaviour of interest involves private interactions between members of a group that cannot be reliably observed from the sidelines. In such cases, the researcher may engage in participant observation. In an observational study using *participant observation* the researcher is an active member of the group being observed (which is why it is sometimes called *active participation*). The researcher will actually join in the activities of the group and may deliberately try to be mistaken by the participants as being part of the group or situation being observed, but their identity as an observer is concealed.

In one well-known observational study that used participant observation, the researchers set up a situation where 8 pseudo-patients had themselves admitted to several different psychiatric hospitals by imitating symptoms of schizophrenia. After they had been admitted, the fake patients took part in ward activities and spent time observing and writing notes about ward staff and how patients were treated. Their record-keeping behaviour was regarded by the hospital staff as being a symptom of their mental disorder. In all, they remained in hospital for 7 to 52 days (average 19 days) and were eventually discharged with a diagnosis of 'schizophrenia in remission' (Rosenhan, 1973).

Advantages and limitations of observational studies

Each type of observational study is useful under different circumstances and has advantages and limitations depending on the specific procedures used, particularly the degree of structure in the data collection technique and the observational setting.

The main advantage of observational studies, especially naturalistic observation, is that researchers can watch and record behaviour as it usually occurs, without the need for any manipulation or intervention. When people are observed in this way, they are not influenced by perceptions that can form in artificial, contrived environments and lead them to behave differently from how they normally do. Sometimes, merely being present in an artificial or unfamiliar environment can cause an unnatural change in behaviour. Thus, naturalistic observation often enables researchers to gain more accurate information about the typical behaviours of people (and animals), both immediately and over a longer period, than do other research methods. When compared to research methods that involve asking people about their behaviour, the researcher can observe what people actually do (or say), rather than what they say they do.

In addition, structured observations through use of checklists and specific criteria enhance the accuracy of data collection and therefore the results obtained. This is a more likely outcome when the observational setting is strictly controlled, as in a contrived laboratory-type situation. Controlled observations in

Figure 1.62 We often watch people engage in normal behaviour in public settings. If you stop and watch for a while without intruding on whatever they are doing then you are engaging in non-participant observation.

laboratory settings can also be more easily replicated by other researchers using the same procedures. This means that the reliability of results can be tested.

Another advantage of naturalistic observational studies is that some types of human behaviour can only be studied as they naturally occur because it would be unethical or impractical to study them in a laboratory situation. For example, it would be unethical to severely deprive children in their early life in order to observe the effect of deprivation on behaviour in the future. Similarly, some behaviours cannot be realistically reproduced in a laboratory. A researcher cannot, for example, study most aspects of true human crowd behaviour in an artificial laboratory setting. Nor could a researcher expect to obtain valid information about how people usually behave when they are in love by bringing a pair of participants into a laboratory situation and asking them to 'be in love' so that observations can be made. However, since the observer doesn't directly influence the behaviour being observed in an unobtrusive observational study, it sometimes requires a lot of time and patience to wait for the behaviour of interest to occur. Consequently, some observational studies can be very time-consuming. But this is often worthwhile as observational studies may enable generation of new hypotheses.

A practical advantage of naturalistic observation is that it does not require the cooperation of participants being observed. However, this raises the ethical issue of not obtaining informed consent, particularly if participant observation is required. When participant observation is used without informed consent, a person's expectation of privacy can be violated. This issue has to be weighed up against the fact that the participants are not informed that they will be observed in some special way so that their observed behaviour is more likely to be true to life.

A limitation of many observational studies, particularly when unstructured, is that it can be difficult to determine the *causes* of the behaviour of interest that is observed, because many factors may influence that behaviour. This is especially the case in a natural environment. For example, the researcher observing aggressive behaviour from the sidelines outside a King Street night club is not manipulating or controlling any variables and will often not be able to determine with certainty *why* people become aggressive towards one another when a skirmish or fight breaks outs unless they intervene in some way, for example, by interviewing those involved. The true factors that control a particular behaviour could be ones the researcher is not immediately aware of. Consequently, an observational study may reveal a relationship between variables, but not a cause–effect relationship as does an experiment.

In addition, naturalistic observation studies such as the King Street example, often lack a representative sample. For instance, they may be biased in relation to participant variables such as age, sex, cultural and socio-economic background. This means that the results may not readily be generalised to a wider population (which impacts on external validity). Furthermore, because of the lack of control of variables in such a setting, the study is also more likely be low in reliability as it will be difficult for a researcher to replicate it.

A potential limitation of any observation procedure is *observer bias,* which is a type of *experimenter bias* (or experimenter effect). It is possible, for example, that researchers sometimes unconsciously distort what they see so that it resembles what they hope to see, even when they are using structured formats. Researchers who collect the data must be trained to observe and record accurately in order to minimise the influence of their personal biases. Furthermore, when recording participant responses or making detailed notes as part of the observation process, the researcher may neglect to record certain behaviours that they either judge to be irrelevant or do not actually see. To overcome these limitations, researchers often use two or more observers for data collection and check for inter-rater ('inter-observer') reliability. This procedure usually results in a more complete and accurate set of data than one observer could obtain alone.

Figure 1.63 Using two or more observers to collect the same data in an observational study can help minimise the influence of observer bias on the results.

BOX 1.15 Studying a doomsday cult using participant observation

American psychologist Leon Festinger (1956) used participant observation in an observational study of a small UFO cult called the Seekers. The cult believed that a great flood would destroy the world on December 21, 1954 and that aliens would arrive in a flying saucer just before the hour of the apocalypse and take the true believers to safety on another planet. Members of the cult left their jobs and families and gave away money and possessions to prepare for the arrival of the superior beings from outer space.

The research involved participant observation because Festinger and three other researchers became members of the group that they were studying and interacted with them in various cult meetings over many weeks before and after the predicted apocalypse.

Festinger wanted to find out how the cult members would cope and react when they realised that the apocalypse did not occur. He observed that when neither the flying saucer nor the apocalypse arrived at the appointed time, the committed cult members did not abandon their doomsday beliefs despite the fact that they had been clearly discredited. Instead, after several uncomfortable hours on the appointed day, they accepted their leader's explanation that 'the little group, sitting all night long, had spread so much light that God had saved the world from destruction' and became even more fanatical about their beliefs.

Festinger proposed that the cult members' beliefs had strengthened because we all have an inner drive to reduce the psychological discomfort we can experience when we hold two conflicting beliefs simultaneously, such as when there is a mismatch between a firm belief (e.g. there will be an apocalypse at X time) and what may be true in reality (e.g. the predicted apocalypse did not occur).

Figure 1.64 Researcher Leon Festinger (1919–1989), shown above, used participant observation to study how cult members would react when the flying saucer they were expecting to carry them to safety did not arrive.

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Weblink
Explanation of cult beliefs – Festinger's cognitive dissonance theory 3m 30s

BOX 1.16 Studying gorilla behaviour using both participant and non-participant observation

In a well-known observational study that spanned 18 years, American researcher Dian Fossey (1983) used both participant and non-participant observation. Fossey, whose work is featured in the 1988 movie *Gorillas in the mist*, lived among gorillas in their remote African highlands habitat.

After first using non-participant observation to learn about key aspects of gorilla behaviour, Fossey changed her method to use participant observation and started to interact with and behave like a gorilla. The more she learnt about the behaviour of gorillas, the more she was able to act like them. She imitated their feeding and grooming behaviours and even attempted to copy their vocalisations. By waiting for the gorillas to approach her, by avoiding actions that might threaten them, and by imitating their actions, Fossey gradually became accepted by them and was able to collect valuable data about their behaviour.

Fossey was not formally trained in scientific research but her contributions to the understanding of gorilla behaviour (and gorilla conservation) are widely recognised. In 1985, she was found hacked to death at her camp site in Rwanda. It is believed that she was murdered by gorilla poachers.

Figure 1.65 Researcher Dian Fossey (1932–1985) engaging in participant observation with gorillas

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Weblink
Video on Fossey's observational studies 3m 03s

LEARNING ACTIVITY 1.27

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Word copy of table

Review questions

1. What is an observational study?
2. (a) Suggest an example of an observational study with a non-experimental independent groups design (but not an example used in the text).
   (b) Explain why this study would be considered a quasi-experiment.
3. What are the key features of naturalistic observation?
4. Distinguish between each of the following with reference to examples not used in the text.
   (a) structured and unstructured observation
   (b) participant and non-participant observation
   (c) event and time sampling
5. (a) Explain the meaning of observer bias and whether or not it is a type of experiment effect.
   (b) What is a suitable means of controlling this variable?
6. Are naturalistic observations of people without obtaining their informed consent ethically acceptable? Explain your answer.
7. Describe three advantages and three limitations of observational studies.
8. To what extent do reality TV programs such as *Bachelorette, Real Housewives* and *Survivor* produce authentic human behaviour? Explain with reference to an example of a program and design features of observational studies that help ensure 'normal' behaviour is more likely to be recorded.

10. Complete the following table to analyse different observational studies.

Observational study	Structured vs Unstructured	Naturalistic vs Contrived setting	Participant vs Non-participant
(a) A teacher concerned about the unsafe behaviour of students at the school's bus stop at the end of the school day organises an observational study. Observations will be made from a nearby classroom with reference to a checklist.			
(b) Trainee counsellors will be assessed while they conduct consultations with each other, taking turns to be the counsellor then the client. All assessments will be conducted in a room at the university set up for that purpose. The course leader will video record each session and a criteria sheet will be used to guide feedback to trainees.			
(c) The captain of the school's senior hockey team will analyse the players' communication styles during an upcoming match.			
(d) A researcher will record the number of drivers who obey a give way sign at a roundabout.			
(e) Researchers will compare the behaviour of AFL football spectators who sit behind the goals with those who sit in a grandstand. Observations will target the number of comments directed at umpires and players (but not the content).			
(f) A VCE student is planning to conduct an observational study in a shopping mall to find out whether people look at their own reflections or avoid doing so when walking past a large department store. Sex differences will be recorded using a 3-point rating scale based on 'Yes', 'No' and 'Not sure'.			
(g) A VCE student is planning to conduct an observational study at school to find out whether junior school students are more disruptive with a replacement teacher. There will be two observation sessions conducted in the same period, in the same classroom, on the same day across two weeks. In week 1, the student will observe a Year 7 Maths class from a storeroom when taught by their usual teacher. Only six of the students will be observed — two seated mid-front row, two mid-middle row and two mid-back row. In week 2, the student will observe students in the same class, seated in the same positions, but when taught by a replacement teacher who has never previously been at the school. Disruptive behaviour has been operationalised to enable development of observation criteria.			

LEARNING ACTIVITY 1.28

Reflection

The use of deception in an observational study allows the researcher to study a person's natural behaviour. Comment on whether deception contradicts the ethical principle of informed consent.

LEARNING ACTIVITY 1.29

Evaluation of research

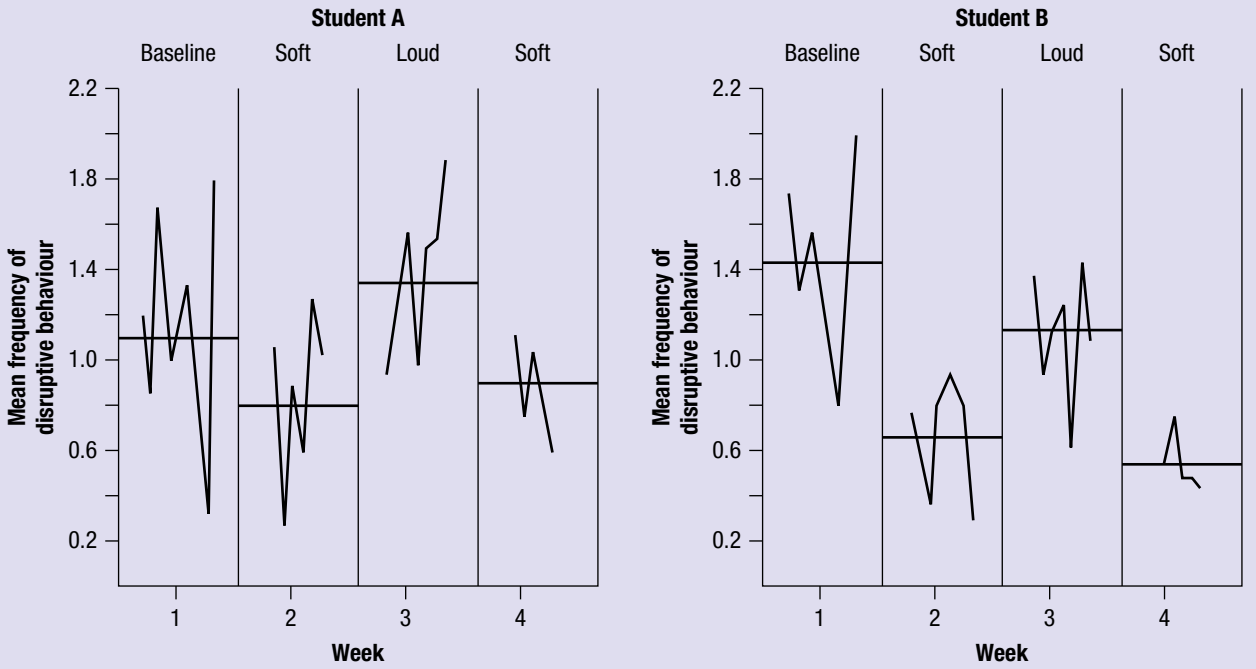
A researcher conducted an observational study to test the effectiveness of different types of reprimands when dealing with disruptive students. On the basis of observations from an earlier study, it was expected that giving soft reprimands to disruptive students would have a greater effect than loud reprimands.

Two disruptive students in a Year 3 class at a local primary school were observed for a 20-minute period during an arithmetic lesson each day for 4 weeks by two trained observers who sat at the back of the classroom and were as unobtrusive as possible. The observers followed a schedule of observing for 20 seconds then recording for 10 seconds using a checklist with eight types of disruptive behaviour, including whether the student was out of their chair, noisy, communicating with another student, interfering with another student's property, or being aggressive.

There were four phases of the study:

1. Baseline: Measurements of disruptive behaviour before any treatment intervention is introduced. The teacher used their normal loud or soft reprimands, however, it was found that the teacher predominantly used loud reprimands throughout this period.
2. Soft: The teacher used soft, 'private' reprimands so that only the student being reprimanded could hear; soft reprimands were used with all students, not just the target students being observed.
3. Loud: The teacher used loud, 'public' reprimands that could be heard by all students; loud reprimands were used with all students, not just the target students.
4. Soft: The teacher used once again used soft, 'private' reprimands.

The results are shown below.



1. Formulate a research hypothesis that would be supported by the results obtained for the study.
2. Identify the sampling procedure.
3. Give an advantage and a limitation of the sampling technique used for this particular study.
4. Explain whether the event sampling or time sampling procedure was used for this particular study.
5. What was the purpose of the baseline measurements?
6. Is the study best described as structured, unstructured or semi-structured?
7. Does the study use participant observation, non-participant observation, or both?
8. Explain whether the study can be described as a naturalistic observation study.
9. Identify the operationalised independent and dependent variables in the study.
10. Suggest a single, relevant title for the series of graphs showing the results.
11. What do the results show?
12. What conclusion can be drawn from the results?
13. To what extent can the results be generalised?

Self-reports

For some topics of research interest, it is best to ask people about their thoughts, feelings or behaviour. For example, a researcher may be interested in studying what people dream about, how often they have nightmares, thoughts and feelings that accompany a stressful experience, why people jump queues, why people with a spider phobia react as they do when they see a spider, or what people do to cope with the fear or anxiety triggered by a phobic event. To ask people how they think, feel or behave when conducting scientific research involves using a measure or technique that will prompt self-reports.

A **self-report** is the participant's written or spoken responses to questions, statements or instructions presented by the researcher. For example, a self-report may take the form of answers about study habits before an important exam, to statements in a seven-point rating scale measuring anxiety, or a participant's diary records kept in response to a researcher's specific request (such as the sleep diary records described on page 452).

Assuming that participants are honest, understand the questions, can accurately recall what they have been asked about and are able to give sufficiently detailed accounts of the thoughts, feelings or behaviour under investigation, self-reports can provide useful data on virtually any topic of research interest.

Questionnaires, interviews and rating scales are the most commonly used self-report measures. All use questions or statements requiring participant responses, but they are often distinguished in terms of how the questions or statements are asked and answered. For example, a questionnaire usually involves asking and answering questions in writing, whereas an interview usually involves asking and answering questions orally. However, this is not a fixed 'rule'. Sometimes, a researcher may prefer to orally ask the questions in their questionnaire.

Although questionnaires, interviews and rating scales can be used exclusively or in combination to collect self-reports, they are also commonly used to collect additional data as a part of research studies using other methods, such as experiments, case studies and observational studies.

Questionnaires

A **questionnaire** is a written set of questions designed to draw out self-report information from people on a topic of research interest. It has a structured format and the questions are usually answered by participants in writing, at their own pace and without supervision.

Questionnaires are most often used when responses are required from a large number of participants; for example, as part of a survey. They are an efficient way of collecting self-reports because a researcher can administer the questionnaire via surface mail, over the phone, the internet, or at the same time to a group who are located in the one place, such as in a school or workplace.

By guaranteeing anonymity to participants, written questionnaires can be a useful way of collecting self-report data that people are not willing to disclose publicly, such as ambitions, motivations, fantasies, sexual behaviour, gambling behaviour, addictive behaviour, socially unacceptable behaviour and illegal behaviour.

Figure 1.66 Researchers conducting surveys often use a questionnaire to collect self-report data. Online administration is usually supported by efficient data processing and analysis.

Interviews

An **interview** usually involves questions that are asked by the researcher with the aim of obtaining self-report information on a topic of research interest. How questions are asked and the categories of response are focused but not necessarily predetermined or fixed.

Interviews are most often conducted with individuals, in a face-to-face meeting or sometimes over the phone, or even through an app like Facetime or Skype. They usually require spoken answers to questions and are rarely used with very large samples as data collection would require a considerable amount of time. Answers may be recorded electronically or in hard copy writing, depending on how the interview is conducted. Unlike questionnaires, which are usually structured, interviews may be structured, unstructured or semi-structured (National Health and Medical Research Council [NHMRC], 2007).

In a *structured interview*, the participant (or 'interviewee') is asked specific, predetermined questions in a controlled manner. The most structured interview is when the interviewer simply asks a set of fixed-response questions and records the participant's answers; for example, questions such as 'Have you ever been awoken by a nightmare?' with predetermined answer options such as 'Yes', 'No', and 'Not sure'. The interviewer follows a script and the questions are read out from a list in a neutral manner with no comments or cues. This is done to ensure

that all participants are treated in the same way and thereby help maintain standardised procedures. A less structured interview may use free-response questions (such as 'How do you feel immediately after waking from a nightmare?'), but the researcher will follow a script and ask a set list of questions to ensure consistency across all participants.

In an *unstructured interview*, the researcher has an overall aim of what data should be collected, but the interview is driven by the participant and there is a spontaneous generation of questions in the natural flow of interaction with the participant. There is also freedom of discussion and interaction between interviewer and participant. For example, the interviewer may ask additional questions to follow up on a participant's response. This means that questions asked in an unstructured interview can vary widely from participant to participant (NHMRC, 2007).

A goal of unstructured interviews is to allow people to describe their thoughts, feelings and behaviour in their own way using their own words and to give more or less emphasis to relevant issues. This is different from structured interviews (and questionnaires) for which participants have to use the questioner's terms and concepts to describe how they think, feel or behave. However, this also means that the data collected through unstructured interviews is much more detailed, has far less structure, and is therefore more difficult to analyse, summarise and describe for reporting purposes.

In a *semi-structured interview*, the researcher uses an interview guide listing a set of issues to be explored. The researcher aims to cover all issues but there are no set questions to be asked. As with the unstructured interview, there is a spontaneous generation of questions through interaction with the participant (NHMRC, 2007).

Figure 1.67 An interview is often a face-to-face discussion between a researcher and an individual for the purpose of obtaining detailed information.

BOX 1.17 Free-response and fixed-response questions

When using a questionnaire or interview to collect self-report data, the researcher may choose to use free-response and/or fixed-response questions.

Free-response (or *open-ended*) *questions* require participants to identify or describe their thoughts, feelings or behaviour 'freely' in their own words; for example:

'What are you thinking?'
'How do you feel when stressed?'
'How do you usually react when this happens?'

These kinds of questions enable participants to provide detailed responses without being restricted to giving answers that fit into predetermined categories (such as those of fixed-response questions). Furthermore, in an unstructured or semi-structured interview, free-response questions enable the researcher to ask questions of clarification or follow-up questions as participants give information about the thoughts, feelings or behaviour under investigation.

With this, however, comes a limitation. Answers to free-response questions are often difficult to summarise or score. This makes it harder for researchers to statistically analyse, describe and interpret the data obtained. Scoring or interpreting the responses also requires subjective interpretation by the researcher. Consequently, the scoring and interpreting of responses are susceptible to the biases and expectations of the researcher; that is, experimenter effects.

To avoid or overcome these limitations, researchers often ask fixed-response questions, which are more objective. *Fixed-response* (or *closed*) *questions* typically require participants to identify or describe their response by selecting from a number of 'fixed' alternative responses; for example:

'Do you dream in colour?' Yes, No, Not sure
'How often you remember your dreams on awakening?' Always, Often, Sometimes, Not often, Never
'How much time does it usually take to fall asleep when you go to bed at night?' 0–10 minutes, 11–20 minutes, 21–30 minutes, 31–60 minutes, 1–2 hours, More than 2 hours

Answers to fixed-response questions are usually easier to interpret than are answers to free-response questions. In addition, because fixed-response questions provide specific alternatives from which the participant chooses, the researcher can accurately and concisely summarise and describe the responses numerically (thereby obtaining quantitative data).

For example, a '0–10 minutes' response to the question about time taken to fall asleep can be assigned a score of 1, '11–20 minutes' a score of 2, and so on. Furthermore, the same scores can be reliably assigned to all other participants who give these responses and all responses can be efficiently analysed, described and interpreted using statistical procedures and tests.

Figure 1.68 Free- or fixed-response questions can be used in a questionnaire to collect self-report data from a large number of people in a relatively short period of time.

Rating scales

A **rating scale** uses fixed-response questions or statements for which participants rank ('rate') each item by selecting from a number of choices. They may be used to collect data on any behaviour or mental process about which a participant can provide information.

For example, participants may be asked to rate their level of fear or anxiety when making an oral presentation to a large group, how often they use social media just before going to sleep, their level of tiredness after completing homework on a weeknight, their level of confidence before sitting a test for which they have done the right amount of study, or the strength of their attitudes to racist comments by competitors in sports matches. The series of questions or statements to which participants respond are usually related as they have been devised by the researcher for the topic or issue under investigation.

Responses are typically assigned numerical values that enable answers to be quantified (converted to numbers) for summary, analysis and interpretation. The rating scale is not unlike a multiple choice test, but the answer options represent levels or degrees of a particular characteristic. However, there is no correct answer for a rating scale item, other than what the participant decides to give. Box 1.18 on the next page shows examples of items in a rating scale for measuring anxious attachment in a romantic relationship.

The best known and most commonly used rating scale is the *Likert scale* (developed by American psychologist Rensis Likert in 1932). This consists of about 20 questions or statements to which the participant responds, typically using a five-point scale. It is most commonly used to measure attitudes. For example, in a study on attitudes to refugees and asylum seekers who reach Australia by boat rather than conventional means, a Likert scale statement could be 'Refugees and asylum seekers arriving by boat on Australian shores should be imprisoned until background checks can be completed'. Participants may then be required to rate their answers by selecting one response from five options ranging in strength, such as strongly agree, agree, neither agree nor disagree, disagree or strongly disagree. Alternatively, options may vary in terms of approval such as strongly approve, approve, undecided, disapprove and strongly disapprove. There are also other possible answer options, depending on what is measured (see Box 1.20 on the next page).

Researchers have several choices in selecting how answers should be indicated on the five-point scale — for example, ticking or crossing a blank space, circling a number or underlining a response. Each of the responses has a numerical value (e.g. from 1 to 5) and the respondent's attitude is defined as the sum (total) of these values. A Likert scale for measuring attitudes towards illegal drugs could include statements such as those shown in Box 1.19.

When developing a Likert scale, half the attitude statements are worded in a positive way and half are worded negatively. For statements 1, 3 and 5, the answers would be scored as follows: SA = 1, A = 2, N = 3, D = 4 and SD = 5. For questions 2, 4 and 6, the answers would be scored in reverse: SA = 5, A = 4, N = 3, D = 2 and SD = 1. In a true Likert scale, however, positive and negative statements are distributed in a random order. Box 1.18 below has an example of a 7-point scale with statements in a random order. For this scale, the higher the score the greater the level of anxiety experienced in a romantic relationship.

When a respondent has completed a Likert scale, all of the responses are scored and a total is calculated. The result is a score on a attitude. Generally, the higher the score, the more positive or favourable the attitude. Box 1.20 below describes how to construct a Likert scale.

BOX 1.18 Rating scale to measure anxious attachment in a romantic relationship

Please rate your agreement with each of these statements using a 1 to 7 scale, with 1 meaning 'disagree strongly' and 7 meaning 'agree strongly'.

1. I'm afraid that I will lose my partner's love.
2. I often worry that my partner will not want to stay with me.
3. I often worry that my partner doesn't really love me.
4. I worry that romantic partners won't care about me as much as I care about them.
5. I often wish that my partner's feelings for me were as strong as my feelings for them.
6. I worry a lot about my relationships.
7. When my partner is out of sight, I worry that they might become interested in someone else.
8. When I show my feelings for romantic partners, I'm afraid they will not feel the same about me.
9. My romantic partner makes me doubt myself.
10. I find that my partners don't want to get as close as I would like.

Source: Fraley, R.C., Waller, N.G., & Brennan, K.A. (2000). An item–response theory analysis of self-report measures of adult attachment. *Journal of Personality and Social Psychology, 78,* 350–365.

BOX 1.19 Sample items in a Likert scale for measuring attitudes towards illegal drugs

Circle your response to each statement below.

1. The use of illegal drugs is a major social problem in Australia today.	SA	A	N	D	SD
2. There should be no restrictions on using illegal drugs as long as the individual using them does not harm anyone else.	SA	A	N	D	SD
3. Laws should be strictly enforced regarding the use of illegal drugs.	SA	A	N	D	SD
4. It is an invasion of privacy when law enforcement authorities search people suspected of carrying illegal drugs.	SA	A	N	D	SD
5. Individuals using illegal drugs should be punished severely.	SA	A	N	D	SD
6. In the privacy of their own homes, individuals should be allowed to use any illegal drug they desire.	SA	A	N	D	SD

SA = Strongly agree A = Agree N = Neither agree nor disagree D = Disagree SD = Strongly disagree

BOX 1.20 How to construct a Likert scale

The following steps enable you to construct a Likert scale to collect quantitative data for your own research on an attitude or other topic of interest. Although your scale is likely to be a useful measure for your research questions, it will not be valid or reliable. This means that you will have to be careful with the conclusions you draw from the results obtained. The steps are written with reference to attitude measurement and a scale varying in strength of agreement or disagreement. However, the steps can be adapted to construct a Likert scale for any topic.

Step 1
Identify an attitude towards an object, group, issue or event of interest or importance to you.

Step 2
Write a list of different aspects of the attitude topic. For example, the Likert scale on illegal drugs in Box 1.19 above is based on aspects such as crime, punishment, civil liberties, privacy laws and impact on Australian society. If you have difficulties in generating a list, you may find it helpful to discuss your topic with others.

Step 3

Use your list to develop a group of attitude items (questions or statements) on the topic. Although Likert scales usually contain about 20 items, you should consider a scale based on about six or eight items. Generally, the list should consist of items which deal with different points of view on the topic. Consider the following guidelines.

- Write items that are unlikely to be agreed with by everyone or no-one. About half of your items should be favourable towards the topic and the other half unfavourable. The more effective items will be those that tend to push respondents towards the strongly agree or strongly disagree ends of the scale. Try to avoid including items which are neutral and likely to cluster responses in the uncertain category (i.e. 'neither agree nor disagree').
- Use simple, clear language that is suited to the experience, age, and educational and cultural background of the participants whose attitudes you are measuring.
- Write your items in such a way that only one interpretation is possible.
- Write each item so it contains only one complete idea.
- Avoid using words such as 'all', 'always', 'none' and 'never' within items.

Note that Likert scale items may also have other answer options, depending on what is measured. For example:

Level of concern
- Not at all concerned
- Slightly concerned
- Somewhat concerned
- Moderately concerned
- Extremely concerned

Frequency
- Always
- Often
- Sometimes
- Rarely
- Never

Belief
- Almost always true
- Usually true
- Occasionally true
- Usualy not true
- Almost never true

Quality
- Excellent
- Very good
- Good
- Fair
- Poor

Level of awareness
- Extremely aware
- Moderately aware
- Somewhat aware
- Slightly aware
- Not at all aware

Affect
- Major affect
- Moderate affect
- Neutral
- Minor affect
- No affect

Knowledge of action
1. Never true
2. Rarely true
3. Sometimes but infrequently true
4. Neutral
5. Sometimes true
6. Usually true
7. Always true

Level of acceptability
1. Totally unacceptable
2. Unacceptable
3. Slightly unacceptable
4. Neutral
5. Slightly acceptable
6. Acceptable
7. Perfectly acceptable

Level of appropriateness
1. Absolutely inappropriate
2. Inappropriate
3. Slightly inappropriate
4. Neutral
5. Slightly appropriate
6. Appropriate
7. Absolutely appropriate

Level of importance
1. Extremely important
2. Very important
3. Moderately important
4. Neutral
5. Slightly important
6. Low importance
7. Not at all important

Level of difficulty
1. Very difficult
2. Difficult
3. Neutral
4. Easy
5. Very easy

Level of influence
1. Not at all influential
2. Slightly influential
3. Somewhat influential
4. Moderately influential
5. Extremely influential

Step 4

When you have written your items, trial ('test') them with people who will not be a part of your sample but who have personal characteristics in common with those likely to be in your sample. This will assist you to identify problems with your items which you may not have noticed.

- Form your items into a list, with columns for respondents to indicate whether, and to what extent, they agree or disagree with each item. Randomly distribute positive and negative items in the list to avoid a pattern of responses.
- Present the items in a questionnaire format. The questionnaire should have a short introduction that includes instructions for respondents. For example: Here is a list of statements about . . . Please read each statement quickly but carefully, then indicate whether you agree or disagree with each one by putting a circle around one of the following:
  SA = Strongly agree
  A = Agree
  N = Neither agree nor disagree
  D = Disagree
  SD = Strongly disagree

Step 5

- Make several copies of your questionnaire and test your questions again by asking two or three people with similar backgrounds to those in your sample to rate each response.
- Determine their scores for each response and then calculate their score for the entire scale. Score responses by allocating 1 for the most negative response, through to 5 for the most positive response for each item.
- Analyse the responses to determine which items you should include in the final scale. The best items are those that have a very high or very low relationship with the total score for all items. You may wish to rewrite or even replace items that seem to cluster responses in the neutral/unsure category.

Adapted from Grivas, J., & Lawrie, P. A. (1991). *Psychology: Experiments and activities*. Marrickville, NSW: Harcourt Brace Jovanovich, pp. 401–403.

Advantages and limitations of self-reports

Self-report measures such as questionnaires, interviews and rating scales are widely regarded as useful techniques for collecting any type of data on how people think, feel and behave. In particular, they can be an efficient means of collecting data from a large number of people in a relatively short period of time. They also have the advantages of making it relatively easy to compare responses among participants and to replicate a study, especially when structured measures are used.

By guaranteeing anonymity, questionnaires in particular, provide a means of collecting self-report data on 'sensitive' or controversial topics that many people are not willing to disclose publicly, such as in an unstructured oral interview. However, like other self-reports, they rely on the assumptions that people are actually willing to answer all questions and that they will give accurate answers. We cannot always reliably recall or communicate information about how we think, feel or behave.

Another limitation of self-reports is *social desirability*. People may intentionally give false or misleading answers to create a favourable impression of themselves. For example, with socially sensitive issues such as attitudes to refugees, Aboriginal land rights, the death penalty and cruelty to animals, people sometimes give socially desirable responses instead of reporting their true attitudes. They want to appear likeable, to have a 'social conscience', or to look good, so they present attitudes which encourage others to see them in a positive way.

Alternatively, the participants may be embarrassed to report their true attitudes or feelings, especially for very personal topics. Furthermore, in self-reports based on interviews, the interview situation may be a source of an experimenter effect whereby the interviewer's personal biases and prejudices influence how questions are asked and how the respondent answers them.

Even when researchers make careful use of random sampling, they need to consider the possibility of a type of sampling bias known as *non-response bias*. For example, if only a small percentage of randomly sampled people agree to respond to a questionnaire, it is quite likely that those who did respond will be different than those who refused or did not bother to participate.

Self-reports are language dependent so there are limitations when used with young children, adults with English speaking backgrounds but with weak literacy skills, people from non-English speaking backgrounds who have yet to learn English well (unless translated) and some people with a severe intellectual disability. Generally, they are best used with people who have well-developed language skills, although interpreters and skilful interviewing can help overcome communication barriers.

When comparing the advantages and limitations of different self-report techniques, it is important to take account of the type of data that will be collected and the type of question used. Generally, questions that allow free, open-ended descriptive responses (a type of qualitative data) give answers that are richer in detail. However, these responses are often difficult to summarise and statistically analyse. Questions with scoreable fixed responses (a type of quantitative data) enable more precise and efficient statistical summaries and analyses.

Figure 1.69 Self-report methods of data collection provide useful information about how people think, feel and behave. However, they typically rely on participants having well-developed language skills and being able to accurately recall and state the information required of them.

BOX 1.21 Meta-analysis

A *meta-analysis* is an advanced statistical technique that combines and summarises the results of multiple research studies on a given topic (or research question). The results are integrated to identify patterns and draw conclusions about those studies. The technique takes account of the fact that the studies have used different samples, different research methods, different measures and have obtained different results of varying significance.

Following are examples of studies that have used meta-analysis. The Smith and Glass (1977) meta-analysis on the effectiveness of psychotherapy for mental health disorders summarised 375 original studies published in a diverse range of journals. There were an estimated 50 000 participants divided across experimental and control conditions. The average age of participants was 22 years and they each received an average of 17 hours of psychotherapy. Rosenthal and Rubin (1978) summarised 345 studies that had verified the presence or influence of the expectancy effect described on page 32.

Meta-analysis	Findings
Smith, M.L., & Glass, G.V. (1977). Meta-analysis of psychotherapy outcome studies. *American Psychologist, 32,* 752–760.	Psychotherapy is very effective (e.g. the typical psychotherapy client is better off than 75% of untreated individuals) and few important differences in effectiveness between behavioural therapies (e.g. systematic desensitisation) and non-behavioural therapies (e.g. psychodynamic)
Rosenthal, R., & Rubin, D. (1978). Interpersonal expectancy effects: The first 345 studies. *Behavioral and Brain Sciences, 1*(3), 377–386.	The expectancy effect is present and influences participant behaviour in many research contexts.
Bond, R., & Smith, P. B. (1996). Culture and conformity: A meta- analysis of studies using Asch's (1952b, 1956) line judgment task. *Psychological Bulletin, 119*, 111–137.	Investigated whether the level of conformity in Asch's classic study has changed over time and whether it is related cross-culturally to individualism–collectivism. Found that collectivist countries tend to show higher levels of conformity than individualist countries.
Brierley, B., Shaw, P., & David, A. S. (2002). The human amygdala: a systematic review and meta-analysis of volumetric magnetic resonance imaging. *Brain Research Reviews, 39*(1), 84–105.	Measured the normal size of the human amygdala and how it changes with age. Found no significant difference in left–right size, the amygdala is significantly larger in men, and an inverse relationship (i.e. negative correlation) between size and age.
Segerstrom, S.C., & Miller, G.E. (2003). Psychological stress and the immune system: a meta-analytic study of 30 years of inquiry. *Psychological Bulletin, 130*(4), 601–630.	Major findings are three-fold. (1) Stress alters immunity, (2) Short-term stress actually 'revs up' the immune system, an adaptive response preparing for injury or infection, but long-term or chronic stress causes too much wear and tear, and the system breaks down, (3) The immune systems of people who are older or already sick are more prone to stress-related change.
Else-Quest, N.M., Hyde, J.S., & Lin, M.C. (2010). Cross-national patterns of gender differences in mathematics: A meta-analysis. *Psychological Bulletin 136*(1), 103–127.	Girls around the world are not worse at maths than boys. Boys are more confident in their maths abilities, and girls from countries where gender equity is more prevalent are more likely to perform better on maths assessment tasks.
Tannenbaum, M., et al., (2015). Appealing to fear: A meta-analysis of fear appeal effectiveness and theories. *Psychological Bulletin, 141*(6), 1178–1204.	Fear-based appeals appear to be effective at influencing attitudes and behaviours, especially among women and when they contain recommendations for one-time only (versus repeated) behaviours.
Firth, J., Cotter, J., Elliott, R., French, P., & Yung, A. (2015). A systematic review and meta-analysis of exercise interventions in schizophrenia patients. *Psychological Medicine, 45*(7), 1343–1361.	Interventions that implement a sufficient dose of exercise (e.g. 90 min of moderate-to-vigorous exercise per week) in supervised or group settings, can be feasible and effective interventions for improving both physical and mental health outcomes in people with schizophrenia.

(continued)

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Meta-analysis	Findings
Borges, G., Bagge, C., Cherpitel, C., Conner, K., Orozco, R., & Rossow, I. (2017). A meta-analysis of acute use of alcohol and the risk of suicide attempt. *Psychological Medicine,47*(5), 949–957.	Acute use of alcohol is associated with increased likelihood of a suicide attempt, particularly at high doses.
Maijer, K., Begemann, M., Palmen, S., Leucht, S., & Sommer, I. (2018). Auditory hallucinations across the lifespan: A systematic review and meta-analysis. *Psychological Medicine*, *48*(6), 879–888.	Auditory hallucinations are quite common (up to 1 in 10 individuals) in the general population, with children and adolescents reporting these experiences significantly more often compared with adults and elderly.

Figure 1.70 A meta-analysis combines and summarises the results of different research studies on a given topic.

LEARNING ACTIVITY 1.30

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Review questions

1. What are self-reports?
2. Complete the following table to summarise three measures or techniques for collecting self-report data.

Self-report	Description	Advantages	Limitations
Questionnaires			
Interviews • structured • semi-structured • unstructured			
Rating scales			

TYPES OF DATA

All psychological research involves collection of information. In research, the information which is collected is called **data**. The data is empirical evidence that will form the results of the study and be the basis of the conclusions that will be made. *Empirical evidence* is data collected through formal observations and/or carefully controlled experiments.

Data can take different forms. The type of data collected is determined by the specific kind of research method or procedure used. For example, questionnaires and interviews often provide data in the form of words, whereas data collected in experiments is usually provided in the form of numbers. There are many ways of classifying data. We consider the distinctions between primary and secondary data and qualitative and quantitative data in relation to psychological research.

Primary and secondary data

Primary data is data collected directly by the researcher (or through others) for their own purpose, usually to test a hypothesis. It is collected from the source and is sometimes described as 'first hand'. For example, you will collect primary data when you undertake an experiment to test a research hypothesis for the practical investigation which is one of the Unit 4 SACs. When using a self-report measure, the primary data will be the participants' responses. Their original responses may also be called *raw data* because they have not been processed. Raw data is a type of primary data.

When you summarise your data as a table or convert it to percentages, it will still be primary data because you are the researcher who collected and processed it. You have also retained control over it.

When someone else accesses your primary data, you lose control over it because they can manipulate or use it in whatever way they want for their own purpose. It will be secondary data for the other person.

Secondary data is data that has been collected by someone other than the original user for their own purpose. It has been collected by some other individual or organisation and will not be used for the first time, which is why it is referred to as 'secondary' (like second-hand). For example, if you access data in a journal, book or at a website to complete a learning activity or SAC, then you will be using secondary data. The Australian Bureau of Statistics is a widely used source of secondary data, as are the results reported by researchers in journal articles.

The main difference between primary and secondary data is in who collects the original data. Both types of data have their advantages and limitations.

Primary data offers tailored information sought by the researcher to test a hypothesis on a topic of their choosing. To the researcher, there is little doubt about the quality of the data collected. They are also responsible for the quality of their data, but it can be time-consuming to collect and process.

Secondary data tends to be readily available and can usually be accessed in less time, especially if you know where and how to look. There can be uncertainty about its quality because it was collected for another purpose and there is often a need to comb through it to find what you're looking for.

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Figure 1.71 (a) Primary data is data collected directly by the researcher (or through others) for their own purpose. (b) Secondary data is data that has been collected by someone other than the original user for their own purpose.

Qualitative and quantitative data

Primary and secondary data may be qualitative, quantitative or a combination of both.

Qualitative data is information about the 'qualities' or characteristics of what is being studied. They are descriptions, words, meanings, pictures and so on. It can describe any aspect of a person's mental experiences or behaviour; more specifically, what type, what category, what something is like or how something is experienced.

Qualitative data could be in the form of written or verbal comments by participants, audio or video recordings, or notes of participants' comments made by the researcher. Anything a person thinks, feels or does can be a source of qualitative data. For example, a researcher may collect and analyse drawings in order to study what the onset of menstruation is like for adolescent girls (Banyard & Grayson, 2000).

Alternatively, a researcher may conduct research on the advantages and limitations of government-funded mental health services provided over the internet and telephone. The researcher may collect data by conducting interviews or holding small-group discussions with individuals who have recently used one or more of these services. Participants may be asked to give examples of when they have used a service and describe their experience without any constraint, other than occasional questions by the researcher to ensure their responses are relevant, have enough detail and have been clearly understood.

Figure 1.72 This child's drawings may be qualitative data on how she is feeling following a recent family trauma.

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ABS — What are quantitative and qualitative data?

Quantitative data is numerical information on the 'quantity' or amount of what is being studied; that is, how much of something there is. This type of data is usually expressed in the form of units of measurement or numbers, such as raw scores, percentages, means, standard deviations and so on. For example, the height or age of a participant is considered quantitative data as both of these characteristics can be expressed in units of measurement (centimetres or years). Similarly, the percentages of participants who respond with 'Agree' or 'Disagree' to interview questions, or the mean time taken to solve a problem in an experiment, are quantitative data.

All types of mental experiences and behaviours can be described in quantitative terms, as quantities or numbers. For example, a survey question might ask participants to use a five-point scale to rate the level of stress caused by different events or the effectiveness of different stress-management strategies.

Psychologists use many different tests to measure various mental processes and behaviours and most of these also provide quantitative data. There are tests to measure intelligence, personality traits and all kinds of aptitudes, interests and abilities. Answers are often totalled to yield a score that can be interpreted and applied to the person or group who did the test.

Similarly, data collected by devices used to record the electrical activity of the brain when awake or asleep are measurements and numerical values that are best described as quantitative data.

Experiments can produce qualitative data as well as numbers. For example, in his classic experiments on obedience to authority in the 1960s, Milgram described the behaviour of his participants in some detail (qualitative data), as well as measuring the extent to which they were prepared to obey the experimenter (quantitative data).

Although different, quantitative and qualitative data are not mutually exclusive and are not often used separately. Qualitative data are typically expressed in the form of words, but they can be converted into a quantitative form. For example, participants' responses to open-ended interview questions about

their thoughts and feelings when they are anxious could be summarised as numbers based on the frequency ('how often') or intensity ('how strong') with which certain feelings are reported.

The majority of studies referred to in this text use quantitative data rather than qualitative data. This reflects the preference for quantitative data in most psychological research. Generally, psychologists tend to prefer quantitative data because using numbers increases the precision of results and the ease with which the results can be communicated. Quantitative data also enables more precise and detailed analysis through the use of statistical procedures and tests. These are also the reasons why qualitative data are often converted into quantitative data.

Figure 1.73 This participant is required to indicate food preferences shown on the computer screen. Are the data collected qualitative or quantitative?

BOX 1.22 Objective and subjective data

The terms 'objective' and 'subjective' are also used to refer to the way that data are collected and the way they are described and explained.

Objective data is information that is observable, measurable, verifiable and free from the personal bias of the researcher. For example, the data can be seen, heard or touched (observable), counted or precisely described (measurable), could be confirmed by another researcher (verifiable) and is factual (free from personal bias).

Data collected through a strictly controlled experiment in which observations and measurements are planned, precise and systematic is considered objective. So is data collected using an assessment tool that yields a score, such as an intelligence or personality test.

Automated and mechanical devices can also be used to collect objective data. For example, an instrument that shows underlying physiological activity in measurable form, such as an EEG which records brain wave activity, provides objective data. Sometimes researchers collect information about behaviour or mental processes that cannot be directly observed; for example, sexual behaviour or criminal acts. In these cases, researchers tend to rely on self-reports — participant responses to questions asked by the researcher. This information will be subjective.

Subjective data is information that is based on personal opinion, interpretation, point of view or judgment. Unlike objective data, this data is determined by the research participants and often cannot be verified by the researcher. It is often biased, can vary from person to person, day to day from the same person, and is not always entirely accurate. When using subjective data, researchers assume that participants are honest, can accurately recall what they are asked to describe and are able to give detailed accounts about their thoughts, feelings or behaviour.

Although subjective data may be more detailed than that available from more scientifically rigorous methods under controlled conditions, it tends to be difficult to interpret accurately when compared with objective data (which is usually quantitative).

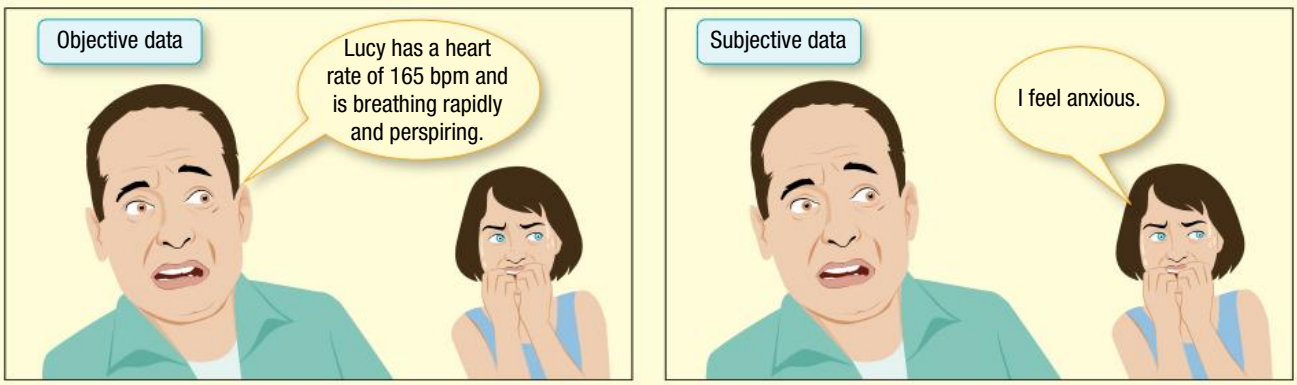

Figure 1.74 Objective and subjective data

BOX 1.23 Scales of measurement

The process of assigning numbers to objects and events that have been studied in research is called *measurement*. Essentially, measurement is no different from the process of assigning words to objects and events when using language. Furthermore, in the same way that language has rules that are followed in its correct use, so too does measurement have certain rules. For example, a measurement rule may use the symbol + (plus) for combining numbers. This means adding one thing to another when the symbol for the addition rule is correctly applied.

Researchers use different scales or 'types' of measurement, when collecting data. In turn, the particular scale used determines the way in which the data can be described and interpreted. For example, a researcher investigating which leadership style is most effective might record how often (the number of times) employees follow instructions given by three different managers, each of whom uses a different leadership style. Alternatively, observers might watch the behaviour of employees in various work situations and rate each interaction between employees and their managers on a scale from extremely negative (a score of one) to extremely positive (a score of 10). In both cases, the researchers are using rules to assign numbers to people's behaviour so that the data can be described and interpreted. However, the rules for assigning the numbers in each example differ. Which rule and therefore measurement scale is used will depend on what the researcher wants to find out and how they collect their data.

Four different scales of measurement used with data obtained from psychological research are called nominal, ordinal, interval and ratio scales.

Nominal scale: Numbers are attached to categories as labels ('names') to identify and differentiate between the data categories (and scores do not actually indicate amounts) e.g. data about eye colour could be organised into the categories of (1) blue eyes, (2) green eyes and (3) brown eyes. This is not unlike the way a footballer is identified by the number on their jumper. But the numbers indicate only that one footballer is qualitatively different from another. In research, if an experiment compares males and females, then this IV involves a nominal scale.

Ordinal scale: Ranks ('orders') categories of data according to some 'more or less' dimension e.g. from highest to lowest, best to worst, or always to never. Thus, the numbers of an ordinal scale show a relationship between numbered items and represent more than simply a category. The AFL ladder uses an ordinal measurement scale to indicate current performance of teams relative to one another. But the same amount does not separate categories in an ordinal scale e.g. 1st on the AFL ladder may be 4 points ahead of 2nd and 2nd may be 12 points ahead of 3rd. In research, if an experiment compares level of obedience to officers with different ranks, then this IV involves an ordinal scale.

Interval scale: Each number indicates an actual quantity and an equal amount separates all adjacent scores (i.e. equal intervals). Temperature in degrees Celsius is an example of an interval scale. The scale includes zero but it is not a true zero – it does not mean none of the variable is present; for example, 0 °C does not mean 'no temperature' or the complete absence of heat. In research, if the experimental conditions were based on whether participants were in a positive, negative or neutral mood, then this IV reflects an interval scale.

Ratio scale: Each number is an actual quantity, an equal amount separates adjacent numbers, and 0 truly means 'absolutely nothing there' (or none of the variable is present). Comparisons can be made between two numbers (or 'bits of data'); for example, it can be said that 100 kg is twice as heavy as 50 kg. In research, if the experimental conditions compare effects of 5, 10 and 15 mg of a new anxiety drug, then this IV involves a ratio scale.

In addition, any measurement scale may be either continuous or discrete.

A *continuous* scale allows for fractional amounts; it 'continues' between the whole number amounts and so decimals makes sense. For example, the variable of age is continuous because it can be represented as specifically as 16.74 years old.

In contrast, some variables involve a *discrete* scale, which can be measured only in whole-number amounts. For example, being male or female, or being in Year 10 or Year 11 are discrete variables, because you can be in one group or you can be in another group, but you can't be in between.

Usually, researchers assume that nominal and ordinal variables are discrete, and that interval or ratio variables are continuous.

LEARNING ACTIVITY 1.31

Review questions

1. Define and distinguish between the following data types with reference to examples that are not used in the text.
(a) primary and secondary
(b) qualitative and quantitative

2. Distinguish between quantitative and qualitative data with reference to characteristics of your psychology class.

3. Complete the following table to apply your understanding of different data types.

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Research investigation	Primary (P) or Secondary (Q)	Qualitative (Ql) or Quantitative (Qn)
(a) A researcher compares the detail in paintings by people with a phobia and people with schizophrenia		
(b) A researcher compares the differences in visual perceptual abilities of kittens with and without damage to the visual cortex in the brain		
(c) A researcher observes how much time male and female adolescents take to get ready for a deb ball		
(d) A researcher reviews a YouTube mini-documentary showing participant responses during an experiment on the effects of playing violent video games		
(e) A researcher uses diary records kept by people hospitalised with a mood disorder to study their mental experiences		
(f) A researcher compares how infants who can walk independently respond when left alone with a stranger in a laboratory setting with infants who can crawl but are unable to walk independently		
(g) A researcher analyses the emotional content of a blog on the ethics of animal research		
(h) A researcher analyses participant scores on a test of recall in a study on long-term memory decline and ageing		
(i) A researcher uses open-ended questions to investigate how people feel when stressed		

4. Give an example of a strength and a weakness of quantitative and qualitative data.

LEARNING ACTIVITY 1.32

Media analysis/response — psychological research reporting in the mass media

Option A

Select a contemporary newspaper, magazine or internet article that reports psychological research and has been published in the last calendar year (but is not a formal research report published in a journal).

Make a copy of the article (or the relevant excerpt/s) so that it can be presented on an A3 sheet of paper or within PowerPoint or similar. If required, reduce the size of the article but ensure it is still legible.

Using point form and lines, arrows or shapes to or around relevant information, complete the following tasks on the article.

1. Identify the research method used to collect data.

2. Suggest a possible research hypothesis if not stated.

3. Identify the data type(s) collected, e.g. qualitative, quantitative.

4. Identify the sample and sample selection procedure (if stated).

5. (a) Outline the main finding(s) of the study reported in the article.

(b) Comment on information that should have been included in the report to enable the reader to judge the accuracy of the reported findings.

6. Suggest a potential limitation of the research, taking account of possible sources of bias and potential extraneous and confounding variables.

7. Comment on your choice of article for the purpose of this Learning Activity, e.g. why it captured your attention, aspects to which you wanted to draw the attention of others.

Option B

Select a contemporary electronic media item that reports psychological research, such as a TV program, movie, YouTube clip, Ted talk or podcast.

Make a copy of the item (or relevant extracts), its URL or another link that would give teacher access.

Write a one paragraph outline of the item, then answer the questions for Option A. Use screen shots, clips or other excerpts or links to exemplify answers or key points.

ORGANISING, PRESENTING AND INTERPRETING DATA

When data has been collected to test a hypothesis, the researcher must decide whether the results support or do not support the hypothesis. The researcher must also draw a conclusion(s) relating to the hypothesis. This conclusion(s) must be based on the results obtained and limitations of the conclusions should be identified, described and explained. Reasons must be suggested about why the particular results were obtained and what they mean, including whether they can be applied to other similar situations. In addition, suggestions for further research and evidence are often made.

To support all these requirements, researchers use statistics to analyse and describe the data they collect. They also use statistics to help interpret and give meaning to the results obtained from the research. Statistics are essentially mathematical procedures.

Two main types of statistics are used in psychology. **Descriptive statistics** are used for analysing, organising, summarising and presenting data obtained for a specific sample. They include calculations such a percentages and mean scores, and preparation of tables and graphs that help 'describe' the data. **Inferential statistics** are used for interpreting and giving meaning to the results. Like descriptive statistics, inferential statistics involve the use of mathematical procedures. However, unlike descriptive statistics, inferential statistics involve judgments about the results, especially conclusions and generalisations that may be made.

Descriptive statistics

Suppose that a researcher is interested in whether memory declines with age. In order to investigate this, some previously unseen information may be given to ten 10-year-olds, ten 25-year-olds, ten 40-year-olds, ten 55-year-olds, ten 70-year-olds and ten 85-year-olds. The research participants would be required to learn the information and then complete a memory test so that their memory could be assessed. In all, there would be 60 bits of data (test scores) about the memory of participants in different age groups. How could the researcher make sense of all these different bits of information so that meaningful conclusions about memory and age might be drawn?

The first step would be to use descriptive statistics to analyse, organise, summarise and describe the data so that it can be interpreted. It is difficult to draw conclusions about whether memory declines with age by looking at 60 individual scores (see Table 1.7). Thus, in order to compare the memory scores of people in the six different age groups to determine whether there has been a decline in memory with age, the data for each age group could be summarised and presented like that in Table 1.8.

The table provides some order to the data by organising the individual scores into age groups, but comparison of scores across the different age groups is still difficult so Table 1.7 is not particularly useful (nor suitable for inclusion in a report).

TABLE 1.7 Individual participants' scores on a test of memory

Age (years)	Participants' scores
10	14, 11, 9, 10, 15, 16, 14, 12, 13, 11
25	14, 16, 16, 18, 13, 17, 14, 15, 17, 8
40	17, 15, 12, 16, 19, 10, 18, 14, 13, 18
55	10, 18, 13, 14, 15, 14, 12, 19, 12, 10
70	13, 10, 12, 16, 7, 15, 9, 12, 11, 8
85	6, 14, 12, 10, 11, 9, 16, 10, 8, 13

To better enable the scores from different age groups to be compared, a single number that summarises the data for each age group could be calculated. For example, the researcher could calculate the *mean* score on the memory test for each age group. The mean scores could be used to describe the 'average' performance on the memory test for each age group and would enable the researcher to compare the different age groups, as shown in Table 1.8. A graph such as a bar chart could also be prepared to visually represent the results, as shown in Figure 1.75 on the next page. In this way, trends, patterns and relationships in the data may become apparent.

Generally, the specific type of descriptive statistic used depends on the kind of research and on the type of data collected. Some descriptive statistics are more suited to particular research and data than others.

TABLE 1.8 Mean scores for each age on a test of memory

Age (years)	Mean scores
10	12.5
25	14.8
40	15.2
55	13.7
70	11.3
85	10.9

In this section we consider the descriptive statistics specified for study in VCE Psychology. We start with tables and graphs. Note that this textbook uses its publisher's conventions for tables and graphs, not the conventions used in psychology for formal research reports.

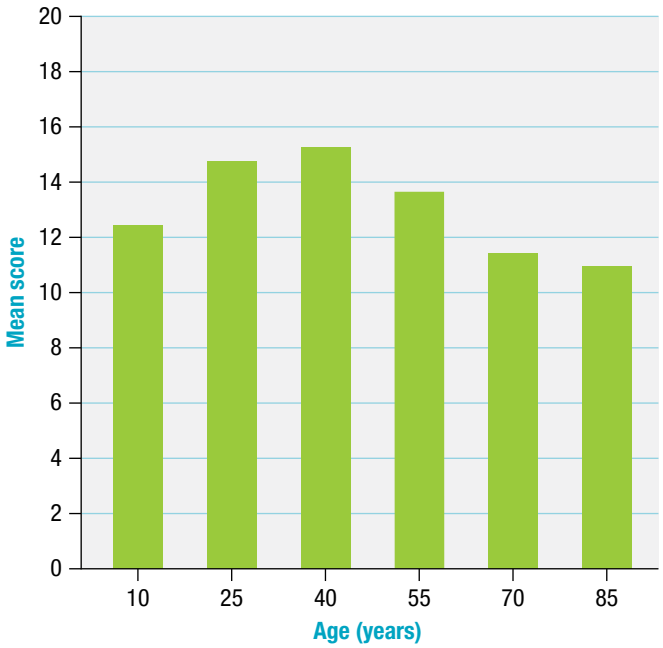

Figure 1.75 Frequency distribution of scores on a memory test

Tables

A table is an orderly arrangement and display of data in columns and rows. The columns and rows are usually identified by names (or 'headers') that assist in making comparisons. A commonly used table in psychology is called a frequency distribution.

A *frequency distribution* is a way of organising data to show how often ('frequently') a value or measure (such as a score) occurs in a set of data. A frequency distribution can also be presented as a graph.

Table 1.9 is an example of a frequency distribution for scores obtained by males and females in an experiment. It shows all the possible values of what has been measured (organised into groups or categories called *class intervals*) and the number of times each value occurs in the set of data (the number of individuals in each class interval). In a frequency distribution, the scores are often arranged either from the highest to the lowest score or from the lowest to the highest score, so that data are presented in an orderly, logical way.

TABLE 1.9 Example of a frequency distribution of scores by males and females

Scores	Males	Females
20–24	0	0
15–19	1	2
10–14	3	5
5–9	4	2
0–4	2	1
Total	10	10

When there is a large number of scores, it is often useful to organise the scores into class intervals, then total the number of scores for each class interval. The class interval can be any size within the range of scores, but the size of each class interval should be consistent across all scores. Intervals of five or ten units are typically used. If an interval of five is used (as in Table 1.9), then the difference between one interval and the next is five; that is, 0–4, 5–9, 10–14, and so on.

Note that the labelling of the table (e.g. its title and headers) is just as important as its contents. Some conventions ('standards'), for tables used in psychology are:

- All tables should be numbered e.g. Table 1, Table 2.
- Each table should have an individual title that is italicised (except the word 'Table' and its number) and has each word in the title capitalised (except words such as 'for', 'of', 'in', 'and', 'with').
- The title should be a clear statement that explains what the table is about without being too long, e.g. *Individual Participant Scores on a Test of Memory*
- The table number and title should be on separate lines with the table number above the title e.g. Table 1 *Individual Participant Scores on a Test of Memory*
- Each column should be identified using a descriptive header.
- The first letter of each header in the table should be capitalised.
- The reader should be able to quickly work out what the table is about and comparisons of data should be easy to make.
- In the research report, essay or other document, the word table is capitalised whenever referring to it, e.g. '. . . as shown in Table 1'.

Although tables are an effective means of recording data, they may not be the best way to show trends, patterns or relationships. Graphical representations are more suited to this purpose.

Graphs

A graph is a pictorial representation of data. Graphing or plotting data typically involves the use of two lines (axes) drawn at right angles to one another. The horizontal line is the *X axis* and the vertical line is the *Y axis*. The point where the axes intersect is called the *origin* (0). When drawing a graph for experimental research data, the IV is represented on the horizontal (x) axis and the DV is represented on the vertical (y) axis.

Graphs are best used to determine and communicate trends, patterns or relationships in the data collected; for example, how often a response is made, how aspects of behaviour change over time or as a research participant's experience changes, and how one variable may be related to or change in relation to another.

Various types of graphs display data in different ways. The kind of graph used depends mainly on the nature of the research that was conducted (e.g. experimental or self-report) and the type of variables investigated (e.g. categorical or numerical) as described in Box 1.4 on page 26.

Among the more commonly used graphs in psychology are bar charts and line graphs. For example, bar charts (and pie charts) can be used to display data in which one of the variables investigated is categorical and line graphs can be used to display data in which both the IV and DV are continuous. In addition, as shown in Box 1.12 (page 61) on correlational research, lines of best fit can be used to illustrate the underlying relationship between variables and scatter plots can be used to show an association between variables (VCE Advice for teachers: Psychology). In psychology, graphs are more formally referred to as 'figures' (along with drawings, photos and any type of illustration). As with tables, there are conventions for presenting graphs. These include:

- All graphs should be consecutively numbered e.g. Figure 1, Figure 2
- Each graph should have an individual title. The title is not italicised, but the word Figure and its number are e.g. *Figure 1*. Reaction time of each age group.
- The title should be a clear statement that explains what the graph is about without being too long.
- The number and title are both on the same line and shown below the graph.
- Both the horizontal and vertical axes must be labelled clearly and indicate what is plotted.
- The reader should be able to quickly work out what the graph is about.

Bar charts

A bar chart is a graph that uses a series of discrete (separate) bars or rectangles next to, but not touching one another, to enable comparisons of different categories of data (i.e. 'categorical data'), as shown in Figure 1.76 below. The bars can be positioned horizontally or vertically. One axis is used to show the types of categories (e.g. age, sex, type of response) and the other axis is used to show the frequency with which each category occurs (e.g. how often, how much).

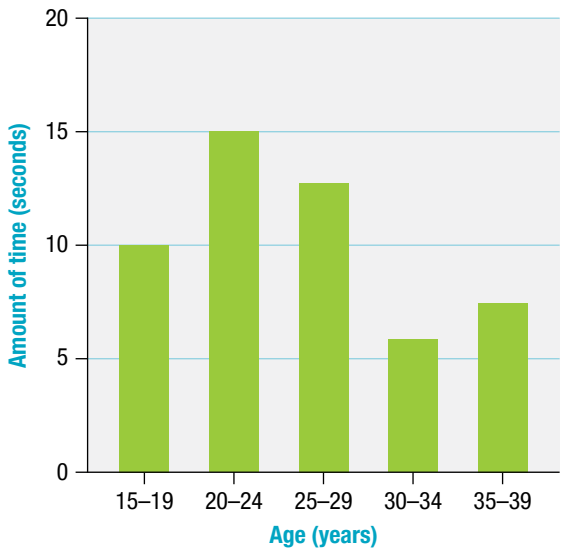

Figure 1.76 An example of a bar chart

One important feature of a bar chart is that each of the categories shown in the graph is discrete and there is no continuation between one category and the next; for example, there would be separate bars for data about female participants' responses and male participants' responses. Each bar is the same width and has a small space between it and the next bar. In addition, the bars can start from either the *x*-axis (vertically) or from the *y*-axis (horizontally).

Sometimes a bar graph is used to represent values from two categories; for example, scores obtained by age group (e.g. amount of time to solve a problem) and by sex. This is shown in Figure 1.77a. The data for two categories can also be presented within a single bar. This is shown in Figure 1.77b which combines results for males and females within single bars.

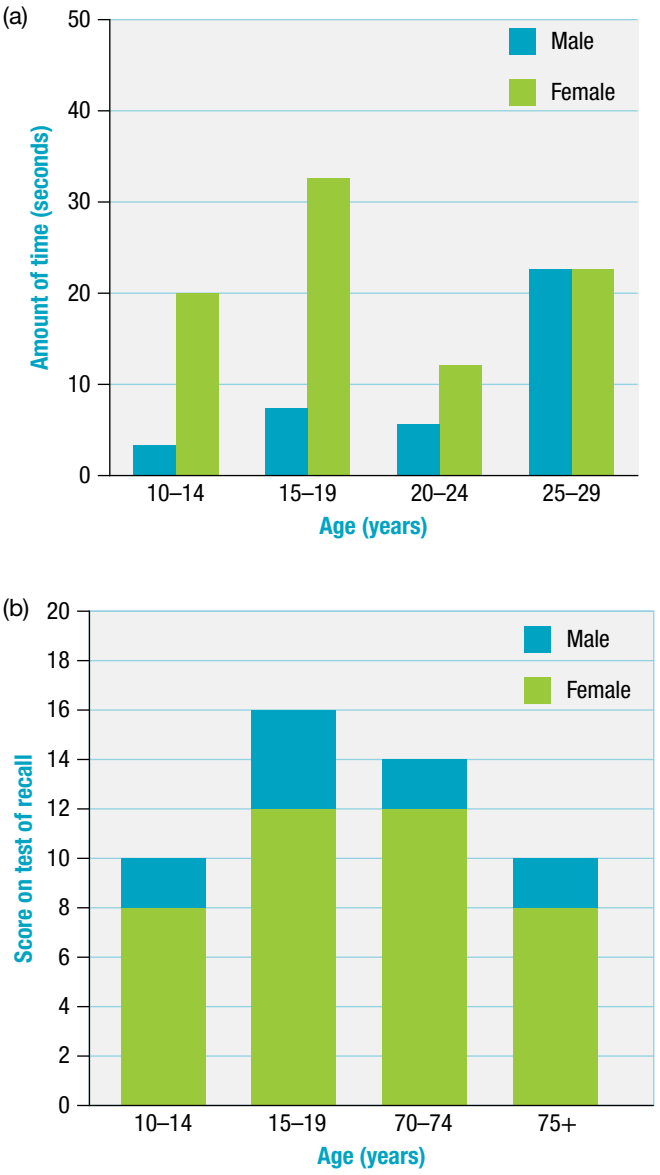

Figure 1.77 Two bar graphs showing different ways of presenting data for males and females of different ages

Line graphs

A line graph uses points connected by lines to show how one variable changes as another variable changes. For example, Figure 1.78 below shows how performance on a speed and accuracy test (e.g. matching symbols with numbers) changes in relation to the number of hours of sleep a person has had. You can see at a glance that the number of errors (the measure of performance) was the greatest when only one hour of sleep was obtained and that the number of errors tended to decrease as the amount of sleep obtained increased.

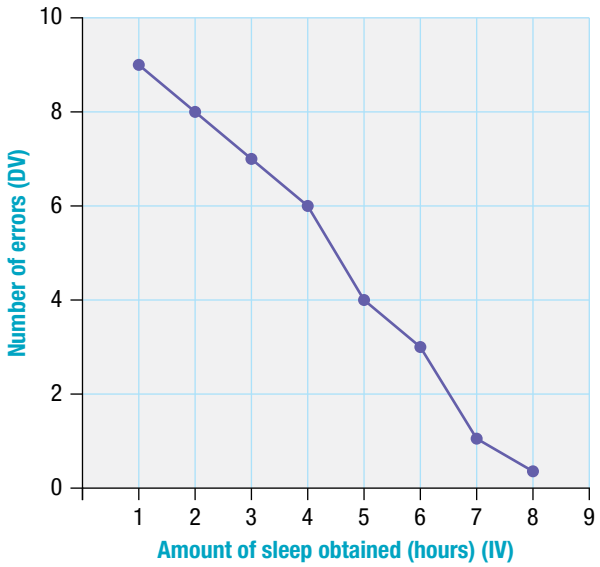

Figure 1.78 A line graph showing the results of an experiment investigating the effect of amount of sleep (IV) on performance on a speed and accuracy test (DV)

When used to show the results of an experiment, the IV is usually plotted on the horizontal (*x*) axis, with the numerical value of the data increasing as you go along this horizontal axis from left to right.

As shown in Figure 1.78, a line graph that describes the relationship between amount of sleep obtained and test performance would list the amount of sleep in hours on the *x*-axis in intervals; for example, beginning at zero, then one, two, three, four hours and so on. One important feature of a line graph is that the variable plotted on the *x*-axis is continuous; that is, a series of progressively increasing values can be listed.

The vertical (*y*) axis usually has the DV (ie. the measure of performance) plotted along it. A line graph that described the data from the experiment on the amount of sleep obtained and test performance would record the test scores (e.g. a total correct score or number of errors) along the *y*-axis in intervals, beginning at zero. This is also shown in Figure 1.78.

Various points on a line graph represent the score on one axis that corresponds with a value on the other axis. The intersecting point can represent a corresponding IV/DV score on the two variables by one research participant, or the mean score of a group of participants.

A number of different sets of data can also be plotted on the one graph. For example, in Figure 1.79 there are three sets of data showing age-related performance on a problem-solving task following different amounts of sleep deprivation. To identify the results of different age groups, a different coloured line has been used for each set of data. Note too the use of dots to identify the points of intersection between data for the X and Y axes.

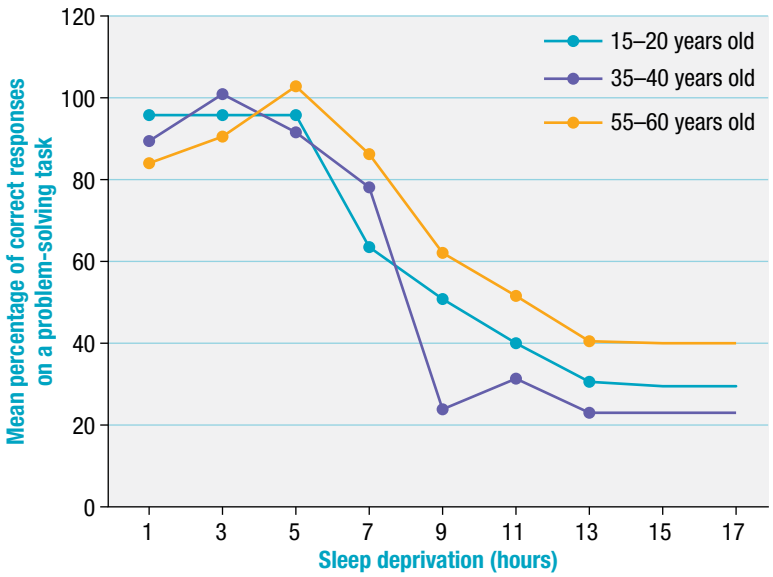

Figure 1.79 A line graph showing three sets of data so comparisons can be made

BOX 1.24 Histogram and pie chart

A *histogram* is like a bar chart but the bars are drawn so that they touch each other because the data are continuous.

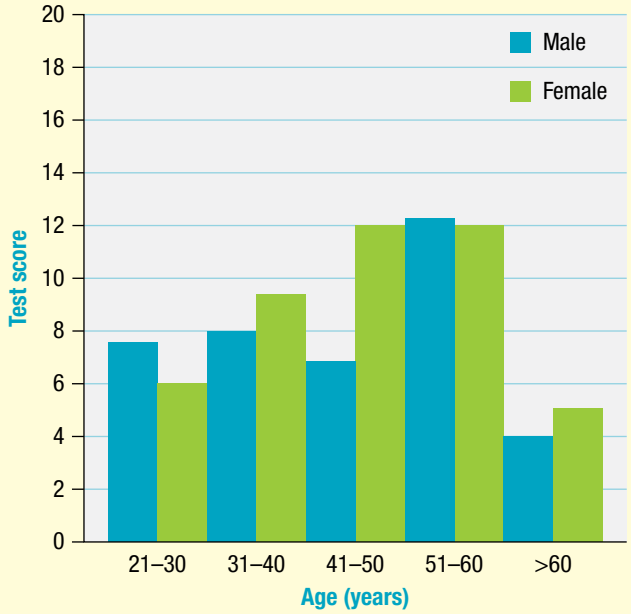

Figure 1.80 An example of a histogram

A *pie chart* (also called a *pie graph*) shows the proportions of scores, values or cases within a set of data. The differences between the categories in a set of data are represented by different-sized 'slices of pie'. This type of graph is best used for categorical data and to compare different parts of the same whole.

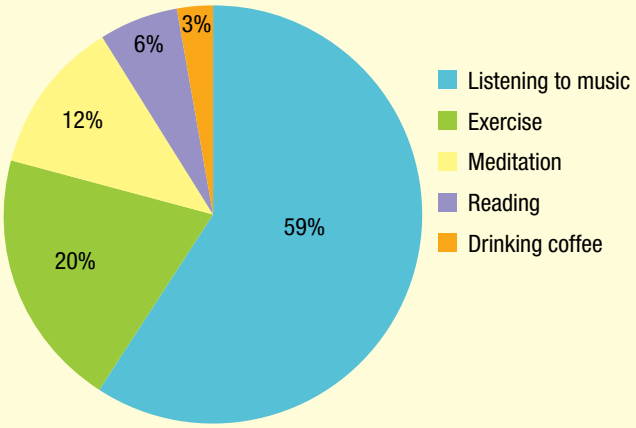

Figure 1.81 An example of a pie chart showing relaxation techniques used by participants when alone

Percentages

Suppose you conduct an observational study to find out whether more year 7 boys engage in disruptive behaviour in the classroom than do year 7 girls. You want to obtain quantitative data, so you work out a list of observable behaviours that you consider to be disruptive in the classroom. Your list includes behaviours such as distracting other students, calling out in class and being out of the seat without permission.

You observe two different classes from a store room at the back where you have concealed your presence. Whenever you see a boy or girl demonstrating one of the disruptive behaviours on your list, you record your observation with a tick and shift your attention to another child. Of the 25 boys you observe, six engage in a disruptive behaviour and four of 16 girls observed are disruptive on at least one occasion.

On the basis of these results, more boys than girls were disruptive at least once. However, more boys than girls were also observed. In order to reach a conclusion, you need to work out whether $\frac{6}{25}$ is more than or less than $\frac{4}{16}$. This can be achieved by calculating the percentages of boys and girls who engaged in disruptive behaviour, then making a comparison.

A percentage is a descriptive statistic that expresses a number as a proportion (or fraction) of 100. The term *per cent* means 'per hundred', or 'for every hundred'. It is shown using the percentage sign (%). For example, 65% is equal to $\frac{65}{100}$ and means 65 parts out of 100; 100% of something means *all* of it. A percentage is calculated using the formula

$$\% = \frac{\text{subtotal}}{\text{total}} \times \frac{100}{1}$$

It is easy to calculate a percentage when the original amount is 100. For example, if you complete a 100 item speed and accuracy test and correctly answer 90 items within the time limit, then your percentage score is:

$$\frac{90\ (\text{subtotal})}{100\ (\text{total})} \times \frac{100}{1} = \frac{90 \times 100}{100} = \frac{900}{100} = 90\%$$

For the data obtained in the observation study described above:

$$\text{Boys: } \frac{6\ (\text{subtotal})}{25\ (\text{total})} \times \frac{100}{1} = \frac{6 \times 100}{25} = \frac{600}{25} = 24\%$$

$$\text{Girls: } \frac{4\ (\text{subtotal})}{16\ (\text{total})} \times \frac{100}{1} = \frac{4 \times 100}{16} = \frac{400}{16} = 25\%$$

This means that the proportion of boys (calculated 'out of 100') who were disruptive in the classroom is slightly less than the proportion of girls. The main problem in making a comparison of the boys and girls based on the raw data is that the two groups were of unequal size. Calculating a percentage for each group overcame this problem and enabled comparison of the scores for boys and girls.

Percentages are commonly used in psychology to describe data; for example, scores on a test, categories of scores, changes or trends in scores, the percentage of people who respond in a particular way (such as correct or incorrect, agree or disagree, do something or do not do something) and the percentage of people in a sociocultural group (such as gender, age, educational qualifications, country of birth and language spoken at home).

Mean as a measure of central tendency

Data are often summarised by determining a single numerical score that can describe the data for the whole group(s). This score, called a **measure of central tendency**, indicates the 'central' or 'average' value in a set of scores. When a measure of central tendency is calculated, it often provides a typical score for a set of scores. The mean is the most commonly used measure of central tendency.

The **mean** is the arithmetical average of all the individual scores (or 'measures') in a set of scores. It is calculated by adding together all the scores and dividing the total by the number of scores. For example, if ten rats were put into a maze, the length of time (in seconds) it might take each rat to reach the end of the maze could be as listed below:

26, 17, 21, 18, 12, 17, 18, 24, 25, 17

The mean ($\bar{X}$ or M) score for the group is calculated by adding the individual scores together ($\Sigma = 195$), then dividing the total by the number of individual scores ($N = 10$). In this example, the mean is 19.5 seconds. The formula for the mean is shown below.

$$\bar{X}(\text{mean}) = \frac{\Sigma\,(\text{sum or total of all scores})}{N(\text{number of scores})}$$

When scores in a set of data cluster closely around a central score, the mean is a suitable and fairly accurate indicator of the typical score. It is representative of the scores. If, however, the scores are widely spread, unevenly distributed or cluster around extreme values, then the mean can be misleading. For example, 'outliers' are scores (or values) that 'lie' well 'outside' most of the other scores in a set of data. An outlier is typically much smaller or much larger than most scores. A few very high or very low values (sometimes even one depending on the number of scores) can inflate or deflate the mean, thereby making it an inaccurate indicator of the typical score. For example, in the set of scores 52, 58, 63, 17, 54, 61 and 92, both 17 and 92 lie a long way from the other results and are therefore outliers.

When it seems that one or more outliers have a big effect on the mean, then the outliers should be analysed and accounted for, rather than being automatically dismissed. Checking the measure, the specific result or some other aspect of the data collection procedure may be useful in further examining an outlier (VCE Advice for Teachers: Psychology). Alternatively, another measure of central tendency may be considered, such as the mode and median described in Box 1.25 below.

BOX 1.25 Median and mode as measures of central tendency

When scores in a set of data cluster closely around a central score, the mean is a fairly accurate indicator of the 'typical' score; that is, it is representative of the scores. If, however, the scores are very widely spread, unevenly distributed or cluster around extreme values, then the mean can be misleading. For example, a few high or low values ('outliers') within a relatively small set of data may inflate (increase) or deflate (decrease) the mean. In such cases, another measure of central tendency will be a more accurate measure of the 'typical' score and would therefore be used. Two other measures of central tendency which can be considered are the median and the mode.

Median

Another way of obtaining a score that may represent the central point in a set of scores is to arrange the scores in order of size and select the score that falls in the middle as being typical of the whole set of scores. This score is called the median.

The *median* is the middle score (or mid-point) of a set of scores. For example, the time taken (in seconds) for each child to complete a jigsaw puzzle in rank order (from lowest to highest) is:

12, 12, 17, 17, 17, 18, 18, 21, 24, 25, 26

In this example the median is 18. When there is an even number of scores, the median is the average of the two middle scores. For example, if the two middle scores are 20 and 21, the median would be 20.5.

The median is a particularly useful descriptive statistic if there is a limited amount of data, but if there is a large amount, determining the median can be time consuming and often impractical. The median is also a useful statistic when many very high or very low scores occur in the set of scores because the median is not affected by extreme scores. For example, the test scores shown in Table 1.10 on the next page were obtained when a psychology teacher gave her class of 10 students a test on research methods in psychology.

(continued)

(continued from previous page)

TABLE 1.10 Test scores

Rank	%
1	98
2	91
3	91
4	60
5	59
6	57
7	57
8	57
9	56
10	54
Total	680
Mean	68
Median	58

The calculation of the mean score on the test does not provide an accurate impression of the average score on the test, because the inclusion of three very high scores inflates the mean figure. In situations such as this, the median is a more accurate reflection of the 'typical' score on the test as it is closer to the majority of scores in the set of data.

Mode

A third measure of central tendency is the mode. In everyday language, the word mode means 'common'. This term accurately describes what the statistical mode is; that is, the *mode* is the most frequently occurring score in a set of scores. Using the scores again for the children completing the jigsaw puzzle:

26, 25, 24, 21, 18, 18, 17, 17, 17, 12, 12

the mode would be 17 because it occurs three times.

The mode is infrequently used in statistics because it is often not typical or representative of a complete set of data. For example, if a set of scores is 1, 1, 6, 7, 8, 10, the mode would be 1, which is not a representative score of the entire group. If one of the scores of 1 is changed to 10, the mode shifts completely to the opposite end of the scale. Thus, a single score can alter the mode dramatically, which is in contrast to the median, and to a lesser extent the mean, where individual score changes tend to have less of an effect.

Standard deviation as a measure of variation around the mean

Suppose that two psychology teachers discussed the abilities of their respective classes. The teacher of Class A explained that the mean of her students' results for a test was 78%. The teacher of Class B replied that the mean of his students' results for the same test was 68% and that his students must therefore be less capable than his colleague's. 'But how do you know I'm not just an easy marker? One of my students got 97%. Then again, another student got 18%,' responded the Class A teacher. The Class B teacher was surprised: 'The lowest mark in my class was 53%, but my highest mark was only 81%,' he said, 'so how do we know which class has the better abilities?'

The discussion between the teachers indicates that a mean, on its own, doesn't provide the complete description of the data. The mean describes the 'central' value of a set of scores. In order to more accurately represent the data, a second kind of descriptive statistic is often used — a measure of variation.

A **measure of variation,** also called *variability*, indicates how widely scores are distributed or spread around the central point. The sets of scores in Figure 1.82 below both have the same mean, but they differ in variation; that is, how far the scores are either side of the mean. The distribution of Class A scores shows that they are tightly packed around the mean, indicating *low variation* (or *variability*). The distribution of Class B scores is more widely spread from the mean, indicating *high variation* (or *variability*).

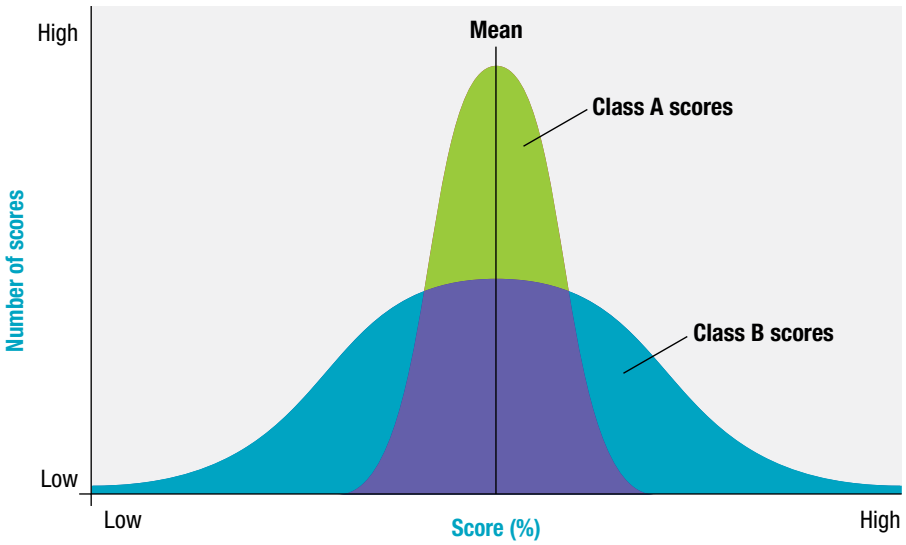

Figure 1.82 Class A and Class B both have the same means. The distribution of scores for Class A (green) shows low variation, as indicated by the clustering of scores around the mean. The distribution of scores for Class B (blue) shows high variation, as indicated by a greater spread of scores from the mean.

The **standard deviation (SD)** summarises how far scores within a set of scores spread out, or 'deviate', from the mean for those scores. If all the scores in a set of scores were the same, there would be no variation and the standard deviation would be zero because none of the scores would be spread out from the mean. A low standard deviation indicates that there is little variation in the scores and that most scores are clustered around the mean. In this case, the mean is a representative descriptive statistic, as shown in Figure 1.83, curve C. The higher the standard deviation, the greater the variation there is among the scores, as shown in Figure 1.83, curve A.

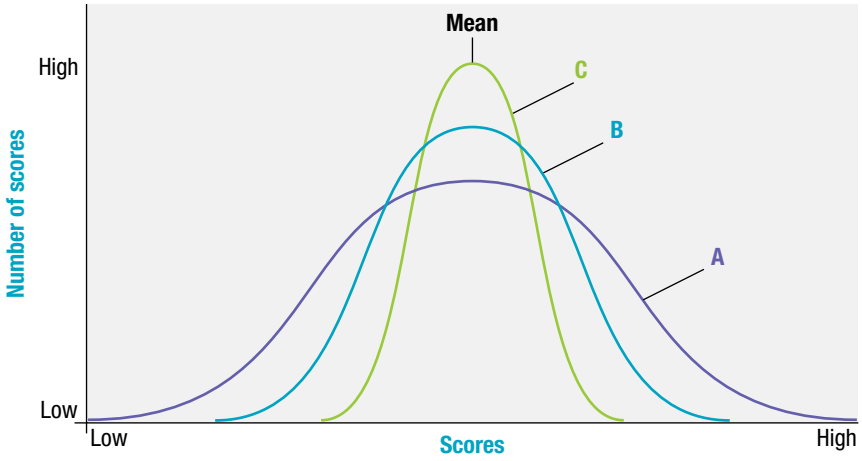

Figure 1.83 This graph shows three distributions of scores, each with a different standard deviation. The purple curve has the highest standard deviation and the orange curve has the lowest standard deviation.

The standard deviation is a particularly useful descriptive statistic in that it provides a point of comparison between the means and the spread of two or more different sets of score. For example, suppose a replacement teacher comes to a new school hoping for an easy day's work. The replacement teacher is offered either of two classes, both of which have a mean IQ score of 100. There appears to be no difference between the two classes. The teacher is then informed that the standard deviation of IQs in one class is 1 and the standard deviation in the other is 3. Since a higher standard deviation means more variability, the class with the standard deviation of three may take more effort to teach because students vary more in ability.

In sum, when considering standard deviations, it is important to recognise that:

- although two or more different sets of scores (or data sets) may have the same mean, they may not have the same degree of variation (or 'spread') in the data; and
- a higher standard deviation represents a greater variation (or 'spread') in a set of scores (and vice versa).

Note also that, for a normal distribution of any set of scores, 68.26% of the scores lie within one standard deviation of the mean and 95.44% of the scores lie within two standard deviations of the mean. These and other standard deviation values are shown in Figure 1.84 below.

For example, 68.26% of the scores will fall within one standard deviation either side of the mean; 95.44% of the scores will fall within two standard deviations either side of the mean. These percentages apply consistently in a normal distribution curve, irrespective of the size of the standard deviation.

Although you need to be able to calculate a mean in VCE Psychology, calculation of standard deviation or any other measure of variation is beyond the scope of the VCE Psychology Study Design (VCE Advice for teachers: Psychology).

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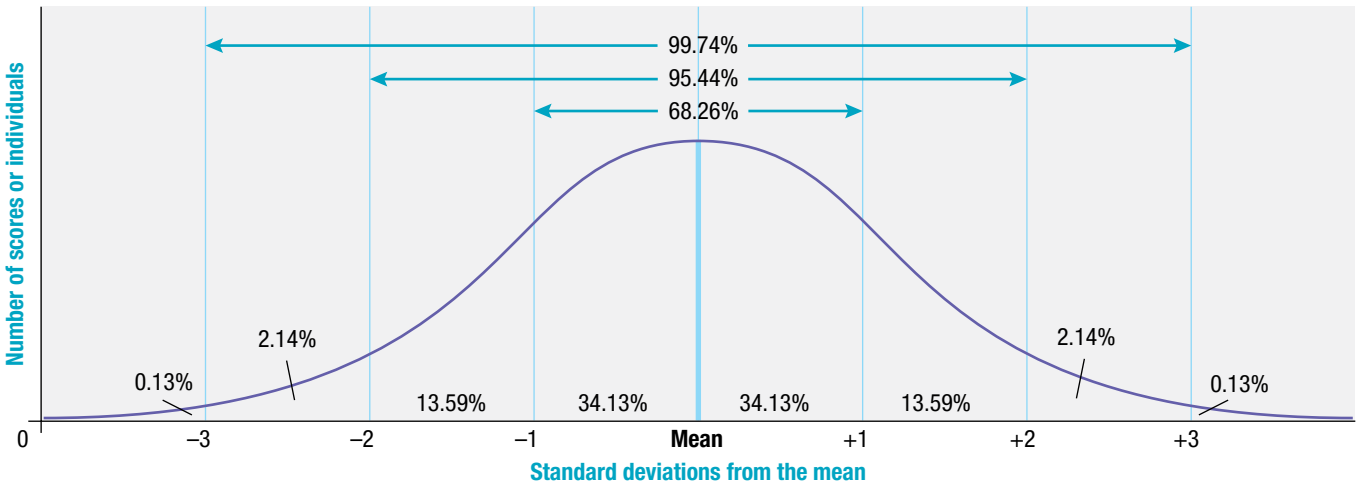

Figure 1.84 Standard deviations in a normal distribution. When standard deviations are represented on the X (horizontal) axis of a normal distribution curve, the percentage of scores falling between the mean and any given point on the axis is always the same.

BOX 1.26 Skewed distributions of scores

The normal distribution curve shown in Figure 1.84 is a 'theoretical ideal' and is rarely perfectly achieved in reality. Often, the scores or other values are unevenly distributed and cluster to the left or the right ends of the graph. In such cases, the spread is called a *skewed distribution* as there is a lack of balance or symmetry. The skew of the graph — whether it is positive or negative — is linked to the direction of its 'tail'.

Positive skew

If the number of words 12-month-old children spoke were plotted, it is highly likely that many of the scores would cluster towards the lower end (left) of the graph producing a positively skewed distribution (or spread).

This is shown in Figure 1.85 below.

When the distribution of scores has a *positive skew*, there is a disproportionate number of low scores. The 'tail' of the graph tapers in a positive direction towards the higher scores.

Negative skew

In contrast with 1-year-olds, if the number of words 16-year olds know were plotted, many of the scores would cluster at the higher end (right) of the graph producing a negatively skewed distribution. This is shown in Figure 1.86 below.

When the distribution of scores has a *negative skew*, there is a disproportionate number of high scores. The 'tail' of the graph tapers in a negative direction, towards the lower scores.

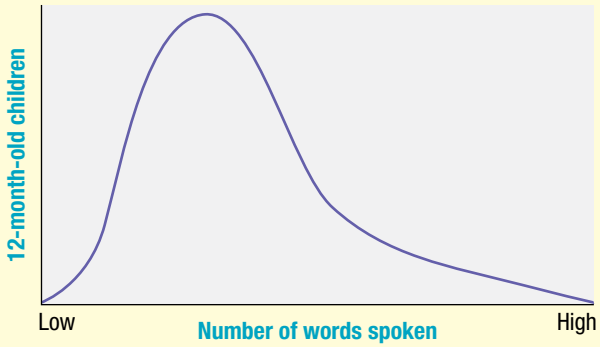

Figure 1.85 Positive skew — a curve skewed to the left, indicating that there is a clustering of a relatively large number of low 'scores'

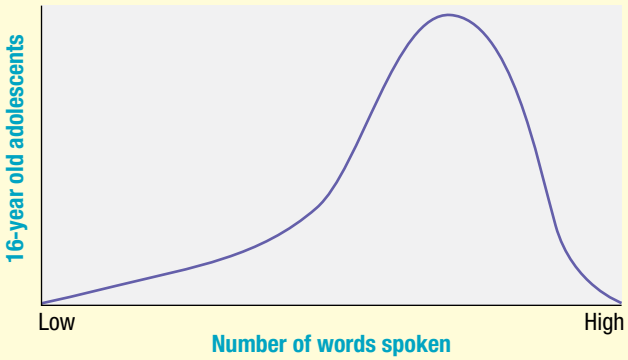

Figure 1.86 Negative skew — a curve skewed to the right, indicating that there is a clustering of a relatively large number of high 'scores'

LEARNING ACTIVITY 1.33

Review questions

1. What does a measure of variation (variability) indicate?

2. (a) What information does the standard deviation provide about the distribution of scores?

(b) Explain why the standard deviation is useful for comparing two or more data sets obtained from research that have very similar or even identical means.

3. What percentage of scores lie within one standard deviation of the mean? Two standard deviations?

4. For each of the following examples, indicate whether you believe there is likely to be high or low variability among the data from Australian samples.

(a) age when infants first walk unassisted

(b) age when infants utter their first sound

(c) age when people go on their first date

(d) speed at which people successfully navigate a complex maze

(e) goal-shooting accuracy of professional netballers who usually play a goal attack or goal shooter position but under a condition of high arousal

5. (a) Two classes sat the same practice Psychology exam. The following descriptive statistics were calculated from the students' results in each class:
Class A: mean 75%.
Class B: mean 75%.
On the basis of the mean scores alone, what might teachers of these classes conclude about the knowledge of students in each Psychology class? Explain your answer.

(b) Suppose the teachers then calculated the standard deviations for their respective classes and obtained the following results:
Class A: mean 75%; standard deviation: 0.1
Class B: mean 75%; standard deviation: 2.5.
On the basis of this additional information, what conclusions might the teachers now draw about the knowledge of the students in each Psychology class? Explain your answer.

Inferential statistics

Descriptive statistics are very useful for summarising and organising data so that it can be comprehended. For example, they can show patterns that emerge from data or provide a single number such as a mean or standard deviation that can help describe the data. However, they do not in themselves indicate whether the data are meaningful.

In order to interpret the data and find out whether the results are meaningful, inferential statistics can be used. Inferential statistics enable researchers to 'infer', or to make judgments or draw conclusions on the basis of some evidence, such as the data collected through research. For example, an inference from data may involve deciding whether manipulation of an independent variable alone is responsible for the changes in the dependent variable. Inferential statistics can help the researcher do this with some degree of confidence.

Of initial interest to the researcher for any type of study is whether the data support the hypothesis that was tested. Furthermore, when results have been obtained for a sample, inferential statistics can be used to help decide whether these would occur in the population from which the sample was drawn.

In most experiments there will usually be a difference in the mean scores of the experimental and control groups. Suppose, for example, a researcher wanted to find out if a new study technique called SupaStudy improved performance on a Psychology test. The researcher conducted an experiment using two groups of Units 3 and 4 Psychology students. The students were randomly allocated to either of two groups. Group A was taught the SupaStudy technique and Group B was not. Both groups attended lunchtime sessions three times a week for a month during which they were taught a new topic in Psychology. At the end of the topic, both groups were given the same test. The mean test score for Group A was 79% and the mean test score for Group B was 73%. On the basis of these results, what legitimate conclusion can the researcher draw about the effect of using SupaStudy on Psychology test performance?

Assuming that the researcher controlled all variables that may have affected the results obtained, other than the use or non-use of SupaStudy, can the researcher draw a conclusion that SupaStudy 'works'? More specifically, can it be concluded that the difference in the mean scores is due to the presence or absence of the IV — the use of SupaStudy?

Perhaps the difference was due to chance factors in that the experimental and control groups were slightly different in their composition of relevant participant variables despite the use of random allocation. Perhaps, by chance, there were a few individuals in the control group who were far more able or motivated than students in the experimental group who used SupaStudy. This may have inflated the control group's mean score. Perhaps, by chance, there were a few individuals in the experimental group who were distracted when learning SupaStudy, missed some vital details and did not apply the technique correctly. This may have deflated the experimental group's mean score. Perhaps the classroom conditions were slightly better for one group and marginally impacted on performance. Perhaps the experimenter was tired and slightly impatient when instructing the experimental group participants. Perhaps the effects of these apparently controlled variables 'added up' and combined in such a way as to cause the difference.

There's no doubt that 79% is a higher score than 73%, but the difference does not seem to be very large. Is the difference in the scores large enough to claim that SupaStudy had a real effect or is the difference in the scores simply due to chance factors? What is an *acceptable* difference? How big does the difference between the mean scores of the two groups need to be in order to say that the difference is not due to chance?

Figure 1.87 These children were participants in a research investigation on sleep patterns conducted by VCE students. They were part of a sample of eight participants who all attended the same eastern suburbs preschool. Can the results obtained from this sample be generalised to all preschoolers at the centre in the year of the study (i.e. the population)? To all children enrolled at the preschool the following year? Can the results be generalised to wider populations, such as all preschoolers in the eastern suburbs? In the Melbourne metropolitan area? In Victoria? Other populations? Inferential statistics can be used to make these types of judgments about results.

One way to find out if the results of an experiment are due to the IV that was tested rather than chance factors is to repeat these studies several times in exactly the same way with the same participants to see if the results are about the same each time the study is replicated. This would be very time consuming, inconvenient and possibly impractical because participants may not be continually available. However, it is usually unnecessary to undertake these replications. A more efficient way of measuring the reliability of the results is to use inferential statistics by applying a test of statistical significance to determine the extent to which chance factors may account for the results (see Box 1.27 below).

Conclusions and generalisations

When the results have been evaluated, evidence-based conclusions need to be drawn. A **conclusion** is a decision about what the results obtained from research mean. All conclusions must be based on evidence (i.e. the results), be consistent with the evidence and relevant to what was actually investigated and take account of potential limitations of the research.

One type of conclusion relates to whether or not the hypothesis is supported on the basis of the results obtained. This requires careful examination of the results so that an objective ('unbiased') judgment can be made. Although the results alone may indicate that the hypothesis is supported, the DV and therefore results may have been influenced in a significant way by variables other than (or in addition to) the IV. Therefore, uncontrolled extraneous variables and potential confounding variables also need to be considered when drawing a conclusion. The researcher must be confident that any change in the DV was due to the IV alone and not any other variable (or chance factors).

The conclusion about the hypothesis is expressed as a statement in a written report that describes the investigation and its findings. In psychology, a hypothesis may be supported or it may be refuted (rejected), but it cannot be said to be 'proven' true or correct. Generally this is because no matter how much evidence a researcher finds to support their hypothesis, there may still be one or more alternative explanations, some of which are not yet known or even thought of, that could better explain the results.

Another type of conclusion that can be made is called a generalisation. A **generalisation** is a decision or judgment about how widely the findings of a research study can be applied, particularly to other members of the population from which the sample was drawn. Because a study usually tests a sample from the population of interest rather than the whole population, making a generalisation is a process of forming an idea about whether findings obtained from a limited number of cases (the sample) can be

BOX 1.27 Statistical significance and *p* values

Statistical significance

Tests of statistical significance can be used to determine the extent to which chance operated in an experiment and whether it is at an acceptable level. The tests enable a precise mathematical value to be obtained that will indicate the probability (likelihood) that if the same experiment were repeated, the results would be similar or different.

If the likelihood of the difference occurring by chance is at an acceptable level, then it is said that the difference is *statistically significant*. In general, psychologists accept a given result, such as the difference in mean scores, as statistically significant if it is found that the probability or likelihood that the result might be due to chance is 5 or fewer times (≤ 5) in 100, or a 1 in 20 chance, if the same study were to be repeated 100 times. The way of saying this is that the result is *significant* at the 0.05 level; that is $p < 0.05$.

A significance level of $p \leq 0.06$ (less than or equal to 0.06) would indicate that there was a 6% (or 6 or less in 100) chance that the result obtained was most likely due to chance and this would generally be viewed as unacceptable. It would then be said that the results are *not significant* and therefore do not support the research hypothesis.

***p* value**

The significance level of any difference is called a *p value*, with 'p' standing for probability. An acceptable *p* value for results is established before the experiment is conducted.

In some cases, a stricter probability level than $p \leq 0.05$ is used, such as $p \leq 0.01$ (less than or equal to 1 in 100) and $p \leq 0.001$ (less than or equal to 1 in 1000). Such a probability level would be used when the findings of the research are so important that the researcher wants to be extremely confident of the results; for example, when the research hypothesis being tested involves a radical new way of treating depression or if it contradicts a research finding or theory that is widely accepted.

If research is being undertaken in an area that is likely to be of immense benefit to the community, or if it involves a treatment that carries with it some chance of harm, then replication of the study is still likely to occur.

In some other cases, a researcher might be prepared to accept a more lenient level of significance than $p \leq 0.05$. For example, a researcher may conduct a pilot, or 'trial', study on a research topic of interest to see if it is worthwhile carrying out a full-scale research study. The researcher may set a significance level of $p \leq 0.1$ (10%). This would indicate that there *may* be a significant difference in the mean scores obtained. Therefore, it is worth continuing with further research, perhaps with refinements to the procedures.

extended to apply to an entire class of objects, events or people (the sample's population).

In experimental research, generalising the results from the sample to the population is risky if the sample is not representative of the population of interest. Like any other conclusion, a generalisation must also be based on the results obtained and must consider the potential extraneous and confounding variables, as well as any other problems with the study.

When drawing conclusions about the results and making generalisations, researchers try to avoid making errors or overstating what the results mean. For example, they attempt to ensure that:

- all conclusions are consistent with the results
- all conclusions are relevant to what was actually investigated
- any influential extraneous variables or confounding variables have not been overlooked
- analysis and interpretation of the results enables an accurate finding about whether or not the hypothesis is supported
- any gaps in the results and further evidence that may be required are identified
- limitations of the sample used in the study have been considered
- any generalisations are reasonable
- the explanation of the findings is reasonable and supported by the results.

In many cases, psychology researchers use university students enrolled in psychology courses as participants in their experiments. Some researchers believe that the results of these experiments cannot be generalised beyond the sample; for example, by applying the results to all students enrolled in a psychology course at a university, to students in other courses, to young adults, or to adults in general. However, other researchers believe that it is reasonable to assume that a relationship between an IV and a DV observed in one group of people is likely to be seen in other groups, as long as the relationship is strong and the sample of participants is not particularly unusual. For example, results from a sample of people with an addictive disorder or an intellectual disability cannot be generalised as easily as data obtained from university students.

The extent to which results can be generalised also depends on the topic studied. Many psychologists believe that researchers who study topics such as sensory processes and biological or physiological factors that underlie behaviour can more easily generalise their results quite widely. The phenomena that these researchers study are usually not affected by individual differences. For example, the visual system is basically the same for all fully developed people (without relevant nervous system damage), therefore, differences between individuals in characteristics such as intelligence, beauty, personality, age, weight, political preferences, willingness to volunteer, and so on, will not affect it. Consequently, it is widely believed that it is reasonable to generalise findings on these topics beyond the populations from which they were drawn, as long as such generalisations are tentative.

Researchers who study topics such as personality, social behaviour, attitudes, consciousness and learning or memory strategies tend to be less likely to generalise their findings beyond the sample's population. In these areas, the effect of the IV is often influenced by the individual characteristics of the person participating in the experiment. For example, a new technique for learning mathematics may be effective for university students but not for secondary school or primary school students (Wood, 1981).

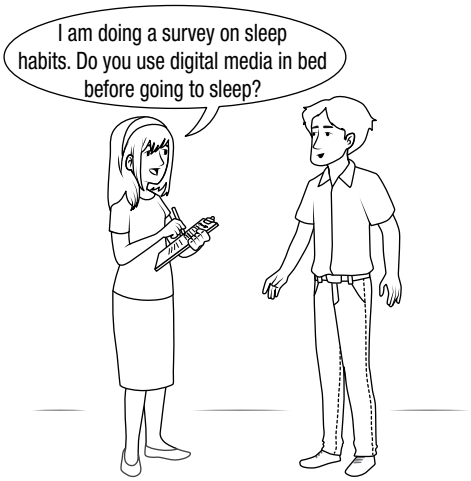

Figure 1.88 On the basis of a sample of one, can the results be generalised?

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LEARNING ACTIVITY 1.34

Review questions

1. What can be achieved with inferential statistics that is not possible with descriptive statistics alone?
2. Explain the meaning of chance factors in relation to research with reference to an example.
3. What kind of judgment is made about the research hypothesis after the results have been obtained and analysed?
4. What is the meaning of the term conclusion?
5. Why must potential extraneous and confounding variables be considered when drawing conclusions from results obtained in a study?
6. What is the meaning of the term generalisation?
7. What are the important considerations when drawing conclusions and making generalisations from the results of a study?
8. Distinguish between the terms conclusion and generalisation as they apply in research studies.
9. How would you answer the question in the Figure 1.88 caption above?

RELIABILITY AND VALIDITY IN RESEARCH

An important goal of research is to obtain results that are both reliable and valid. This will mean that the results are consistent and accurate. It also means that the results are of value and use. Reliable and valid results can be achieved when the research, its data collection procedures and measurement tools are reliable and valid.

Although researchers may refer to a study or results as either 'reliable' or 'not reliable', 'valid' or 'not valid', reliability and validity are not necessarily 'present-or-absent' features of a research design, its measurement tools or the results. Instead, they are considered to vary in degree on a scale ranging from low to high. Both are ways of assessing the quality of a research design, the specific procedures or tools used to collect data, and the results obtained.

Reliability

Reliability refers to the extent to which the results obtained from a research study are consistent, dependable and stable. This means that each time a behaviour or event is measured under the same conditions, the procedure(s) used should produce very similar results at the least. For example, if your body temperature was measured with an oral thermometer while you were laying down in a resting state and the reading was double-checked immediately, you should expect the same result. Similarly, if you conducted an experiment on a group of participants and repeated it again with the same group or a similar group under the same conditions, you should expect the results to be very similar.

Conducting an experiment is a more complicated process than measuring your body temperature level because it involves human participants and the strict control of many variables, so it is not likely, or expected, that the results will be identical each time the experiment is conducted. The main reason the results of an identical study are unlikely to be exactly the same when replicated is due to individual participant differences within another sample.

Even when a researcher repeats their experiment with the same participants it is unlikely that identical results will be obtained due to participant differences in responses to the IV manipulation and/or DV measurement, even if these are only minor differences. For example, consider the likelihood of your responding exactly the same way as you did in the original experiment if you are a participant in an identically repeated experiment, especially an experiment for which responses are relatively unrestricted. However, researchers believe that if the results of an experiment are to be considered reliable, they should be *similar* (i.e. fall within a very narrow range of values) each time the experiment is repeated under the same conditions on other occasions.

The general idea behind research reliability is that significant results must be more than a 'one-off' finding and be replicable ('repeatable'). A researcher always sets out to obtain reliable results. However, when their study is repeated, it may be found that the results are not reliable. This is more likely to occur if the study is not repeated in exactly the same way in which it was first conducted; for example, if there are differences in important personal characteristics of participants, or if the conditions under which the study was first conducted are significantly different in some way.

In addition, experiments that use human judgment may not always produce reliable results due to potential bias. For example, in an experiment where participant responses are recorded by observers, there is a possibility that observers may rate certain responses differently depending on what they are attending to, their concentration span, the time of day, their mood, and so on, even if a checklist is used. Consequently, such an experiment may be inherently less reliable than one using a stopwatch where time is crucial. It is also more likely that experiments that use small sample sizes or an insufficient number of trials will produce results that are not reliable when compared with similar experiments that use large samples and an adequate number of trials.

Validity

Validity refers to the extent to which the research study and its procedures measure what the research intended to measure. Basically, the research design and the specific procedures used should match the requirements of the investigation to produce results that are relevant to the aims of the research. If a research study has a high level of validity, this means that the investigation has produced results that accurately measure the behaviour or mental process that was claimed to have been measured. For example, an experiment on some aspect of memory would use a test that actually measured that aspect of memory and not something else such as intelligence, language ability, numerical skills or emotional state.

Validity also relates to the conclusions (including any generalisation) the researcher makes about a study. In this case, the results are considered valid if the conclusion(s) drawn by the researcher is (are) correct. This means that the conclusion is specifically based on those variables that the study was investigating and the data obtained from the study. For example, if a researcher concludes that a new drug they tested in an experiment reduces symptoms of depression, or that participants in a taste-preference study preferred Coca-Cola over other colas, the research has a high level of validity only if the new drug really works or if the participants really did prefer Coca-Cola (Stangor, 2004).

As with seeking reliability, researchers always attempt to conduct valid research and to draw accurate conclusions from their data. Yet often, despite a

Figure 1.89 If a researcher concludes that participants in a taste-preference study preferred Coca-Cola over other colas, the research has a high level of validity only if the participants really did prefer Coca-Cola.

researcher's best intentions, their research has low validity or is not as valid as it could have been. This can occur for a number of different reasons.

Sometimes a researcher may draw a conclusion from their data that cannot actually be drawn; that is, the data do not actually justify, support or 'back up' the conclusion. Another reason that research and its results may be lacking validity is because one or more extraneous variables have not been adequately controlled, have become confounding variables, and have therefore influenced the results in an important way. For example, in an experiment, a confounding variable and the IV may both affect the results. When this happens, the researcher will find it difficult to separate the effects of the IV and the confounding variable and therefore cannot be certain whether it was the IV or the confounding variable that caused the change in the DV. Consequently, when researchers evaluate the validity of a study, they consider both the research and its implementation.

Note that a measure can be reliable even though it is not valid, but a measure cannot be valid unless it is reliable. For example, if you measured your biceps with a cloth tape measure that had been left outside in the open weather for a long time and had become inaccurate through stretching, the result would not be a valid measure of your true bicep size. The inaccurate cloth tape measure, however, is reliable as it will give you the same result each time it is used (even if inaccurate). Similarly, it is possible to obtain a reliable measurement for skull size using a stretched cloth tape measure, but that would not be a valid measure for intelligence.

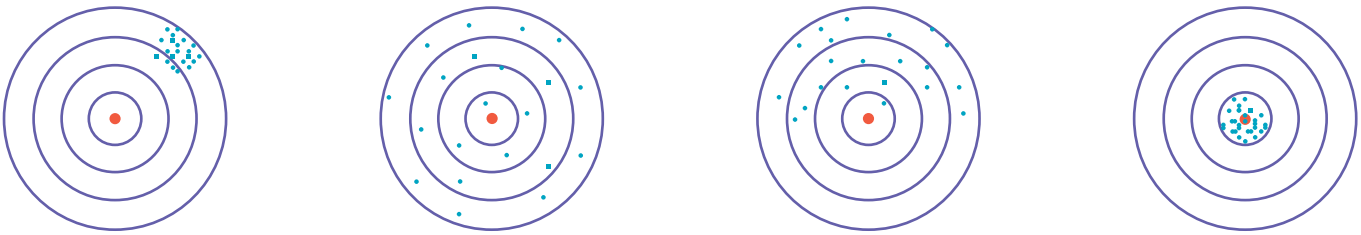

Figure 1.90 Researchers seek to conduct investigations that are both reliable and valid. Reliability is a necessary condition for validity.

BOX 1.28 Replication of procedures: repeatability and reproducibility

Experimental data and results must be more than one-off findings and should be repeatable and reproducible to draw reasonable conclusions.

Repeatability refers to the closeness of agreement between independent results obtained with the same method on identical test material, under the same conditions (same operator, same apparatus and/or same laboratory).

Reproducibility refers to the closeness of agreement between independent results obtained with the same method on identical test material but under different conditions (different operators, different apparatus and/or different laboratories). The purposes of reproducing experiments include checking of claimed precision and uncovering of any systematic errors that may affect accuracy from one or other experiments/groups. Reproducibility is often used as a test of the reliability of an experiment.

Source: VCE Advice for teachers: Psychology. Retrieved from http://www.vcaa.vic.edu.au/Pages/vce/adviceforteachers/psychology/measurementterms.aspx

Internal and external validity

Researchers often distinguish between the internal and external validity of their studies. They consider both internal and external validity in judging the overall validity of a study, both its design and implementation. Strengths and limitations of different types of investigations and their procedures and results can be discussed in terms of these aspects of validity. As with reliability and validity in general, these types of validity also vary in degree; that is, a research study is considered to be more or less valid rather than valid or not valid in either or both these aspects. However, without internal validity, there is no external validity.

Internal validity refers to the extent to which the results obtained for a study are actually due to the variable(s) that was tested or measured and not due to some other factor. For example, in an experiment, the researcher needs to be confident that the measured change in the DV was produced solely by the IV and not by any extraneous or confounding variable, nor due to chance. It can therefore be inferred that there is a causal relationship between the IV and DV.

When a study is said to have internal validity, then the measurement tools and procedures used for the research measured what they were supposed to measure. Internal validity is maximised when the research is free from the presence of confounding variables. If a study has gaps or 'flaws' in its procedures, such as the use of a sampling procedure that resulted in an unrepresentative sample when it was important to have a representative sample, then it may be considered as lacking in internal validity if the biased nature of the sample produced one or more confounding variables.

Similarly, if participants were required to rate facial attractiveness of people in photos, then the researcher needs to be confident that the scores (ratings) actually and only are based on measured facial attractiveness. Internal validity may be lost if participants didn't understand the rating procedure or their ratings partially reflected the style of dress worn by each person in a photo.

Internal validity can be improved through a number of methods, especially use of a research design that is appropriate for testing the research hypothesis and

Figure 1.91 The term *ecological validity* is specifically used to refer to the extent to which the findings of a research study are able to be generalised to everyday, common real-life behaviours and natural settings. Studies that take place under highly controlled artificial conditions are often closely evaluated for ecological validity. Consider Zimbardo's (1971) Stanford Prison Experiment. The study took place in a very realistic prison environment set up in the basement of the university's psychology building and participants displayed realistic behaviour. However, it was an artificial environment and not a real prison. To what extent did this situation reflect real life in a real prison? Did the results generalise to prisons in the outside world? How likely is it that participants simply behaved in ways they thought they should be behaving in that setting and acted out their assigned roles? Do you think the research is high or low in ecological validity?

by controlling relevant extraneous variables to ensure none become confounding variables; for example, by using appropriate sampling procedures for selection and allocation of participants, counterbalancing, single and double blind procedures, placebos, and standardised instructions and procedures.

External validity refers to the extent to which the results obtained for a study can be generalised to the population from which the sample was drawn or to other people in other settings and over time. For example, suppose that a researcher conducted a laboratory experiment on the effects of stress on behaviour using a relatively small sample of participants. If the experiment has high external validity, this means that the results can more confidently be generalised to apply to the population from which the sample was drawn and to situations outside, or 'external' to, the laboratory at another point in time.

Similarly, if an observed effect may actually be found only under certain conditions (e.g. in a laboratory) for specific groups of participants (e.g. university students obliged to participate as a course requirement), then a study *may* be lacking in external validity. In addition, the results should not be time-dependent; that is, the results should apply across time and be found in the future if the research were to be replicated under the same conditions.

Generally, the bigger and more representative a sample is of its population, the more confident the researcher can be in generalising from the sample to the population. Conducting an experiment in a real-world setting natural to the research question of interest and therefore more like an event in 'real life' can also improve external validity.

Internal and external validity are related. Internal validity is a precondition of external validity, which means that a study cannot have external validity without internal validity. Furthermore, a study that is said to have external validity is also said to have internal validity. It does not necessarily follow, however, that an effect observed in a strictly controlled laboratory experiment with a high level of internal validity will also have the same effect in a real-world situation.

LEARNING ACTIVITY 1.35

Review questions

1. Distinguish between validity and reliability in research.
2. Is it essential that the results of an experiment can be replicated in order for the experiment to be considered reliable? Explain your answer.
3. Give an example of when results would not be considered reliable.
4. Under what circumstances can it be said that the conclusions or findings of research are 'valid'?
5. (a) Distinguish between internal and external validity with reference to an example.
   (b) List three procedures that could adversely impact on the internal validity of an experiment.
   (c) List three procedures that could improve the external validity of an experiment, with reference to a relevant example.
   (d) Explain, with reference to an example, whether a study can have high internal validity but not external validity.
6. Explain, with reference to an example, why reliability is possible without validity but validity requires reliability.
7. Find an example of an online test on some aspect of how people may think, feel or behave. This could include personality and intelligence tests.
   (a) Name the test and insert a copy of the URL where it can be located.
   (b) Comment on the validity and reliability of the test.

LEARNING ACTIVITY 1.36

Designing an experiment and interpreting the results

Outline the design of an experiment that could be undertaken to test the following hypothesis: 'If a newborn infant has extra contact with their mother soon after birth, then the bond formed between the mother and infant will be stronger.' Twelve mothers who are about to give birth have volunteered to be participants in your experiment for two years. In designing your experiment, make sure that you address the following:

- What groups will be used?
- What are the independent and dependent variables?
- How will these variables be operationalised?
- What is your research hypothesis for the experiment?
- What potential extraneous or confounding variables will it be important to control?
- What type of experimental design will you use? Explain your choice of design.
- When considering your results, what question will you ask about your experiment's:
  – internal validity?
  – external validity?
- If you find an acceptable difference in the results for the two groups, what conclusion would you draw? What generalisation would you make?
- How could you determine the reliability of your results?

ETHICS IN PSYCHOLOGICAL RESEARCH AND REPORTING

Is it appropriate to expose human participants to stressful conditions in order to study bodily changes when stressed? Is it appropriate to deprive participants of sleep for a prolonged period in order to study the effects? Is it appropriate to deceive participants and misinform them of what an experiment is about in order to control responses that may not ordinarily occur? Is it appropriate to test a new medication by giving a placebo treatment that is known to not work to participants in a placebo group who are unwell and genuinely need the new medication, and are therefore intentionally allowed to remain unwell? Should all participants be fully informed of the purpose of the research before they agree to participate? Should participants have the right to withdraw from an experiment at any time without giving a reason for wanting to do so? Such questions raise important ethical issues that need to be considered by researchers.

The term **ethics** refers to standards that guide individuals to identify good, desirable or acceptable conduct. Essentially, ethical standards help us to judge which behaviours are appropriate ('right') and inappropriate ('wrong'). 'Ethical conduct' is more than simply doing the right thing. It involves acting in the right way out of 'respect and concern' for others (NHMRC, 2007).

All societies and cultures have ethical standards that guide the behaviour of their members. In addition to these standards, most professions have their own standards of ethical conduct that must be followed. For example, just as it would be considered unethical for a medical doctor to discuss a patient's condition with anyone apart from the patient or people responsible for the patient, so too would it be unethical for a psychologist to reveal information discussed in a counselling session or the results of a psychological test to anyone apart from the client (or the guardians of the client if the client is a child or under a guardian's care).

Ethical standards and considerations also apply to any type of research or data collection method involving people (or animals). These help ensure that the wellbeing and rights of research participants are respected and protected before, during and following their involvement in the research. In addition, ethical standards help prevent unnecessary research and promote research that is or will be of benefit to the wider community or humankind in general.

The Australian Psychological Society (APS) has a *Code Of Ethics* (2007) which provides standards and guidelines for all psychological research (and other areas of professional practice). The *Code of Ethics* has been devised with reference to a national set of standards and guidelines in a document called the *National Statement on Ethical Conduct in Human Research 2007*. This document is simply referred to as the National Statement. The National Statement is regularly updated, with the May 2015 version incorporating most updates.

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Figure 1.92 Ethical standards for human research ensure all participants are given the respect and protection due to them, irrespective of who they are.

National Statement on Ethical Conduct in Human Research

The National Statement has been jointly developed by the National Health and Medical Research Council (NHMRC), the Australian Research Council and the Australian Vice-Chancellors' Committee. The NHMRC is the Australian Government's expert body for providing advice on research.

The purpose of the National Statement is to 'promote ethically good human research'. It is organised around four values — research merit and integrity, beneficence, justice and respect for human rights. The design, review and conduct of all research with people as the participants must reflect each of these values.

1. **Research merit and integrity**: Research that has *merit* is worthwhile and conducted in an appropriate way to achieve the aims. It has the potential to contribute to knowledge and understanding, and to improve social welfare and individual wellbeing. It must be properly designed and undertaken by people with suitable expertise.

   Integrity generally refers to honesty and 'doing the right thing'. Research that is conducted with *integrity* is carried out with a commitment to the search for knowledge and understanding, to following recognised principles for conducting research and to the honest conduct of research, including accurate and responsible reporting of findings, whether the results are favourable or unfavourable.
2. **Beneficence**: Research beneficence refers to the likely *benefits* to participants or the wider community. The researcher must consider and maximise all possible good outcomes while minimising the risks of harm to participants and to the community in general. The potential benefits must justify any risk or harm or discomfort to participants.
3. **Justice**: Justice involves fairness. Research that is *just* has a concern for the use of fair procedures and fair distribution of the costs and benefits of the investigation. The process of recruiting and selecting participants should be fair so a researcher must avoid imposing on particular groups an unfair burden of participation in their research. Similarly, the benefits of the research should be distributed fairly between the participants and the wider community.
4. **Respect for human beings**: This involves recognition that each human being has value in himself or herself. *Respect* is demonstrated when the researcher recognises and takes account of the rights, beliefs, perceptions and cultural backgrounds of all participants. In particular, all participants have the rights to privacy, confidentiality and to make informed decisions about matters that affect them. People must be protected and empowered if they are vulnerable or their capacity to make informed decisions is impaired; for example, children and people with an intellectual disability who depend on others.

All four values apply to all research conducted with or about people, including experiments, questionnaires, interviews, observational studies, psychological testing or treatment and analysis of personal documents or other materials with information about participants.

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Weblinks
- National Statement
- APS Code of Ethics

Figure 1.93 All psychological research with human participants must follow the guidelines in the *National Statement*. The guidelines in the *APS Code of Ethics* are consistent with those in the *National Statement*.

Role of ethics committees

The National Statement requires that all research that carries more than a low level of risk to human participants must first be reviewed and approved by an ethics committee. This type of committee is formally called a *Human Research Ethics Committee* (*HREC*).

A HREC has a minimum of eight members, with a mix of researchers and non-researchers (including community members). Its main purpose is to assess research proposals for approval purposes, and then monitor the conduct of the research (if approved) to ensure all relevant ethical standards are adopted and followed.

Generally, the roles and responsibilities of the HREC include:

- deciding whether a research proposal meets all the requirements of the National Statement and is therefore ethically acceptable
- deciding whether the researcher(s) is adequately experienced and qualified (or the researcher is supervised by a qualified person if there are concerns about their experience and qualifications)
- monitoring approved research (e.g. through progress reports, random inspections of research sites, interviews with participants)
- handling complaints (e.g. from participants, the wider community)
- ensuring accountability of the researcher (e.g. the researcher understands, accepts and maintains responsibility for all aspects of their research).

If the committee is satisfied that all ethical questions and issues raised by the research have been dealt with satisfactorily, approval will be given for the research to proceed. If the committee has concerns about some aspects, it can highlight these and return the proposal to the researcher so the concerns can be addressed, possibly with suggestions on how. If the proposal has ethical issues that cannot be addressed, then the research will not be allowed to proceed.

HRECs are usually established by organisations (public, not-for-profit or private) which conduct a considerable amount of research involving humans. Universities and hospitals are the most common of these organisations. Not all organisations which conduct human research, however, have their own HREC. Some organisations and individual researchers use the services of a HREC within another organisation (NHMRC, 2007).

Human research considered to be at a low level of risk, where the only foreseeable risk is one of discomfort, does not have to be submitted to a HREC. In such cases, a research proposal may be reviewed by 'a competent person or group' familiar with the National Statement and other relevant ethical standards.

The NHMRC also requires the use of ethics committees for research involving animals. These are called *Animal Ethics Committees* (*AECs*) and members have roles and responsibilities similar to those of HRECs.

Figure 1.94 Human research ethics committees are established to review research proposals for approval purposes, and then monitor the conduct of the research to ensure all relevant ethical guidelines are adopted and followed. Review meetings are usually informal.

Australian Privacy Principles

The *Privacy Act 1988* is an Australian law which regulates the handling of personal information about individuals. This includes the collection, use, storage and disclosure of personal information, and access to and correction of that information.

Personal information is information or an opinion about any individual who can be identified; for example, information about someone's racial or ethnic origin, health, genetics, political opinions, religious beliefs and sexual orientation or practices (Office of The Australian Information Commissioner, 2017).

The Privacy Act includes 13 *Australian Privacy Principles* (APPs) which set out standards, rights and obligations for the handling of personal information, some of which apply to psychology research. The APPs include requirements such as:

- *Open and transparent information management* — how personal information will be handled must be clearly expressed and made available
- *Anonymity* — ensure individual participants cannot be personally identified
- *Data collection* — collect personal information only if necessary; ensure informed consent
- *Data use* — use only for the purposes specified
- *Data quality* — ensure information is accurate, complete and up to date
- *Data security* — protect the information (e.g. from loss or unauthorised access) and destroy or permanently de-identify personal information if no longer needed.

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Weblink
Australian Privacy Principles

Role of the experimenter

The experimenter (or researcher) must ensure their research is ethically appropriate so that participants are given the respect and protection that is due to them. They must observe ethical guidelines, codes or legislation such as the National Statement, the APS *Code of Ethics* and the *Privacy Act*. These will help them to meet their responsibilities to identify and properly address all ethical issues (APS, 2007; NHMRC, 2007).

Protection and security of participants' information

The researcher must ensure that personal information is secure (kept safely) and protected from

- misuse, interference and loss; and
- unauthorised access, modification or disclosure.

In addition, the researcher must make provisions for maintaining confidentiality in the collection, recording, accessing, storage, dissemination and disposal of personal information. If personal information about an individual is no longer needed, then the information should be destroyed or de-identified.

Confidentiality

Confidentiality refers to the obligation of the researcher (or anyone else) not to use or disclose private information for any purpose other than that for which it was given to them. Participants have a right to privacy, so the researcher must avoid undue invasion of privacy by collecting only information that is needed. In addition, any information that may identify an individual or their involvement in research, such as personal data or test results, cannot be revealed unless consent has been obtained.

The right to privacy and procedures for establishing and maintaining confidentiality must be explained to participants before the study commences. As stated previously, the confidentiality requirement applies to the collection, recording, accessing, storage, dissemination and disposal of personal information.

Voluntary participation

The researcher must ensure participants voluntarily consent to be involved in a study. For example, participants must not be forced or pressured to take part in a study. The researcher must also ensure that prospective participants do not experience negative consequences if they choose not to be involved in a study.

Withdrawal rights

Participants have an unconditional right to opt out of a study at any time without giving a reason for doing so. This includes withdrawing their data after the study is finished regardless of the effect this may have on the overall results. Withdrawal rights must be explained to participants before the study commences and the researcher must ensure that participants suffer no negative consequences as a result of withdrawing from the study.

Informed consent procedures

Consent is a voluntary choice for participants and must be based on sufficient information and adequate understanding of both the proposed research and the consequences of participation in it. In order for this to be achieved, information should be given about the purpose, methods, demands, risks and potential benefits of the research.

This information must be presented in ways suitable for each participant; for example, it should be in plain language (with the least possible technical jargon) and the researcher should take account of personal characteristics such as age, educational background, cultural background and any other possible barriers to understanding the information (such as intellectual or mental health status). There should be an opportunity for prospective participants to ask questions about the research.

It is essential that participants have the competence to give informed consent. A wide variety of symptoms, diseases, injuries and other conditions can affect a person's ability to understand information and researchers must take this into account when seeking informed consent and providing documents or information relevant to informed consent.

For participants who are legally unable to give informed consent (e.g. children and people impaired by an intellectual disability), the researcher must obtain appropriate consent from the persons who are legally responsible for participants' wellbeing (i.e. parent or guardian).

Consent may be expressed orally, in writing or by some other means that indicates consent (e.g. return of a questionnaire), depending on: (a) the nature, complexity and level of risk of the research; and (b) the participant's personal and cultural circumstances.

Often, researchers obtain informed consent using a document like that in Figure 1.96 on the next page. Two copies are made so that one can be kept by the researcher and one by the participant.

There are specific ethical issues associated with informed consent for mental health research. These are examined in Chapter 11.

Use of deception

Deception occurs when participants are deliberately misled or not fully informed about the aim or some other aspect of the research. This is sometimes necessary to avoid unduly influencing their responses during the study and consequently the accuracy of the results.

By its nature, deception violates the ethical requirement of informed consent. Its use also means that the relationship between the researcher and participant is not open and honest. However, deception is considered acceptable if the potential benefits of the research justify its use and there is no feasible alternative to its use.

Whenever deception is used, it is essential that all participants are debriefed at the conclusion of the study.

Debriefing

Debriefing involves clarifying each participant's understanding of the nature of the research as soon as possible after it has been conducted. This includes explaining the true purpose of the research and why it was necessary to deceive them if deception was used, correcting any mistaken ideas and impressions participants may have, and providing an opportunity for questions about any aspect of the study, including the need for deception.

Another important requirement of debriefing is to check the wellbeing of each participant and address any harm that may have resulted from their participation in the study; for example, providing information about counselling services and how to access them to help treat any distress resulting from the study. In extreme cases, participant wellbeing may be monitored after the research; for example, participants may receive questionnaires, be asked to complete diaries, and/or have follow-up meetings with a researcher.

Figure 1.95 The researcher is responsible for the proper ethical conduct of their investigation.

SAMPLE ONLY

CONSENT FORM TO PARTICIPATE IN RESEARCH

TITLE OF RESEARCH: .....

DESCRIPTION OF RESEARCH: Insert an outline of the research and other relevant information. Include:

- aim/purpose/reasons for the investigation
- method used to collect data
- how the data will be analysed, described and presented
- what the participants will need to do and time commitment
- how confidentiality will be maintained
- whether the participant will have a chance to see and comment on the final report
- what will happen to the final report
- who will read the report and have access to it
- withdrawal right
- name(s) of researcher(s), supervisor/teacher and school
- status of the researcher(s).

I, ..., give my informed consent to taking part in the research investigation described above. I understand my rights as a participant in this research. The aim and procedures of the study have been explained to me and I understand them.

[*Where deception is used a clause such as the following should be included.*]
I understand that it is sometimes essential for the validity of research results not to reveal the true purpose of the research to participants. If this occurs, I understand that I will be debriefed as soon as is possible after my participation and, at that time, given the opportunity to withdraw from the research and have records of my participation deleted.

I have been advised the results of the research will be presented in a formal written report but that my personal details will remain confidential.

I voluntarily consent to participate but I understand that I may discontinue participation from the study at any time without giving a reason.

If I have any questions, comments or complaints to make on this research, I can contact [*insert the researcher's name and/or the Psychology teacher's name*] at [*insert the researcher's and/or the Psychology teacher's contact details, including phone number(s)*].

Name of Participant: .....

Signature: .....

Name of Researcher: .....

Signature: .....

Date: .....

Figure 1.96 An example of a document for obtaining written consent to participate in research. Researchers often separate the study information from the consent form by using two separate documents — an Information Sheet and a Consent Form. In addition, a copy of the signed consent form is often given to the participant.

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Weblinks
Templates for psychology research consent forms

BOX 1.29 Ethical practices and conduct in VCE Psychology

The VCAA Psychology study design has advice on ethical conduct that must be followed by VCE Psychology students and teachers. This advice includes the following:

Ethical conduct of experimental investigations

As part of this study teachers and students will be involved in teaching and learning activities that include experimental investigations using human subjects. Teachers and schools have a legal and moral responsibility to ensure that students follow ethical principles at all times when undertaking such investigations. Teachers should refer to the following documents for detailed advice:

- the National Statement on Ethical Conduct in Human Research (2007), issued by the National Health and Medical Research Council (NHMRC) in accordance with the *NHMRC Act 1992* (Cwlth), www.nhmrc.gov.au/publications/synopses/e72syn.htm
- the National Privacy Principles in the *Privacy Amendment (Private Sector) Act 2000* (Cwlth), www.privacy.gov.au/
- the Code of Ethics of the Australian Psychological Society (APS), www.psychology.org.au.

It is not expected that animals will be used in the teaching of this study. If using animals in teaching, schools must comply with the current legislation including:

- the *Prevention of Cruelty to Animals Act 1986* and its Regulations 2008
- the *Australian Code of Practice for the Care and Use of Animals for Scientific Purposes 2014* (8th edition), www.nhmrc.gov.au/guidelines/publications/ea28

Safety and wellbeing

This study may include potentially sensitive topics. Teachers should ensure that students have opportunities to consider topics systematically and objectively, and to become aware of the diversity of views held on such matters. Students should not be asked to disclose personal information about their own or others' health status and behaviours.

When dealing with sensitive mental health matters, students should be specifically advised that they are neither trained nor equipped to diagnose problems or offer any counselling or therapy. Students should be given information as appropriate about sourcing available treatment services within and outside school.

As part of this study teachers and students may consider different psychological assessments, including standardised psychological tests which are designed to be administered only by trained psychologists. Teachers must limit access to such tests and ensure that students understand that such tests should only be administered by a qualified psychologist.

It is the responsibility of the school to ensure that duty of care is exercised in relation to the health and safety of all students undertaking the study. Teachers and students should observe appropriate safety precautions when undertaking practical work. All laboratory work should be supervised by the teacher. It is the responsibility of schools to ensure that they comply with health and safety requirements.

Relevant acts and regulations include:

- *Occupational Health and Safety Act 2004*
- *Occupational Health and Safety Regulations 2007*
- *Occupational Health and Safety Management Systems (AS/NZ 4801)*
- *Dangerous Goods (Storage and Handling) Regulations 2012*
- *Dangerous Goods Storage and Handling Code of Practice 2000*
- *Hazardous Substances Code of Practice 2000*
- *Electrical Safety Act 1998*

Legislative compliance

When collecting and using information, the provisions of privacy and copyright legislation, such as the Victorian *Privacy and Data Protection Act 2014* and *Health Records Act 2001*, and the federal *Privacy Act 1988* and *Copyright Act 1968*, must be met.

Source: © VCAA, *VCE Psychology Study Design* (June 2017 update), pp. 8–9.

USE OF ANIMALS IN PSYCHOLOGICAL RESEARCH

Although psychology is primarily interested in people, about 7–8% of psychological research involves the use of animals. About 90% of the animals used have been rodents and birds, mostly rats, mice and pigeons. About 5% of the animals are monkeys and other primates. Use of dogs and cats is rare (American Psychological Association [APA], 2017a).

Research with animals has and continues to have an important role in psychology. Discoveries through animal research have advanced understanding of human behaviour and mental processes in a diverse range of areas; for example, behavioural and bodily changes that occur when stressed; the role of the brain in behaviour; basic learning processes; the neurobiology of learning and memory; processes of recovery after neural damage; brain plasticity; mechanisms that control hunger and thirst; behavioural and psychological effects of medications used in the treatment of various mental disorders; addiction to illegal drugs; how the senses function and physiological influences on perception; the critical role of early experience in development; attachment; aggression; emotion and cognition (APA, 2017a; Bennett, 2012; Puente, 2017).

The main reasons animals are used in psychological research to achieve the kinds of benefits described previously are:

- Some studies cannot be conducted with humans due to the risk of psychological and/or physical harm that may be caused, or because suitable human participants are unavailable. Various examples are included throughout this text.

Figure 1.97 Animals are used in a wide variety of psychological research studies. Research with animals is governed by NHMRC ethical guidelines.

- Bodily systems and/or behaviours of some animals are similar to those of humans; therefore, using animals can be a 'starting point' for learning more about human behaviour.
- Animals have practical advantages over people for use as research participants. For example, studying the effects of ageing from birth through to 'old age' is not generally practical in humans because most people live more than 75 years, compared with rats which have an average life expectancy of two years, or many species of monkeys which live for 15–20 years. Another advantage is that some animal species breed a lot faster than humans. For instance, rats produce a new generation every three months and can be used to study the development of certain behaviours over successive generations within a relatively short period of time. Animals can also be kept for long periods of time in captivity in laboratories and it is easier to observe their behaviour under these conditions.
- The behaviour of animals can usually be controlled to an extent not possible with human participants. For example, a rat can be raised from birth in a cage. The rat can then be used in a learning experiment and the researcher will have a good idea of what it has already learned before the experiment is conducted.
- When certain experiments require large numbers of participants who have, for example, the same genetic background, animals are more easily obtained than humans.

- Participant expectations can influence the results of an experiment; however, animals don't usually have expectations and they are not able to guess the purpose of an experiment.

Many arguments have been presented against the use of animals in psychological research. One argument is that it is not possible to generalise the results of animal studies to humans because the species are not the same even though there may appear to be similarities. An issue for researchers is how far they can generalise about human mental experiences and behaviour from the results of animal studies. If laboratory animals die after prolonged sleep loss, would humans? If a drug causes a brain disorder in animals, should it be banned for human use? Another argument is that humans should respect animals and protect them from harm rather than use them in research. It is also suggested that humans do not have the right to dominate other species.

In order to ensure that all reasonable steps are taken to minimise the discomfort, illness and pain to animals used in research, ethical standards and guidelines have also been established for the use of animals in research. The use and care of laboratory animals must be directly supervised by a person competent to ensure their comfort, health and humane treatment. The care and use of animals in research must follow the NHMRC *Australian Code for the Care and Use of Animals for Scientific Purposes 2013 (8th ed)*.

The purpose of the Code is 'to promote the ethical, humane and responsible care and use of animals for scientific purposes'. An obligation to respect animals is central in the Code. According to the Code (p.1), 'This obligation brings with it a responsibility to ensure that the care and use of animals for scientific purposes is ethically acceptable, balancing whether the potential effects on the wellbeing of the animals involved is justified by the potential benefits to humans, animals or the environment. The use of animals for scientific purposes must have scientific or educational merit; must aim to benefit humans, animals or the environment; and must be conducted with integrity. When animals are used, the number of animals involved must be minimised, the wellbeing of the animals must be supported, and harm, including pain and distress, in those animals must be avoided or minimised.'

Figure 1.98 Psychologists must ensure that research animals are well cared for, humanely treated and experience minimal pain and suffering.

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Weblink
NHMRC Code for care and use of animals

Figure 1.99 Although many important benefits have been achieved through animal research and that there are ethical obligations for their care and use, many people remain vigorously opposed to all animal research. This Animal Liberation Victoria activist covered herself in fake blood and strapped herself to a giant vivisection board as part of three days of protest at an international animal research conference held in Melbourne. Undoubtedly, the use of animals in research has been, and continues to be, a highly charged, controversial issue.

LEARNING ACTIVITY 1.37

Review questions

1. Explain the meaning of ethics in relation to research.
2. What is the main purpose of ethical standards for research with human participants?
3. (a) Name and describe the four values that should be reflected in all human research.
   (b) Give an example of a research practice that would be:
   (i) consistent with each value
   (ii) inconsistent with each value.
4. What are three essential informed consent procedures?
5. What is the ethical responsibility of a researcher who does not want to fully inform prospective participants of the true purpose of an experiment because it may influence how they respond during the study?
6. If a participant became very upset during an experiment, what is the responsibility of the researcher?
7. Explain what privacy is and the ethical relevance of the Australian Privacy Principles.
8. (a) What is an ethics committee?
   (b) List three of its roles or responsibilities.
9. Give two advantages and limitations of animal use in psychological research.
10. List three ethical guidelines to be followed for research with animals.
11. Construct a table that summarises the ethical standards and guidelines for conducting human research. Use the table to develop an ethics checklist that could be used for your practical activities and research investigation in Units 3 and 4.

LEARNING ACTIVITY 1.38

eBook*plus*
Word copy of table

Applying ethical values

Which ethical research value — *research merit and integrity*, *beneficence*, *justice* or *respect for human beings* — is relevant to each of the following statements?

	Statement	Ethical value
1.	The process of recruiting participants is fair.	
2.	The researcher ensures all members of the research team are properly qualified to undertake their respective responsibilities.	
3.	The participant is given a chance to have their questions about the research answered.	
4.	The researcher does not unnecessarily invade privacy.	
5.	The researcher is confident that what will be learnt from their study justifies the risks of discomfort to participants.	
6.	The researcher is based on a thorough study of the current literature, as well as previous studies.	
7.	Where there are no likely benefits to participants, the risk to participants should be lower than would be ethically acceptable where there are such likely benefits.	
8.	There is no exploitation of participants in the conduct of research.	
9.	There is due regard for the customs and cultural heritage of all individual participants.	
10.	Research outcomes are made accessible to participants in a way that is timely and clear.	

LEARNING ACTIVITY 1.39

Identifying ethical issues

Consider the following fictitious examples of research studies that may breach one or more ethical standards or guidelines and identify the ethical issue(s) raised, if any, in each example.

Study 1
A psychology lecturer at a university was studying techniques for reducing fear of spiders. He asked a research assistant to telephone students in the first-year psychology course he was teaching to determine their willingness to participate. The researcher was unaware that the assistant told participants that they had to participate.

Study 2
A researcher was interested in factors influencing cheating. She gave participants an exam, then collected and photocopied their answers. The participants were not informed about the photocopying. The answers were returned unmarked and the participants were given the opportunity to cheat while marking their own papers. The answers were collected again and compared with the photocopies.

Study 3
Another researcher investigated cheating by concealing themself and three colleagues in a projection booth in an auditorium during an exam. From this vantage point, high above all students, the researchers used binoculars to observe cheating behaviours of students in different quadrants of the room. Each observer used a checklist to record inappropriate head movements, exam paper switching, note checking, note passing and other suspicious exam behaviours within the quadrants.

Study 4
An experiment was conducted to assess driver reaction to a stressful situation. Each participant was asked to drive a car past a construction site. The researcher rigged a human-looking dummy in such a way that it would be propelled in front of the car, making it impossible for the participant to avoid hitting it. The participants reacted as expected. When they learned that the situation was faked, they informed the researcher of their displeasure. Despite their complaints, the researcher continued testing further participants (adapted from Wood, 1981).

Study 5
A VCE Psychology student was required to undertake a research investigation to satisfy the course requirements. The student researcher replicated an experiment on learning that involved classical conditioning of an eye-blink response using two preschool children and two adults as participants. The student researcher thought that the adult participants' knowledge of the conditioning procedure would affect the results in an unwanted way and decided not to seek their informed consent. The student researcher also based their decision on the belief that the conditioning procedure was physically and psychologically harmless. The student researcher did, however, obtain informed written consent from both parents of each child.

Study 6
A researcher conducted an observational study to investigate behaviour in public rest rooms. This research method was expected to obtain more valid and reliable data than could be accessed through a self-report measure. A team of male and female researchers concealed themselves in vacant toilet stalls of the respective restrooms and observed behaviours of men and women (adults only), such as flushing vs non-flushing, hand washing vs hand drying, mirror checking, clothing adjustments, littering and graffiti writing.

LEARNING ACTIVITY 1.40

Reflection

Comment on whether the potential benefits of using non-human animals in psychological research justify their use. Does this apply to all types of research or only those studies for which there is a risk of harm? Only certain animal species? When should and should not animals be used in psychological research, if at all?

REPORTING CONVENTIONS

The final and very important stage in the research process involves preparation of a detailed written report on the research study and its findings. This is done for two main reasons:

- to communicate or 'share' the results with others, particularly other researchers interested in what was studied, and
- to enable replication of the study to test the validity and reliability of its results.

Generally a written report provides a detailed description of the study and its findings. The written report has two important characteristics:

- there is enough information to enable close examination of all stages of the research (including the results) and, if required, to replicate the research
- reporting conventions are used.

Reporting conventions are well-established and widely recognised standards for how a report is written and presented. Reporting conventions

determine aspects of the report such as writing style, structure of the report, headings, presentation of tables and graphs, and formats for referencing.

For example, the writing style, or language, used in a psychological research report is like that of all scientific reports. The language is formal, clear and concise. It is written in the past tense, in the third person and using the passive voice. Appropriate phrases that meet these language standards are:

- 'An experiment was conducted to test . . . '
- 'Each participant was . . . '
- 'The results show . . . '
- 'It can be concluded that . . . '.

Scientific reports are *not* written using the first person; for example, 'I did . . . ', 'We asked . . . ', 'In my opinion . . . ', 'I believe that . . . ', ' . . . and then we asked the participants to . . . '.

Conventions for psychological research reports are based on those described in the *Publication Manual of the American Psychological Association, Sixth Edition* (2010). This manual, commonly called the 'APA manual' and its conventions are commonly referred to as 'APA format'.

The APA format is widely recognised and used by psychological researchers throughout the world to guide their preparation and presentation of written and poster reports. These conventions are also used by psychology students for writing research reports conducted as part of their university studies. VCAA does not mandate specific reporting conventions for VCE Psychology.

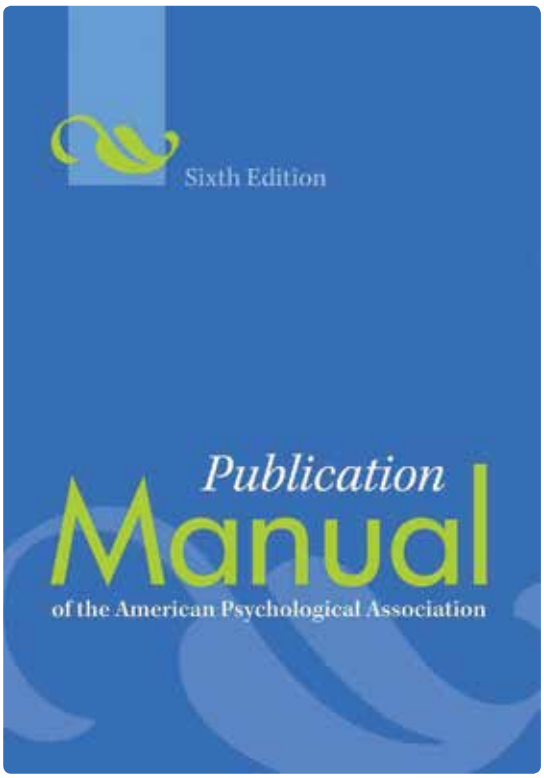

Figure 1.100 The cover of the APA manual

The following guidelines for writing a research report and referencing are based on the APA manual. Guidelines for preparing a poster report are then outlined. The poster is less detailed and is commonly used to provide a summary of the key features of a research study for display and discussion at conferences or meetings with other psychologists likely to be interested in the research and its findings.

Written report

A standard research report is presented in sections that follow a set order. However, the structure of the report and organisation of the sections may sometimes be modified to suit a particular investigation.

Generally, the report is presented in a logical sequence that describes

- what was done
- why it was done
- how it was done
- what was found
- what the findings probably mean.

Although the different sections of the report (described below) are usually presented in the order shown, they do not have to be prepared in that order. For example, the abstract, which summarises the investigation, appears first in the report but is usually easier to write last.

Title

This should be brief (usually one sentence) and indicate clearly what the research was about e.g. 'Effect of practice on reading speed'. Quite often, researchers use a statement based on the hypothesis for a title. Words that have no useful purpose should be avoided e.g. 'An experiment on . . .'

The title should be centred and positioned in the upper half of a cover page. The author's name is written under the title and centred on the page.

Abstract

This is a brief, comprehensive summary (about 120 words) of the entire report, usually presented as a single paragraph on a separate page.

It should include a description of what was investigated (in one sentence if possible), participants (specifying relevant personal characteristics such as age and sex), the key features of the research method, the main result(s) and the conclusion(s).

Considering the nature of its contents, the abstract is best written last.

Introduction

This section gives the background to the research. It often summarises theory and results of other relevant research. If you are unable to find background information, or it is not required by your teacher, then you should explain the rationale ('reasoning') for conducting the research.

The introduction is often written in a way that leads the reader to a statement of the aim of the research and the hypothesis that was tested. The hypothesis is usually included in the last paragraph of the introduction and should be expressed as a specific statement which, for an experiment, usually refers to the independent and dependent variables (but not necessarily operationalised).

In formal journal articles, the introduction does not have a heading because it is clearly identified by its position in a report.

Method

This section clearly describes how the research was conducted. There should be enough details for the reader to know exactly what was done so that the research could be replicated exactly in order to test the results.

The method is often divided into three sub-sections, each with the relevant heading — participants, measures and procedure.

Participants

Includes details on how many participants were used, important characteristics that might have influenced the results (such as age, sex, educational background), the population (i.e. the larger group) from which they were drawn, and how the participants were selected (i.e. the sampling procedure) and allocated to groups. Details of the participants are often presented as a table.

Measures

Describes the test or other means used to collect data. A description of any questionnaire, observation checklist, test items, word lists and so on which were used in conducting the research should be included. For example, you may state that a 10-item questionnaire was used to measure attitudes towards violence in cartoons. Any evidence of the measure's validity and reliability should also be stated. Examples or more detailed information about any measure should be included in an appendix at the end of the report.

Procedure

This is a detailed description of the research method and design. This information should be presented in a way that another researcher could conduct the same study just by reading your description.

Relevant information may include the roles of the researcher, how participants were recruited, whether they were placed into groups or whether this was achieved by using random allocation, what participants were asked to do, the setting and duration and so on.

Results

This section has a summary of the main results. There should be sufficient detail to justify the conclusion(s). All results should be accurate and displayed clearly. Tables, graphs, charts and other figures are used, depending on what suits the type of data collected. The reader should be able to understand any table or figure without referring to another section of the report.

Only summary data should be presented in the results section. If relevant, raw data could be included in an appendix. Detailed comments on the results are included in the discussion.

Discussion

This is where the results are examined, interpreted and explained, especially with reference to the hypothesis. It is also where you draw conclusions from the results.

The section usually starts with a clear statement about whether the research hypothesis is supported or refuted on the basis of the results obtained. If the results do not support the hypothesis, then an explanation is given.

The general relevance of the results to the population from which the sample was drawn, and similarities and differences between the results and theory or other research (referred to in the introduction), is also described in this section.

In drawing conclusions, the researcher also, considers and explains sources of potential bias and other limitations or weaknesses of the research. Then, they suggest ways of effectively addressing these if the study were to be replicated.

Finally, the practical applications of the findings to the real world are considered. Often, this section ends with suggestions for future research.

References

This section has a list of all sources cited in the report (but no others). Every quotation or summary of information from another source which is used in the report must be substantiated with a reference.

The list of references should be presented in alphabetical order based on the surname of the first named author of a source. The formats for referencing in psychology are described in Box 1.30 on the next page.

Appendices (if any)

This is where materials which do not fit into the other sections of the report and are easily presented in print format are placed. There should be a different appendix for each set or category of materials. Each appendix should be numbered and have a title (e.g. *Appendix 1*. Test items for visual perception skills) and be presented on a separate page.

Materials included in an appendix should be referred to in the body of the report (e.g., Test items for visual perception skills (see Appendix 1)).

Poster report

A poster is another format for reporting research. In psychology, it is most commonly used for display and discussion at a meeting or conference. It may also be used for reporting research conducted by students in psychology courses.

Poster formats and their specific headers can vary. Generally, a well-constructed poster is less detailed than the written report, covers the key features of the research and is self-explanatory.

The VCE Psychology study design (p. 13) includes a VCAA template ('format') to guide the headings, organisation and content of a poster report, shown below. More comprehensive information about the poster is available in the VCE Advice for teachers: Psychology digital document at the VCAA website.

In Unit 4, there is a SAC requiring a student-directed practical investigation and the VCAA poster template must be used for the report. The poster may be produced electronically or in hard copy and should not exceed 1000 words. The production quality of the poster is not assessed. Scientific poster templates available on the internet may be used provided that the mandated poster sections (Title, Introduction, Methodology, Results, Discussion, Conclusion, References and Acknowledgments) are included.

Section	Content and activities
Title	Question under investigation is the title
Introduction	Explanation or reason for undertaking the investigation, including a clear aim, a hypothesis and/or prediction and relevant background psychological concepts
Methodology	Summary that outlines the methodology used in the investigation and is authenticated by logbook entries
	Identification and management of relevant risks, including the relevant health, safety and ethical guidelines followed in the investigation
Results	Presentation of collected data/evidence in appropriate format to illustrate trends, patterns and/or relationships
Discussion	Analysis and evaluation of primary data
	Identification of outliers and their subsequent treatment
	Identification of limitations in data and methods, and suggested improvements
	Linking of results to relevant psychological concepts
Conclusion	Conclusion that provides a response to the question
References and acknowledgements	Referencing and acknowledgement of all quotations and sourced content as they appear in the poster

Source: © VCAA, *VCE Psychology Study Design* (June 2017 update), p.13.

BOX 1.30 Referencing in psychology

The APA manual also describes conventions for citing and referencing sources of information used in a research report, essay or other psychological document. The conventions described in the APA manual are based on referencing styles commonly known as the 'author–date' or 'Harvard'. There are numerous examples of the APA method within this text and in the references at the back.

Citations

Whenever another source is used to present evidence, give an example, develop an argument and so on, the source must be cited. This procedure helps the reader distinguish between your 'ideas' and 'work' and those of another person(s).

When writing a research report or essay, it is sometimes necessary to cite within a sentence, and at other times at the end of a sentence (or paragraph).

Examples of how this is done are:

Within a sentence

One author: In a study by Smith (2011), participants were required…

Two authors: A similar result was reported by Voulos and Jones (2014), who found that…

Three to five authors: List all authors (separate the names with commas) and publication date e.g. Black, White, and Grey (2015) studied the effects of…

Six or more authors: First author + et al. + date e.g. According to Hemming et al. (2016), the frontal lobes…

Note that 'et al.' is a short form of 'et alia', which is Latin for 'and others'. In this text we prefer to use et al. for citations from journal articles or texts with four or more authors.

(continued)

(continued from previous page)

At the end of a sentence

One author: Participants who are rewarded are more likely to repeat the response for which they are rewarded (Canasta, 2010).

Two authors: When individuals are anxious they tend to seek the company of other people (James & Mahir, 2012).

Three to five authors: The human stress response has physiological and psychological components (Stavros, Wilson & Pink, 2015).

Six or more authors: . . . therefore, the amygdala has a crucial role in emotion (Hemming et al., 2016).

Citing a reference within another source

Sometimes you need to cite a source that was referred to by another author; for example, when you read about a study or research finding that was summarised and cited in a textbook. In this case, you would cite the source as follows:

Watson (as cited in Jackson, 2012, p. 142) was concerned about . . .

Quoting from a source

If you copy (word-for-word) information from another source instead of summarising the information using your own words, you should use quotation marks at the start and end of the quotation, use an ellipsis (. . .) when you omit words, and provide the reference and page number.

For example: Tanaka and Schlink (2010) explained the observation in terms of "the interaction between short-term memory and long-term memory and . . . decay of memory traces (p. 92)".

Reference list

The reference list includes all references used in compiling the report or other document. The references are presented in alphabetical order based on the surname of the first author (if there is more than one) using formats such as those in the following chart. There are some minor variations to suit VCE Psychology. Generally, the goal is to provide sufficient information about a source to enable it to be efficiently located.

Type	Format	Example
Book	1. *Author*. (Surname of author then their initials. If more than one author, all names are presented in the order they appear on the title page of the book.) 2. *Year of publication*. (Enclosed in brackets, followed by a full stop) 3. *Title of book*. (Italicised and followed by a full stop, but no full stop if there is an edition number.) 4. *Edition*. (If a second or subsequent edition, 'edition' is abbreviated, enclosed in brackets and followed by a full stop.) 5. *City of publication* (and state if city is not well known, followed by a colon) 6. *Name of publisher.* (Followed by a full stop. Omit unnecessary terms such as Publishers, Co., and Inc. Retain the words Books or Press.)	**Book with one author:** Baddeley, M. (2011). *Memory*. London: Psychology Press. **Book with two or more authors:** Red, J., & White, N. (2016). *Psychology of life*. New York: W.M. Freeman. **Book with another edition:** Grivas, J., & Letch, N. (2018). *Psychology: VCE Units 3 and 4* (7th ed.). Milton, Qld: John Wiley & Sons. **Online book:** If available only online, the URL (full http address) takes the place of the publisher location and name but it is not underlined, active or followed by a full stop e.g. Grivas, J., & Letch, N. (2018). *Psychology: VCE Units 3 and 4* (7th ed.). Retrieved from http://content.jacplus.com.au/Psychology VCE Units 3 & 4
Chapter or article in an edited book	1. *Author of chapter/article*. (Surname of the author, then their initials. If more than one author, all names are presented in the order they appear on the title of the chapter/article.) 2. *Year of publication*. (Enclosed in brackets, followed by a full stop.) 3. *Title of chapter/article.* (Not italicised, followed by a full stop and the word In.) 4. *Author of book*. (Initials of author followed by their surname and Ed. in brackets. If more than one author, all names are presented in the order they appear on the title of the chapter/article and followed by Eds. in brackets.) 5. *Title of book*. (Italicised and followed by the page numbers in brackets, then a full stop.) 6. *City of publication* (and state if city is not well known, followed by a colon.) 7. *Name of publisher.* (Followed by a full stop. Omit terms such as Publishers, Co., and Inc. Retain the words Books or Press.)	**One author:** Purpley, M. (2016). Neuroplasticity throughout the lifespan. In N.O. Dixon & S. Lim (Eds.), *Biological basis of behavior* (pp. 103–115). New York: Academic Press. **Online:** If available only online, the URL takes the place of the publisher location and name, but it is not underlined, active or followed by a full stop e.g. Purpley, M. (2016). Neuroplasticity throughout the lifespan. In N.O. Dixon & S. Lim (Eds.), *Biological basis of behavior* (pp. 103–115). Retrieved from http://store.elsevier.com/Academic-Press/IMP_5/

Type	Format	Example
Journal article	1. *Author*. (Surname of author then their initials. If more than one author, the names are presented in the order they appear in the article.) 2. *Year of publication*. (Enclosed in brackets, followed by a full stop) 3. *Title of article*. (Followed by a full stop) 4. *Title of journal*. (Underlined or italicised and followed by a comma) 5. *Volume number of journal*. (Italicised and followed by the issue number (if there is one) in brackets and not italicised, then a comma.) 6. *Page numbers*. (Followed by a full stop)	**One author:** Mandalis, D.S. (2016). Stress and athletic performance. *Australian Journal of Psychology*, *10*, 334–345. **Two or more authors:** Blackmore, A.B., & Chan, I. (2012). Memory decline and aging. *Developmental Psychology, 19* (2), 121–128.
Pamphlet/ brochure/ fact sheet	1. *Author*. (Surname of author then their initials, or the organisation name, followed by a full stop.) 2. *Year of publication*. (Enclosed in brackets, followed by a full stop.) 3. *Title (Italicised)* 4. *Type.* Identify as a pamphlet, brochure or fact sheet. (In brackets, followed by a full stop.) 5. *City of publication* (and state if city is not well known, followed by a colon) 6. *Name of publisher*. (Followed by a full stop.)	**Print copy:** SANE Australia. (2014). *Dealing with a traumatic event when you have a mental illness* (Fact sheet, 37). South Melbourne, Vic.: Author. **Online:** beyondblue. (2014).*Specific phobias* (Fact sheet). Retrieved March 23, 2017, from http://resources.beyondblue.org.au/prism/file?token=BL/0508
Newspaper or magazine article	1. *Author*. (Surname of author then their initials. If more than one author, the names are presented in the order they appear in the article.) 2. *Date of publication*. (Enclosed in brackets, with the year before the month and day, followed by a full stop) 3. *Title of newspaper/magazine*. (Italicised and followed by a comma) 4. *Page numbers*. (Followed by a full stop)	**If you know the author:** Paggio, I. (2016, July 20). Improve your memory. *The Sunday Age*, p. 11. **If you do not know the author:** Video games promote violence. (2017, January 4). *Herald Sun*, p. 6. **Online:** If accessed online, the URL takes the place of the page number/s, but it is not underlined, active or followed by a full stop e.g. Black, M. (2016, December 12). Study shows practice is beneficial. *The Age*. Retrieved from http://www.theage.com.au
Dictionary or other text reference with no author	1. *Title* (Italicised) 2. *Edition*. (If a second or subsequent edition, 'edition' is abbreviated (e.g. 2nd ed.), enclosed in brackets and followed by a full stop.) 3. *Year of publication* (Enclosed in brackets, followed by a full stop.) 4. *City of publication* (and state if city is not well known, followed by a colon) 5. *Name of publisher*. (Followed by a full stop. Omit unnecessary terms such as Publishers, Co., and Inc. Retain the words Books or Press.)	**In the reference list:** *APA dictionary of psychology* (2nd ed.). (2015). Washington, DC: American Psychology Association. **Within text citation:** The APA Dictionary of Psychology (2015, p. 65) defines . . . as . . . or . . . can be defined as . . . (APA Dictionary of Psychology (2015, p. 65). *Note capitalisation of all major words for a within text citation*.
Internet (including YouTube and Pod casts)	1. *Author*. (Surname of author then their initials, or the organisation name, followed by a full stop) 2. *Date of website publication* (If available and enclosed in brackets, followed by a full stop) 3. *Title of article*. (If specified) 4. Retrieved from 5. *When retrieved if date of publication is not available or if the material is not subject to frequent change*. (Year, month, date followed by a comma and the word from) *Otherwise, simply state* Retrieved from 6. *URL*. (Not underlined, active or followed by a full stop)	**Site when publication date is known:** mindhealthconnect. (2015). *Phobias*. Retrieved from http://www.mindhealthconnect **When publication date is not known:** Smartie, J. (n.d.). *How I felt when I saw a spider.* Retrieved 2017, January 12, from http:// XXXXXXXXX **You Tube:** Mount Sinai Hospital (2013, April 18). *Deep brain stimulation surgery to treat Parkinson's Disease at Mount Sinai Hospital* (Video file). Retrieved from https://www.youtube.com/watch?v=MEBdXbZ5CDM **Pod cast:** Hammond, C. (2010, August 11). *Case study: HM — The man who couldn't remember* (Audio podcast). Retrieved from http://www.bbc.co.uk/programmes/b00t6zqv

(continued)

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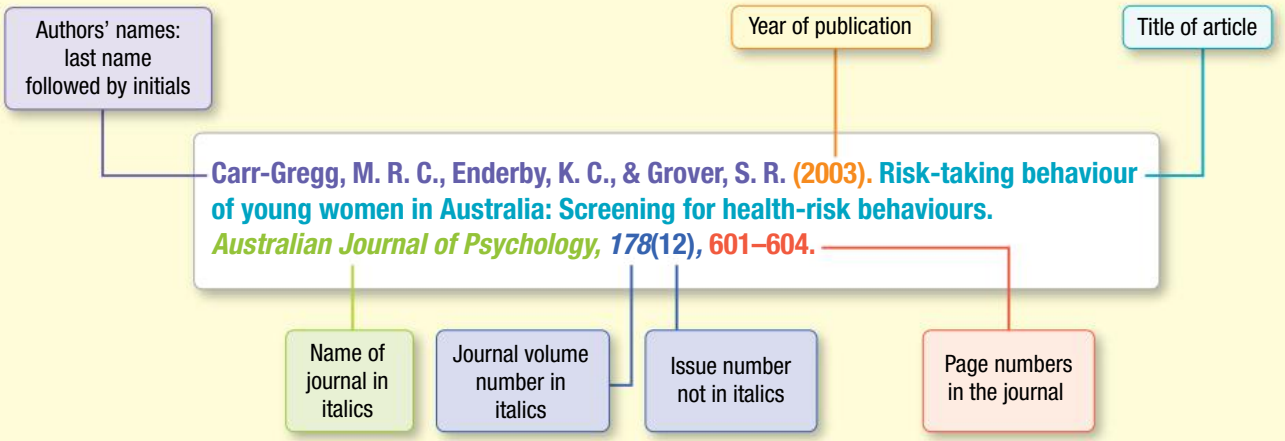
Type	Format	Example
Motion picture (movie), TV, DVD, audio	1. *Main contributors*. (Surname first, and, in brackets, the role of the main contributors, usually the director and/or writer) 2. *Year or date released*. (Enclosed in brackets and followed by a full stop) 3. *Title*. (Italicised) 4. *Type*. (Identify as a motion picture or other media type, in brackets and followed by a full stop.) 5. *Origin*. (Give the motion picture's country of origin, where it was primarily made and the name of the production company)	**Movie:** Mamin, S.A. (Producer), & Samir, M. (Director). (2010). *Old and young* (Motion picture). Australia: Billabong Productions. **TV program:** Smith, J. (Executive producer). (2016, December 12). *The 7pm project* (Television broadcast). Melbourne,Vic: Network TEN. **DVD:** Hays, P.A. (2015). *Culturally responsive cognitive behavior therapy over time* (DVD). Available from http://www.apa.org/pubs/videos/4310945.aspx
Personal communication or interview e.g. class notes and data, letters, personal interviews, telephone conversations, email	1. *Initials and surname of communicator* 2. *Type of communication* (in brackets) 3. *Date of communication* (in brackets and followed by full stop). Note: Personal communications are not included in an APA type reference list because they are usually not recoverable/accessible.	J. Smith (interview, March 12, 2017).

Example 1. Journal article (print copy)



Example 2. Website

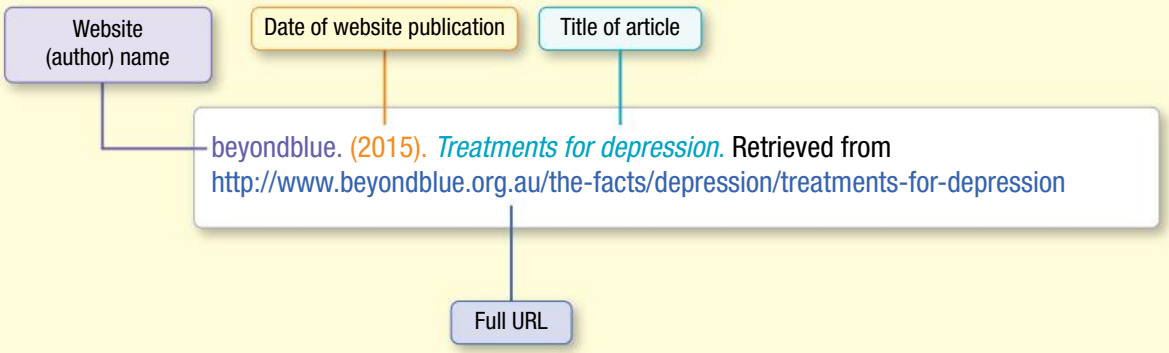
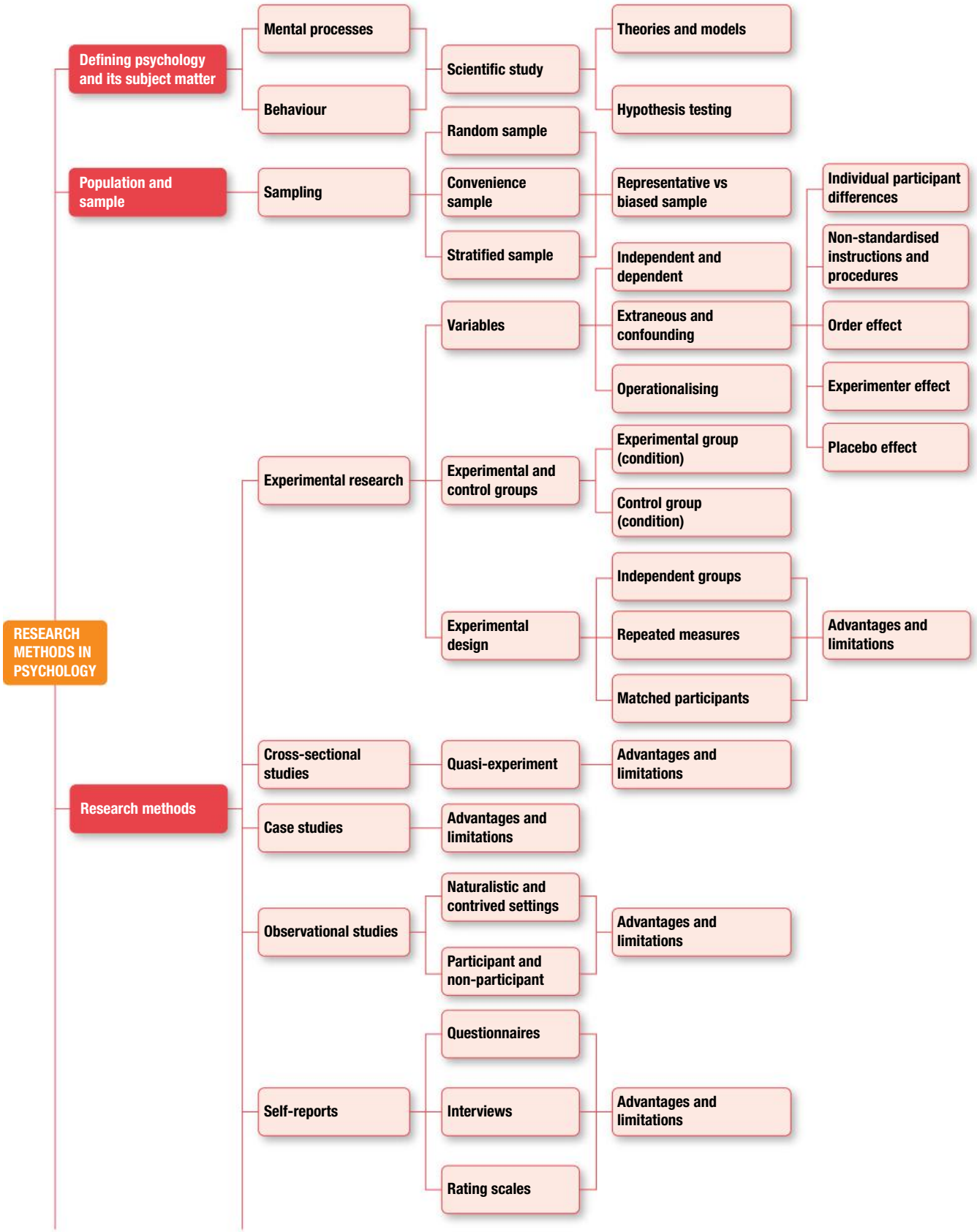


Figure 1.101 Examples of conventions used by psychological researchers for referencing. Note the use of commas, full stops and italics. Colour is used here for illustration purposes and is not a convention. Note also that researchers now include digital object identifier numbers for references that are available electronically. These have been excluded from references at the back of this text.

eGuideplus

Weblink
Digital Object Identifier (DOI) number

CHAPTER SUMMARY



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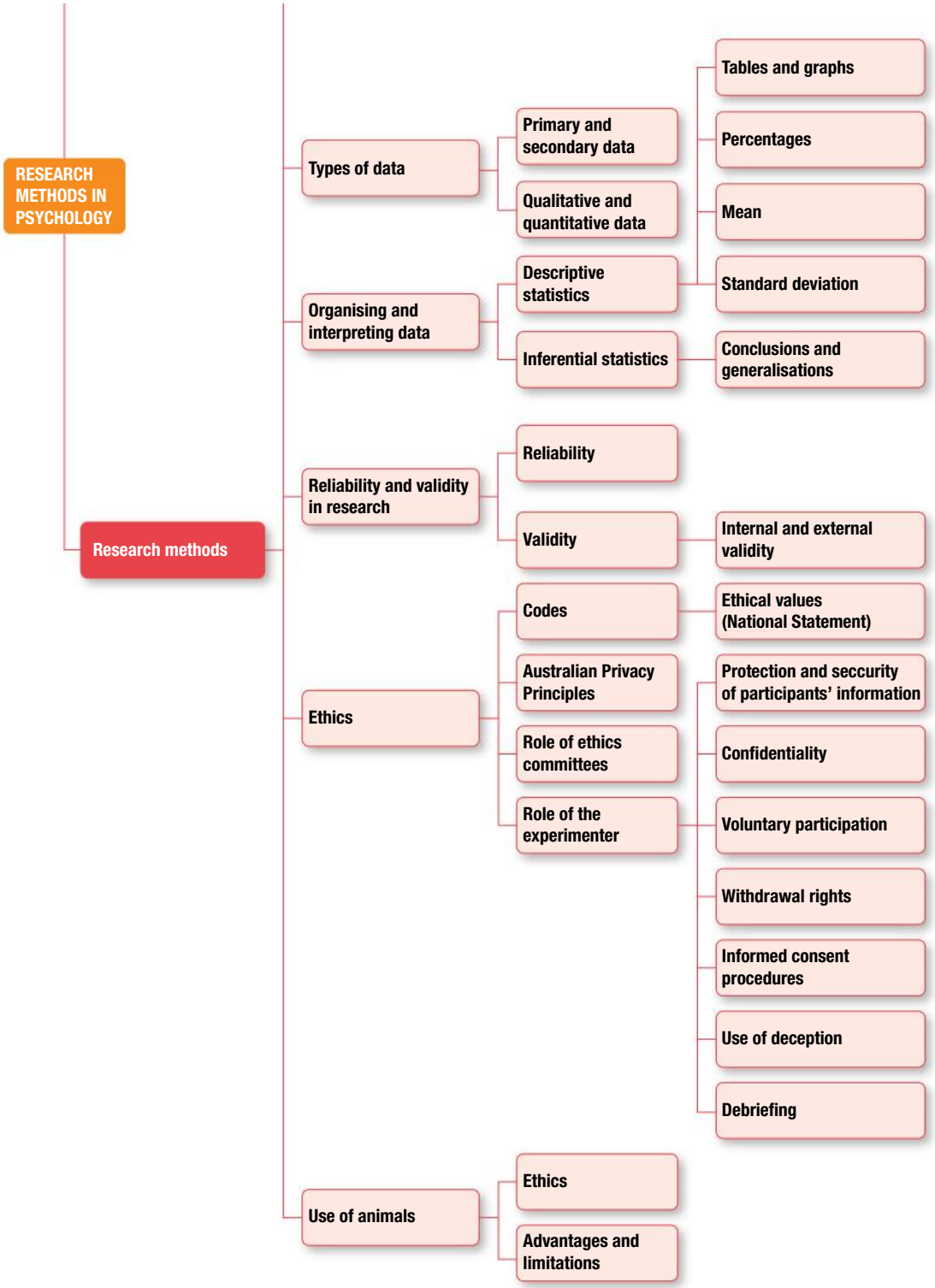

KEY TERMS

beneficence (ethics) p. 111
biased sample p. 39
case study p. 69
chance p. 103
cohort effect p. 67
conclusion p. 104
confidentiality (ethics) p. 113
confounding variable p. 24
control condition p. 22
control group p. 22
convenience sampling p. 43
counterbalancing p. 50
cross-sectional study p. 66
debriefing (ethics) p. 114
deception (in research) p. 114
dependent variable (DV) p. 19
descriptive statistic p. 94
double blind p. 51
ethics p. 110
ethics committee p. 112
experiment p. 17
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experimenter effect p. 32
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extraneous variable p. 23
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independent variable (IV) p. 18
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variable p. 17
withdrawal right (ethics) p. 113

LEARNING CHECKLIST

Complete the self-assessment checklist below, using ticks and crosses to indicate your understanding of this chapter's key knowledge (a) before and (b) after you attempt the chapter test on pages 133–39. Use the 'Comments' column to add notes about your understanding.

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Word copy of checklist

Key knowledge I need to know about research methods	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to revisit *after* chapter test	Comments
• Sample and population			
– sample vs population			
– representative vs biased sample			
– random sample			
– convenience sample			
– stratified sample			
• research hypothesis			
– key features			
– how to formulate			
• Experimental research			
– independent and dependent variables			
– operationalising variables			
– experimental and control groups (conditions)			
– random allocation			
○ procedure			
○ purpose			
– extraneous and confounding variables			
○ individual participant differences			
○ non-standardised instructions and procedures			
○ order effects			
○ experimenter effect			
○ placebo effect			
– Ways of minimising extraneous and confounding variables			
○ participant selection and allocation			
○ counterbalancing			
○ single and double blind procedures			
○ placebos			
○ standardised instructions and procedures			
○ use of an appropriate experimental research design			

Key knowledge I need to know about research methods	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to revisit *after* chapter test	Comments
• Experimental designs			
– key features			
– independent groups			
– repeated measures			
– matched participants			
– advantages and limitations			
• Cross-sectional studies			
– key features			
– advantages and limitations			
• Case studies			
– key features			
– advantages and limitations			
• Observational studies			
– key features			
– natural and contrived settings			
– participant and non-participant			
– advantages and limitations			
• Self-reports			
– key features			
– questionnaires			
– interviews			
– rating scales			
– advantages and limitations			
Types of data			
• Primary and secondary data			
• Qualitative and quantitative data			
Organising, presenting and interpreting data			
• Descriptive statistics			
– tables			
– graphs (especially graphing IV and DV)			
– percentages			
– mean			
– standard deviation			
• Inferential statistics			
• Conclusions and generalisations			

(continued)

Key knowledge I need to know about research methods	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to revisit *after* chapter test	Comments
• Reliability and validity in research			
– reliability			
– validity			
○ internal validity			
○ external validity			
• **Ethics in psychological research and reporting**			
– National Statement values			
– Australian Privacy Principles			
– Role of ethics committees			
– Role of the experimenter			
– Ethical standards			
○ protection and security of participants' information			
○ confidentiality			
○ voluntary participation			
○ withdrawal rights			
○ informed consent procedures			
○ use of deception			
○ debriefing			
• Use of animals in psychological research			
○ advantages and limitations			

studyon

Unit 3 › Area of study 1 › Topics 1–5

Concept screens and practice questions

CHAPTER 1 TEST

SECTION A — Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Question 1

Which of the following procedures is an essential feature of any type of psychological experiment?

A. random allocation
B. independent groups
C. double blind
D. counterbalancing

Question 2

A random sample of VCE students in a school could be achieved by selecting

A. every tenth student walking out of a VCE assembly.
B. all students who walk to school.
C. all students who are enrolled in three or more science studies.
D. all students whose VCE candidate number ends with an even number.

Question 3

Operationalising the variables for an experiment involves

A. strictly controlling all variables that can impact on the dependent variable.
B. defining and explaining how the independent and dependent variables will be measured.
C. deciding on the importance of all the experimental variables.
D. identifying all potential extraneous and confounding variables.

Question 4

A structured observational study will involve

A. naturalistic observations.
B. observations in a contrived setting.
C. the non-participant procedure.
D. a pre-prepared system to guide and record observations.

Question 5

In an experiment, the group that receives the treatment is called the _____ group, whereas the group that does not is called the _____ group.

A. independent; dependent
B. control; experimental
C. dependent; independent
D. experimental; control

Question 6

Random allocation and random sampling

A. are avoided by researchers as they are haphazard procedures.
B. differ in that random allocation is used to place participants in groups and random sampling is used to select participants for the research.
C. differ in that random sampling is used to place participants in groups and random allocation is used to select participants for the research.
D. are both used to select participants for an experiment.

Question 7

A matched participants experiment involves

A. allocating each member of a matched group to a different experimental condition.
B. matching participants to the experimental condition to which they will be allocated.
C. allocating each participant to the same experimental conditions.
D. randomly selecting participants, then randomly allocating to a different experimental condition.

Question 8

A researcher selects participants by randomly sampling different groups from a target population. The researcher believes that the sex and religious beliefs of participants will be influential on the results, so the researcher ensures these characteristics are proportionally represented in the sample.

This type of sampling procedure is best described as

A. biased.
B. random.
C. stratified.
D. stratified random.

Question 9

Ethical standards in psychological research are intended to ensure that

A. participants are responsible for the research.
B. participants can comment on the results whenever they want to.
C. the rights and wellbeing of the researcher are safeguarded.
D. the rights and wellbeing of participants are not compromised in any way.

Question 10

Heart rate can be an independent variable in an experiment because

A. everyone has a heart.
B. heart rate can be measured.
C. a researcher can manipulate heart rate.
D. participants can manipulate their heart rate.

Question 11

For a normal distribution, about _____ of data values lie within one standard deviation of the mean and about _____ of data values lie within two standard deviations of the mean.

A. 13%; 34%.
B. 34%; 13%.
C. 34%; 68%
D. 68%; 95%

Question 12

A researcher gives vitamin C to one group of research participants and a placebo to another group to measure the effect of vitamin C on the common cold.

The frequency of colds is

A. the independent variable.
B. the dependent variable.
C. an extraneous variable.
D. a confounding variable.

Question 13

An experiment was conducted to assess the effectiveness of a new technique for learning Greek words. One group used the learning technique and another group did not. Both groups were then given the same test of recall of Greek words.

The results showed that the group using the learning technique recalled more Greek words than did the group who did not use the learning technique. In this experiment, _____ is the independent variable, whereas _____ is the dependent variable.

A. number of Greek words correctly recalled; using the learning technique
B. using the learning technique; number of Greek words correctly recalled
C. number of Greek words learned; number of Greek words correctly recalled
D. number of Greek words correctly recalled; number of Greek words learned

Question 14

A researcher intentionally arranged the order in which the conditions of a repeated measures experiment were experienced. This was done to control a practice effect that was expected to occur.

This procedure is most commonly referred to as

A. manipulation.
B. control.
C. counterbalancing.
D. experimenter bias.

Question 15

In a repeated measures experiment, each participant is exposed to

A. all conditions of the experiment.
B. the independent variable only.
C. the independent variable repeatedly.
D. the dependent variable repeatedly.

Question 16

Generalising from of the results of research involves

A. determining the reliability and validity of the results.
B. establishing a cause–effect relationship between the independent and dependent variables.
C. applying the findings obtained from the sample to its population.
D. drawing a conclusion about whether the results support or do not support the hypothesis.

Question 17

Which of the following is an example of a self-report?

A. notes kept by a person with a phobia of research interest
B. the researcher's raw data collected for their study
C. the researcher's formal report on their study
D. the researcher's records in an observation checklist

Question 18

Which of the following researcher behaviours would be considered unethical?

A. informing participants about the results of the experiment
B. preventing a participant from opting out midway through the experiment
C. checking up on the age of a participant when there is doubt that the participant may not be old enough to give informed consent
D. publishing the results of the experiment without obtaining informed consent from the participants

Question 19

A researcher investigated the effect of a new drug designed to improve memory. A placebo was used to control

A. participant expectations.
B. experimenter expectations.
C. experimental error.
D. ethical issues.

Question 20

Before conducting an experiment, a researcher identified all extraneous variables with the potential to affect the dependent variable, then refined the experiment's design to control the influence of these variables. The researcher did this to help ensure that

A. the independent variable could be manipulated.
B. the dependent variable could be measured.
C. the experiment would be reliable.
D. there would be no confounding variables.

Question 21

The standard research procedure for ensuring control over participant variables and experimenter effects is the use of

A. operationalised variables.
B. double blind.
C. standardised variables.
D. single blind.

Question 22

A researcher uses test scores as a measure of their dependent variable. The test scores are best described as _____ data.

A. primary
B. secondary and quantitative
C. primary and quantitative
D. primary and qualitative

Question 23

A general description or explanation of a set of observations or findings about behaviour and/or mental processes which seem to be related is best described as a

A. research finding.
B. research hypothesis.
C. generalisation.
D. theory or model.

Question 24

A common feature of cross-sectional studies is

A. random allocation to groups.
B. use of an independent groups design.
C. one time only study of age-related differences.
D. long-term study of age-related differences.

Question 25

If research procedures are standardised, then

A. the results will be valid.
B. the research will be conducted ethically.
C. all participants will understand what the experiment is requiring of them.
D. the procedures used in a specific condition will be the same for all participants.

SECTION B

Answer all questions in the spaces provided. Write using black or blue pen.

Question 1 (1 mark)

What is the most essential feature of a research hypothesis?

Question 2 (1 mark)

What is the main purpose of using a control group in an experiment?

Question 3 (6 marks)

(a) Distinguish between an extraneous variable and a confounding variable. 2 marks

(b) Explain why confounding is evident in the following data. 2 marks

Participants		Group 1 (IV present)	Group 2 (IV absent)
Number		50	50
Sex	Males	40	10
	Females	10	40
Mean age (years)		35	70
Mean score on an intelligence test (IQ)		100	130

(c) Explain why a confounding variable is an unwanted variable in an experiment. 2 marks

Question 4 (2 marks)

How does random allocation in an experiment minimise the likelihood of individual participant differences becoming a confounding variable?

Question 5 (2 marks)

Distinguish between internal and external validity in relation to research.

Question 6 (5 marks)

Read the following extract from a student's report on a research investigation and answer the following questions.

> *To ensure randomisation, questionnaires were handed out at many different places and at different times throughout the day. Moreover, by choosing to sample a relatively large population, we were able to ensure that the average results of many individual results would produce a stable result.*

(a) Identify the sampling procedure. 1 mark

(b) Explain whether or not the researcher actually 'ensured randomisation'. 2 marks

(c) What technical term do psychologists use to refer to 'stable results'? 1 mark

(d) Explain whether 'stable results' were actually achieved. 1 mark

Question 7 (4 marks)

Suppose that a researcher wants to test the hypothesis that participating in psychotherapy will cause a decrease in reported anxiety.

(a) Outline the design of a cross-sectional study that could be used to test this hypothesis. 2 marks

(b) Explain the problem a cohort effect creates when interpreting the results. 2 marks

Question 8 (4 marks)

(a) Give two reasons to explain why variables of research interest are operationalised. 2 marks

(b) Give an example of how each of the following variables of research interest could be operationalised for an experiment.

(i) student satisfaction as an IV _____

_____ 1 mark

(ii) decision making as a DV _____

_____ 1 mark

Question 9 (10 marks)

To test the effectiveness of a new sleeping pill, a researcher conducts an experiment at the participants' homes rather than in a sleep laboratory.

Eighteen volunteer adult participants, who reported that they have been suffering from sleep-onset insomnia (i.e. difficulty falling asleep) for more than a year, are each given a packet of 14 pills and asked to take one each night for 14 consecutive nights, 15 minutes before their usual sleeping time. They are also given a special apparatus to record the time they fall asleep. The apparatus, worn on the body, measures various physiological responses associated with sleep–awake states, has a timing device and has been reported by participants in previous studies as not being uncomfortable in any way.

The participants do not know that they have been randomly allocated to either of two groups. The researcher's assistant is also unaware of the group to which each participant has been allocated. Group 1 has nine participants whose pills are arranged in the pack so that pills 1 to 7 are the new sleeping pills, and pills 8 to 14 look and taste like the sleeping pills but do not contain the sleep-inducing chemical. Group 2 also has nine participants, but their pills are arranged so that pills 1 to 7 are the fake pills and pills 8 to 14 are the new sleeping pills.

The results are shown in the following table.

TABLE 1 Time taken to fall asleep

Group	Mean time (minutes)	
	Sleeping pills	Non-sleeping pills
1	37	64
2	78	31

(a) Operationalise the independent and dependent variables in the experiment:

independent variable _____

_____ 1 mark

dependent variable _____

_____ 1 mark

(b) Explain an ethical standard that should have been followed for this particular experiment. 1 mark

(c) Explain the difference between a placebo effect and an experimenter effect in relation to this particular experiment. 2 marks

(d) Name the experimental research design used by the researcher. 1 mark

(e) Discuss the double blind procedure in relation to this experiment. 1 mark

(f) Discuss counterbalancing in relation to this experiment. 1 mark

(g) Identify a potential extraneous or confounding variable that may have affected the results of the experiment and the extent to which this variable was controlled. 2 marks

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The answers to the Section A multiple-choice questions are in the answer section at the end of this book and in eBookPLUS.
The answers to the Section B questions are in eBookPLUS.

Unit 3

How does experience affect behaviour and mental processes?

AREA OF STUDY 1

How does the nervous system enable psychological functioning?

CHAPTER 2 Nervous system functioning
CHAPTER 3 Stress as a psychobiological process

AREA OF STUDY 2

How do people learn and remember?

CHAPTER 4 Neural basis of learning and memory
CHAPTER 5 Models to explain learning
CHAPTER 6 Process of memory
CHAPTER 7 Reliability of memory

On completion of this unit, the student should be able to:

OUTCOME 1

- explain how the structure and function of the human nervous system enables a person to interact with the external world and analyse the different ways in which stress can affect nervous system functioning

OUTCOME 2

- apply biological and psychological explanations for how new information can be learnt and stored in memory, and provide biological, psychological and social explanations of a person's inability to remember information.

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UNIT 3 KEY KNOWLEDGE

CHAPTER 2 **Nervous system functioning**	• the roles of different divisions of the nervous system (central and peripheral nervous systems and their associated sub-divisions) in responding to, and integrating and coordinating with, sensory stimuli received by the body • the distinction between conscious and unconscious responses by the nervous system to sensory stimuli, including the role of the spinal reflex • the role of the neuron (dendrites, axon, myelin and axon terminals) as the primary cell involved in the reception and transmission of information across the synapse (excluding details related to signal transduction) • the role of neurotransmitters in the transmission of neural information between neurons (lock-and-key process) to produce excitatory effects (as with glutamate) or inhibitory effects (as with gamma-amino butyric acid [GABA]) • the effects of chronic changes to the functioning of the nervous system due to interference to neurotransmitter function, as illustrated by the role of dopamine in Parkinson's disease.
CHAPTER 3 **Stress as a psychobiological process**	• sources of stress (eustress and distress) including daily pressures, life events, acculturative stress, major stress and catastrophes that disrupt whole communities • models of stress as a biological process, with reference to Selye's General Adaptation Syndrome of alarm reaction (shock/counter shock), resistance and exhaustion, including the 'fight–flight–freeze' response and the role of cortisol • models of stress as a psychological process, with reference to Richard Lazarus and Susan Folkman's Transactional Model of Stress and Coping (stages of primary and secondary appraisal) • context-specific effectiveness, coping flexibility and use of particular strategies (exercise and approach and avoidance strategies) for coping with stress.
CHAPTER 4 **Neural basis of learning and memory**	• neural plasticity and changes to connections between neurons (including long-term potentiation and long-term depression) as the fundamental mechanisms of memory formation that leads to learning • the role of neurotransmitters and neurohormones in the neural basis of memory and learning (including the role of glutamate in synaptic plasticity and the role of adrenaline in the consolidation of emotionally arousing experiences).
CHAPTER 5 **Models to explain learning**	• classical conditioning as a three-phase process (before conditioning, during conditioning and after conditioning) that results in the involuntary association between a neutral stimulus and unconditioned stimulus to produce a conditioned response, including stimulus generalisation, stimulus discrimination, extinction and spontaneous recovery • operant conditioning as a three-phase model (antecedent, behaviour, consequence) involving reinforcers (positive and negative) and punishment (including response cost) that can be used to change voluntary behaviours, including stimulus generalisation, stimulus discrimination and spontaneous recovery (excluding schedules of reinforcement) • observational learning as a method of social learning, particularly in children, involving attention, retention, reproduction, motivation and reinforcement • the 'Little Albert' experiment as illustrating how classical conditioning can be used to condition an emotional response, including ethical implications of the experiment.
CHAPTER 6 **Process of memory**	• the multi-store model of memory (Atkinson-Shiffrin) with reference to the function, capacity and duration of sensory, short-term and long-term memory • interactions between specific regions of the brain (cerebral cortex, hippocampus, amygdala and cerebellum) in the storage of long-term memories, including implicit and explicit memories.
CHAPTER 7 **Reliability of memory**	• methods to retrieve information from memory or demonstrate the existence of information in memory, including recall, recognition, relearning and reconstruction • the effects of brain trauma on areas of the brain associated with memory and neurodegenerative diseases, including brain surgery, anterograde amnesia and Alzheimer's disease • the factors influencing a person's ability and inability to remember information, including context and state dependent cues, maintenance and elaborative rehearsal and serial position effect • the reconstruction of memories as evidence for the fallibility of memory, with reference to Loftus' research into the effect of leading questions on eyewitness testimonies.

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2 NERVOUS SYSTEM FUNCTIONING

KEY KNOWLEDGE

- the roles of different divisions of the nervous system (central and peripheral nervous systems and their associated sub-divisions) in responding to, and integrating and coordinating with, sensory stimuli received by the body
- the distinction between conscious and unconscious responses by the nervous system to sensory stimuli, including the role of the spinal reflex
- the role of the neuron (dendrites, axon, myelin and axon terminals) as the primary cell involved in the reception and transmission of information across the synapse (excluding details related to signal transduction)
- the role of neurotransmitters in the transmission of neural information between neurons (lock-and-key process) to produce excitatory effects (as with glutamate) or inhibitory effects (as with gamma-amino butyric acid [GABA])
- the effects of chronic changes to the functioning of the nervous system due to interference to neurotransmitter function, as illustrated by the role of dopamine in Parkinson's disease.

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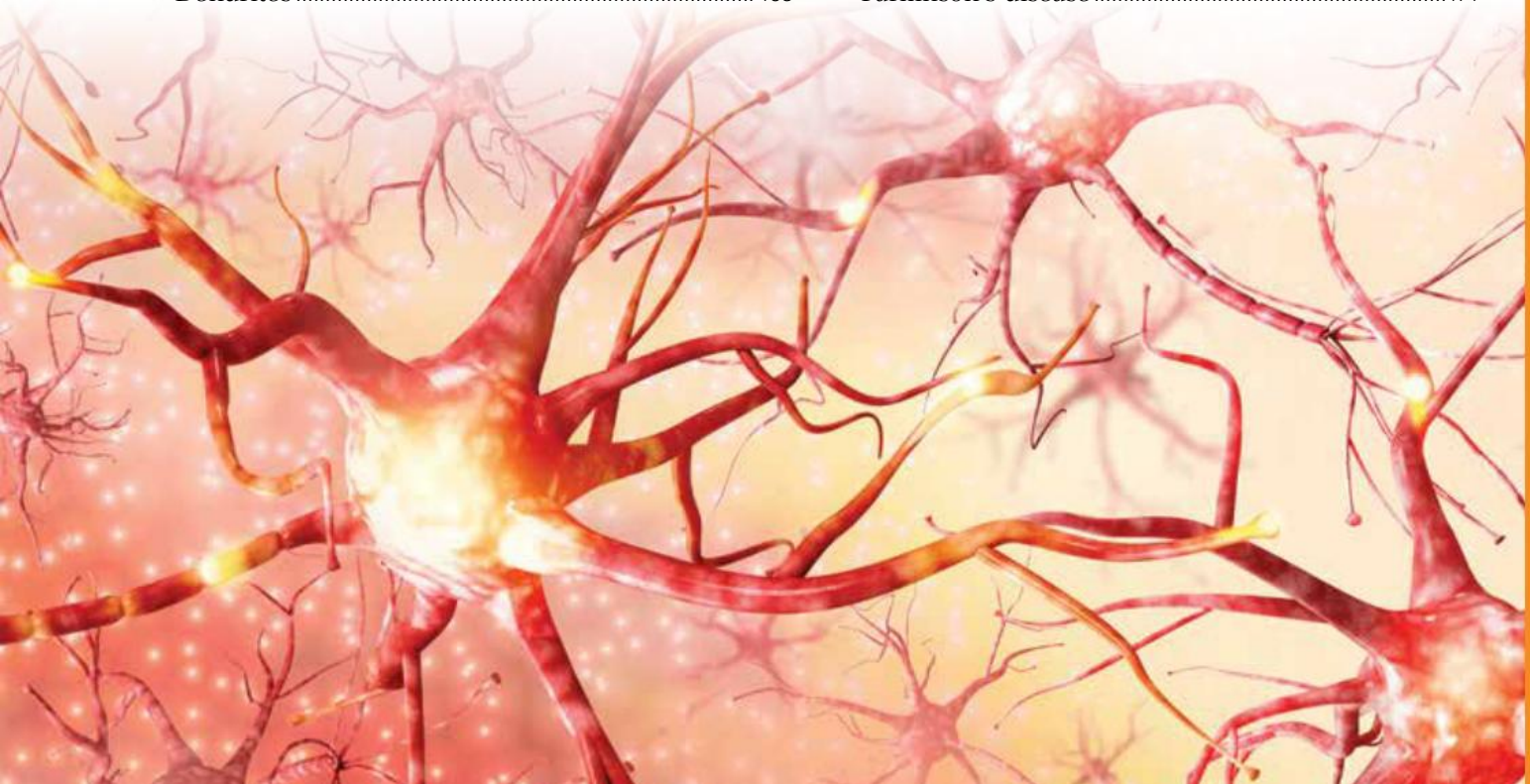

The human nervous system is a complex, highly organised network of specialised cells that enables the brain to receive information about what is going on from both inside and outside the body and to respond appropriately. Everything you sense, feel, think and do is controlled by your nervous system in some way. This includes not only your everyday sensing, perceiving, learning, remembering, thinking, imagining, speaking, moving and the vast array of other responses you voluntarily make, but also your involuntary responses such as breathing, heartbeat, squinting when someone turns on a bright light in the middle of the night, and the 'butterflies' you may feel in your stomach when anxious or meeting someone special.

The nervous system achieves this by serving as a communication system between the body's internal cells and organs and the external world. Through its vast network of nerves distributed throughout the body, the nervous system enables the brain to obtain information about what is going on inside and outside the body and to respond appropriately. Its three main functions are to:

- *receive* information
- *process* information, and
- *coordinate a response* to information.

Although the nervous system is a single body system, it is made up of different sub-systems. These are commonly referred to as 'divisions' or 'branches'. Although each division carries out identifiable functions, the nervous system functions as a coordinated whole.

As shown in Figure 2.1 below, the two main divisions are the central nervous system and the peripheral nervous system. They are connected by the spinal cord and constantly work together maintaining communication throughout the body, thereby enabling us to not only think, feel and act as we do, but also to keep us alive.

The brain is kept continually informed of the ever-changing external and internal environments of the body through sensory information received by the many and varied receptor cells located at or near the surface of the body and also deep within the body. These sensory receptors specialise in detecting and responding to different types of information.

Sensory information from the external environment is received through sensory receptors that are sensitive to specific types of stimuli arising outside the body. For example, neurons that function as sensory receptors at the back of the eye respond only to light for vision, the inner ear contains receptors for hearing, balance and body position, and the skin has receptors that are responsive to touch, pressure, temperature and pain. The nervous system also receives information from within various parts of the body. For example, sensory receptors located in the muscles, joints and tendons provide information about muscle tension, position and movement, and receptors located in internal organs such as the heart, lungs, liver and intestines provide information about the body's internal environment.

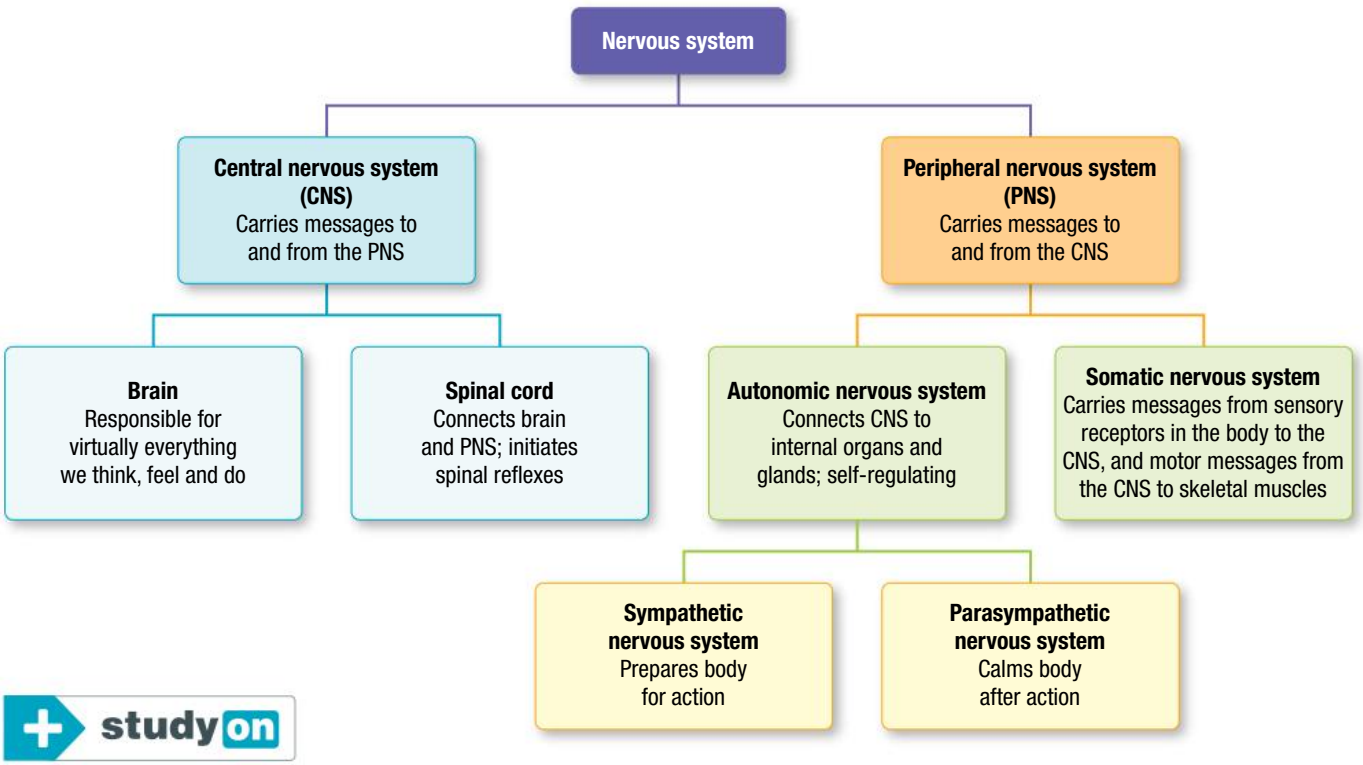

Figure 2.1 The major divisions of the human nervous system

When the sensory information is received at the brain it is processed. This enables perception — interpretation of the sensory information so meaning can be assigned. Processing often involves integrating incoming information with other information already in the brain. For example, incoming auditory and visual sensory information may be combined with information stored in memory in order to recognise what was seen and heard. If required, the brain will also coordinate a response by initiating appropriate action; for example, by sending neural messages to muscles, glands and internal organs. This, in turn, enables muscles to move, causes glands to secrete ('release') hormones and initiates the responses of internal organs, thereby enabling our body systems to function effectively.

Neurons and glial cells (or glia) are the building blocks of the nervous system. Basically, neurons are responsible for communicating information and glia support their functions. For example, some glia surround neurons to provide a coating (i.e. myelin) that insulates them, whereas others clear up debris that could interfere with efficient neural transmission.

In this chapter we examine the roles of different divisions of the nervous system in responding to, and integrating and coordinating with, sensory stimuli received by the body. We also explore how the specialised structures and functioning of neurons allow the nervous system to transmit neural information throughout all points of the body.

The brain is more than a mass of networked cells. Brain cells are organised into many identifiable areas (or 'regions') and structures that have specialised functions. For example, some parts are dedicated to sensory or motor functions. Most parts, however, have integrating and overlapping functions. The apparently simple task of naming a familiar object, such as a car or mobile phone, will trigger activity in multiple structures and areas throughout the brain. These include areas at the back and side to process visual information received from the eyes, areas at the front, at the sides and near the centre to recover information from memory and to identify the object, and areas towards the front involved in language and speech production to state the name of the object.

Many brain functions involve the activation of neural pathways that link different brain areas and structures. A **neural pathway** comprises one or more circuits of interconnected neurons that form a communication network. Some pathways span short distances and others extend from one side of the brain to the other. Neural pathways also connect the brain to other parts of the nervous system and the body. Although much is known about the brain's neural circuitry, chemistry, structures and functioning, more remains unclear or unknown. For example, although it is known that different types of memory are associated with activity in distinctive parts of the brain, it is not fully understood how the brain goes about locating and retrieving specific memories when needed. Nor is it known exactly how different types of memories are actually stored.

ROLES OF DIFFERENT DIVISIONS

Central nervous system

The **central nervous system (CNS)** comprises the brain and its extension, the spinal cord. Its main function is to process information received from the body's internal and external environments and to activate appropriate responses.

The brain

The brain is an intricate network of cells that plays a vital role in processing information received through neural pathways from the body and in directing actions within the body. It continuously receives and analyses sensory information, responding by controlling all bodily actions and functions. Because of its crucial role in almost everything we think, feel and do, it is sometimes called the 'control centre' or 'master regulator'.

Figure 2.2 The human brain has a complex structure and is responsible for virtually everything we think, feel and do.

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TED talk: What is so special about the human brain? 13m 28s

BOX 2.1 Structure and function of brain areas

Neuropsychologists often describe the brain using three main areas (or regions) — the forebrain, midbrain and hindbrain. This is based on how the brain develops early in life. Each area is associated with identifiable mental processes and behaviour but these function in an integrated way to enable us to think, feel and behave as we do.

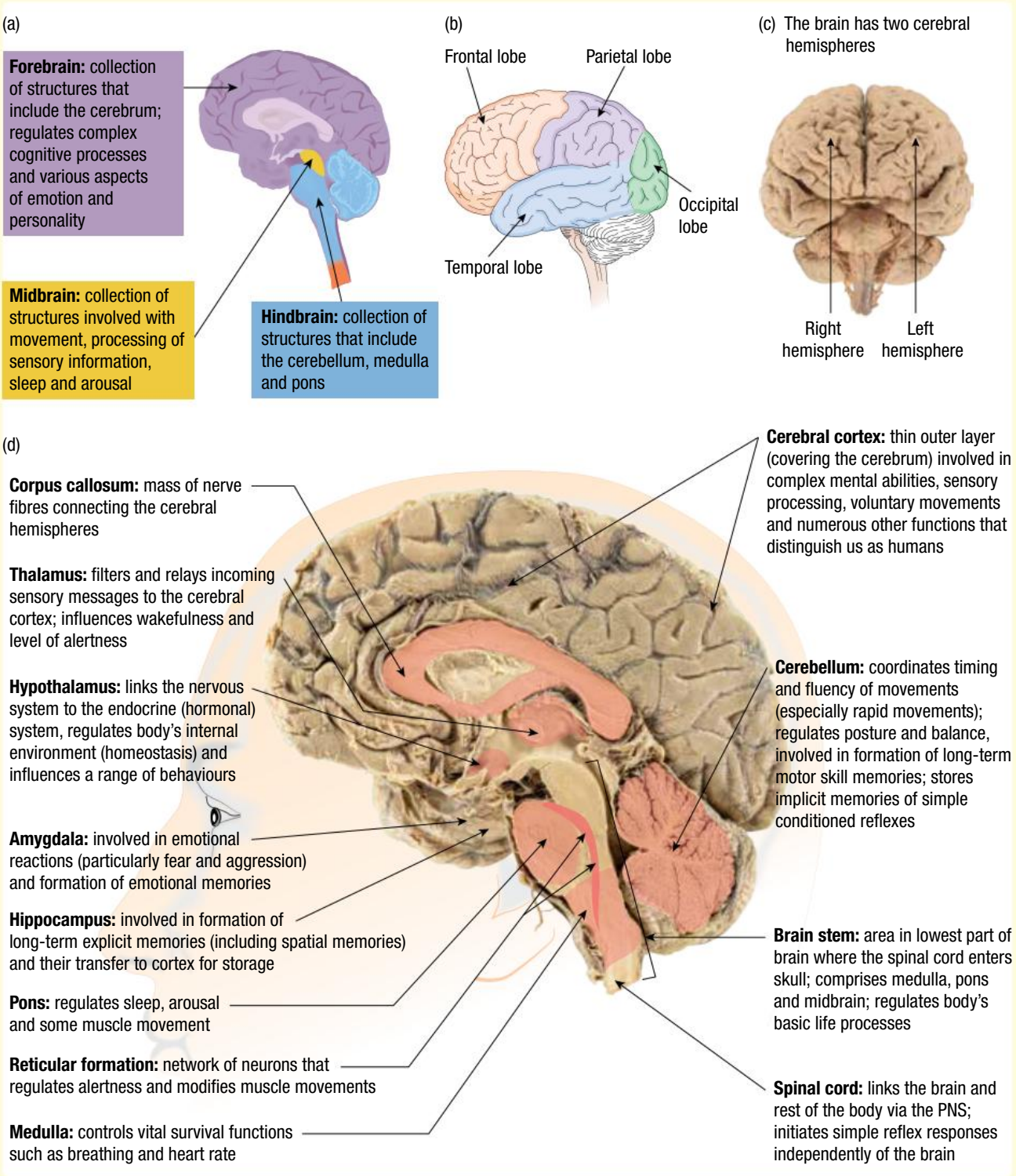

Figure 2.3 Brain structure and functions

The spinal cord

The **spinal cord** is the long, thin bundle of nerve fibres that extends from the base of the brain to the lower back. It is encased in a series of bones called the *vertebrae* that extend further than the actual cord. As can be seen in Figure 2.4 below, the spinal cord links the brain and the parts of the body below the neck.

Two major functions of the spinal cord are to:

- receive sensory information *from* the body (via the peripheral nervous system) and send these messages to the brain for processing. For example, an itch on your big toe, the sensation of heat as you step into a warm bath and the pain of a sprained wrist are all carried via the spinal cord to the brain area responsible for initially processing this type of sensory information
- receive motor information from the brain and send it *to* relevant parts of the body (via the peripheral nervous system) to control muscles, glands and internal organs so that appropriate actions can be taken. For example, as shown in Figure 2.5 on the next page, to pick up a water bottle and bring it to your mouth for a drink, millions of neural messages are sent from the primary motor cortex to the muscles in your shoulder, upper arm, forearm, wrist and fingers. This is complemented by other relevant

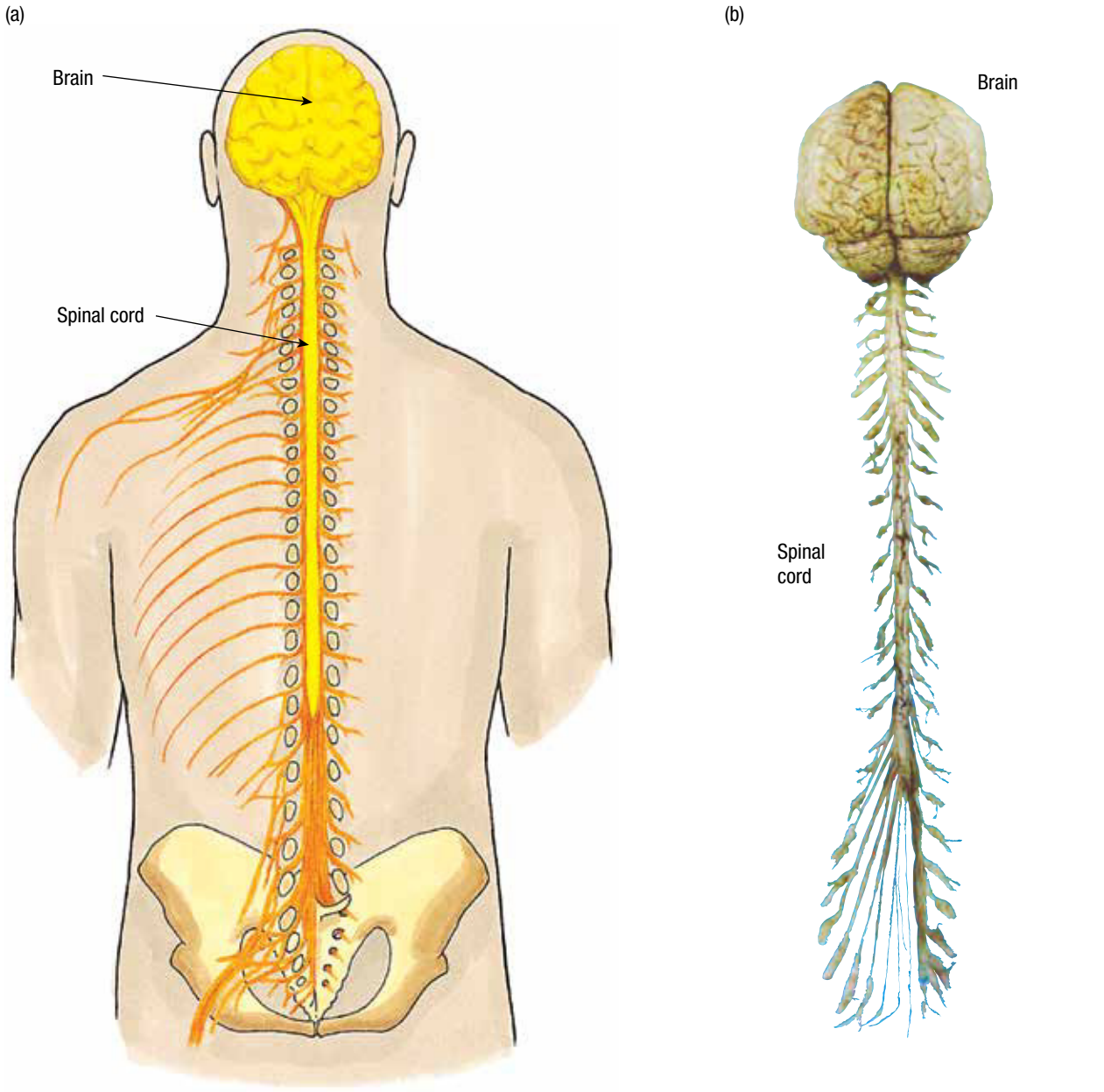

Figure 2.4 (a) The CNS consists of the brain and spinal cord. (b) Anatomically, the spinal cord links the brain and peripheral nervous system.

information that has been processed by your brain such as the size, shape, texture, weight, distance and location of the bottle in relation to your eyes, mouth and hand, so that you can successfully execute a highly coordinated series of individual movements performed in one, well-timed, smooth action with just enough pressure to grasp the bottle and hold it without squeezing it too hard.

The transmission of information along the spinal cord, to and from the brain, occurs through interconnected neurons that form neural (nerve) pathways. There are *ascending tracts* (pathways) that carry sensory information up to the brain and *descending tracts* for motor information, which leaves the brain and travels down the spinal cord to exit via the spinal nerves to their destination in specific muscles, glands and/or organs. The tracts are actually nerves comprising nerve fibres that are bundled together (as shown in Figure 2.19 on page 164). All nerve fibres in a given tract usually have a similar origin, destination, and function. When the spinal cord is injured, the brain can lose both sensory input from and control over the body. The severity of feeling loss and paralysis depends on where the spinal cord is injured and the severity of the injury. Generally, the higher up on the spine the injury is, the greater the number of nerve connections between the brain and body that are disturbed.

The spinal cord has a relatively simple organisation but does more than provide pathways for messages to and from the brain. It can also initiate some simple motor reactions in the form of reflexes that occur extremely rapidly, independently of the brain. We consider the function of these *spinal reflexes* and how they occur in the next section.

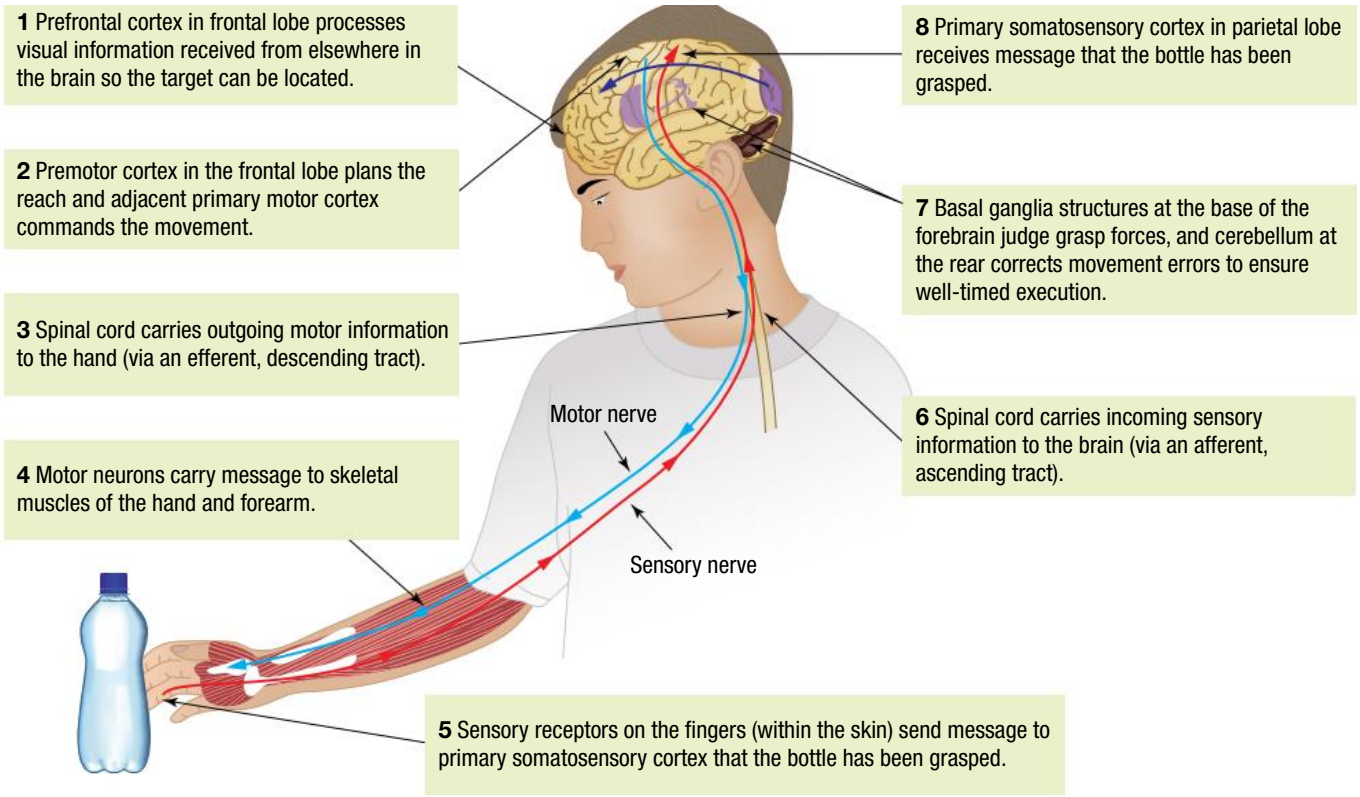

Figure 2.5 This illustration shows some of the brain processes and information transmission via the spinal cord that occur to pick up a water bottle in one, well-timed, smooth action with just enough pressure to grasp the bottle and hold it without squeezing it too hard. Note that the right arm is picking up the bottle. This means that motor information will be sent *from* the brain's left hemisphere (because it controls voluntary movements on the right side of the body) and somatosensory ('body sense') information will be sent *to* the brain's left hemisphere.

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BOX 2.2 The spinal cord nerves

The spinal cord is the linking conduit or 'pipeline' that integrates the central nervous system and peripheral nervous system, which work together to transmit information around the body. As shown in Figure 2.6, the spinal cord is divided into four sections that are named by groups of spinal nerves: the cervical nerves, the thoracic nerves, the lumbar nerves and the sacral nerves.

At the top of the spinal cord, nearest the brain, the *cervical nerves* are further divided into eight levels. Each of these levels contributes to different motor functions in the neck, shoulders and arms. Similarly, sensations from the neck, shoulders and arms use the sensory nerves in these eight levels as their neural pathway to the brain.

Below the cervical region, the 12 pairs of nerves in the *thoracic* region of the spinal cord radiate to muscles in the chest, known as the pectoral muscles. Besides the pectoral muscles, they also link to the visceral muscles, which are those connected to the large internal organs in the chest cavity, such as the lungs. Visceral muscles are therefore involved with actions such as breathing and coughing. Messages from the internal organs as well as those sent from sensory receptors in the chest area enter via the thoracic nerves.

The lower two sections (*lumbar* and *sacral*) are referred to jointly as the lumbosacral spinal cord. This area has ten pairs of nerves: five pairs from the lumbar and five pairs from the sacral sections. These nerves send nerve impulses to move the pelvis, legs, feet, bladder and bowel. Sensory messages from the same parts and the lower abdomen enter the spinal cord here on their way to the brain.

The spinal cord only extends down to the last bone of the thoracic vertebrae. Nerves radiate laterally (sideways) from the spinal cord in the cervical and thoracic sections of the vertebrae, but not in the lumbar and sacral sections. Instead, nerves below the thoracic section form a bundle that runs vertically inside the vertebrae. This large collection of nerves is known as the *cauda equina*, which means 'horse tail'.

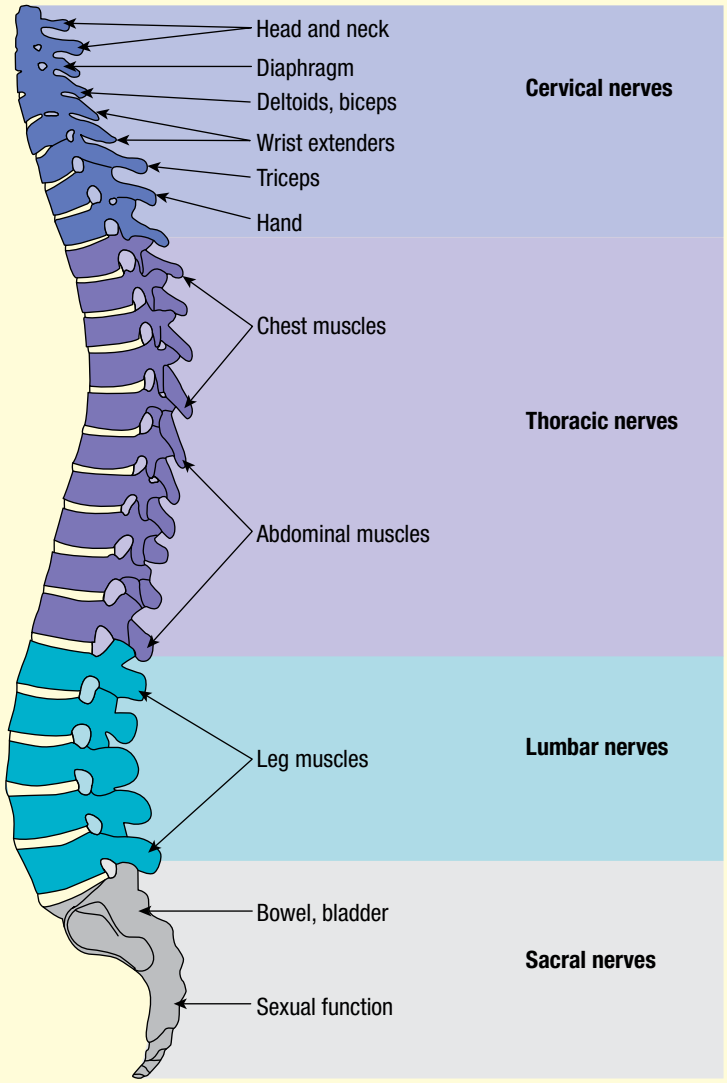

Figure 2.6 The four sections of the spinal cord. Note that the spinal cord ends at the last vertebrae in the thoracic section.

Peripheral nervous system

The central nervous system does not have direct contact with the outside world. It relies on the peripheral nervous system to link it to the rest of the body so that messages can be carried to and from the brain via the spinal cord.

The **peripheral nervous system (PNS)** is the entire network of nerves located outside the CNS. It extends from the top of the head, throughout the body to the tips of the fingers and toes and to all parts of the skin. Its main function is to transmit information to and from the CNS. More specifically, the PNS:

- carries information *to* the CNS from the body's muscles, organs and glands (about the internal environment) and from the sensory organs (about the external environment)
- carries information *from* the CNS to the body's muscles, organs and glands.

The peripheral nervous system does this through its two divisions: the somatic nervous system and the autonomic nervous system.

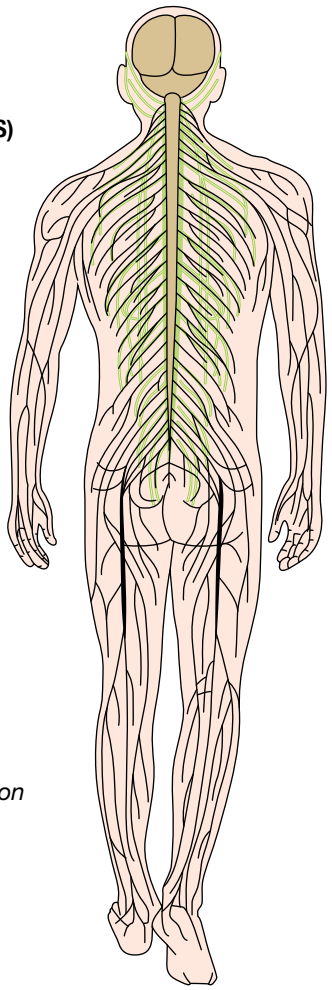

Figure 2.7 The peripheral nervous system (PNS) consists of all nerves outside the central nervous system (CNS). It carries information to and from the CNS.

LEARNING ACTIVITY 2.1

Review questions

1. Describe three main functions of the human nervous system, with reference to examples not used in the text.
2. Which part of the nervous system coordinates the activity of the entire nervous system?
3. (a) Describe the two main functions of the spinal cord in terms of the types of messages that travel up and down its length, and the division of the nervous system to which it connects.
   (b) What is a third function of the spinal cord?
4. Explain why spinal cord damage can result in loss of brain–body control.
5. (a) What is the peripheral nervous system?
   (b) What is its primary function?
6. Describe the relationship between the central nervous system and the peripheral nervous system, with reference to key functions of each division.

LEARNING ACTIVITY 2.2

Reflection

The term 'peripheral' means outlying or surrounding, suggesting lesser importance than the term 'central'. With this in mind, suppose that your peripheral nervous system suddenly stopped 'working' for 30 seconds right now.

Comment on your experience of the world during the 30 second period. What does this suggest about the importance of the PNS?

Somatic nervous system

The **somatic nervous system (SNS)** is a subdivision of the peripheral nervous system comprising a network of nerves that carries sensory information *to* the CNS and motor information *from* the CNS. Sensory information is received at sensory receptor sites in the body (skin, muscles, joints and tendons) and carried along sensory neural pathways by sensory neurons. Motor information is carried along motor neural pathways by motor neurons to skeletal muscles to control their activity by causing them to contract or relax. Skeletal muscles are attached to our bones and respond to messages from the CNS to initiate, change or stop movement.

The sensory information is called afferent and the motor information efferent. These terms refer to the direction of the neural information flow. More specifically, *afferent* information is sensory information coming into the CNS (incoming information), whereas *efferent* information is motor information leaving the CNS (outgoing information).

The *sensory* function of the SNS is demonstrated when someone touches your hand. The SNS sends the sensory signals about touch from the skin to your brain, resulting in the sensation of touch (or pressure on the skin). The *motor* function of the SNS is demonstrated whenever voluntary actions are performed. For example, when you 'text', talk, chew, shower, surf or dance, your somatic nervous system is active.

Thus, the somatic nervous system is involved in all skeletal muscle activity that enables us to participate in our relationship with the external environment. Its nerves send information to the brain from the body's various sensory receptors. These nerves also enable us to respond to these stimuli by moving through the environment.

Although motor pathways carry messages that initiate or stop movement, *voluntary* movement is controlled through the coordinated actions of *both* motor and sensory information. For example, when you use a finger to scratch your nose, your brain (primary motor cortex) sends messages via motor neurons to skeletal muscles in your arm, hands and fingers to move in specific ways. Sensory receptors in

your skin and muscles send back messages through sensory neurons that help determine how much pressure is needed to hold the pen. However, your somatic nervous system does not make your heart beat faster when you are suddenly threatened, nor does it regulate your internal environment. For these reactions, the other subdivision of the PNS is required—the autonomic nervous system.

Figure 2.8 (a) Sensory receptors within the skin detect the nibbling bites in the fish spa and transmit the sensory information along the SNS to the CNS. (b) Our SNS is also active when we voluntarily move, such as when walking up a set of stairs.

LEARNING ACTIVITY 2.3

Review questions

1. (a) Describe the two main functions of the somatic nervous system.
(b) Give an example of each of these functions, using examples not referred to in the text.

2. Distinguish between afferent and efferent information with reference to the type of information and the direction in which it is transmitted.

3. Whenever you reach to pick up a glass of water on a table, both the sensory and motor functions of the somatic nervous system are involved. Explain both the sensory and motor roles in grasping the glass.

4. The athlete shown at right has restricted movement due to paraplegia caused by spinal cord damage.

Explain the athlete's restricted movement with reference to the somatic nervous system.

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Learning activity
Visual presentation on somatic nervous system

The autonomic nervous system

The **autonomic nervous system (ANS)** is a subdivision of the peripheral nervous system that connects the CNS to the body's internal organs (such as the heart, stomach and liver) and glands (such as sweat, salivary and adrenal glands), providing feedback to the brain about their activities. The ANS is called 'autonomous' because many of the organs, glands and processes under its control are self-regulating and therefore occur without conscious effort and are not usually under our voluntary control. For example, your heartbeat, breathing, digestion and perspiration occur without your conscious activation or control of them.

While skeletal muscles are completely inactive in the absence of motor neuron messages from the brain, the muscles involved in the activity of internal organs and glands (called *visceral muscles*) have built-in mechanisms for generating and maintaining their activity and do not depend on voluntary control by the brain. This is an important feature of the ANS, as it functions continuously — whether we are awake, active, asleep, under an anaesthetic or even in a coma. Regardless of our level of awareness or alertness, the ANS keeps the vital organs and systems of our body functioning, thereby maintaining our survival.

Unlike the somatic nervous system, which is responsible for *initiating* skeletal muscle movement, the ANS *regulates* the activity of the visceral muscles, organs and glands. This means that the messages carried between the CNS and the visceral muscles, organs and glands either increase or decrease their respective activities in response to the varying demands placed on the body throughout each day.

You often become consciously aware of ANS functions when you experience emotions such as fear, anger and excitement at intense levels because this is when there is heightened ANS activity. For example, think about how you can feel your heart and breathing rates change when you suddenly become very frightened, or during exhilarating moments on a roller-coaster ride. Recall also the physiological changes you can instantly feel when the fear or exhilaration start to diminish. Your heart rate noticeably slows and your breathing becomes more regulated. Any goosebumps or feelings of butterflies in your stomach will also eventually disappear.

The ANS is not completely self-regulating. It is linked to the brain's cerebral cortex so we can voluntarily control a few autonomic responses at certain times. For example, with conscious effort, you could control your breathing rate right now.

Some people are able to use techniques they have learned to exercise extraordinary control over specific autonomic responses. For example, it has been reported that some Hindu holy men in India who are highly skilled yoga practitioners have been able to increase their heartbeat from the normal resting rate of 75 beats or so per minute to 300 per minute without undertaking any physical activity, or have slowed their heartbeat to less than 50 beats per minute. Some have also been reported as being able to control their body temperature to the extent that one side of their hand is warm while the other side is cold (Blanchard & Young, 1973; Pines, 1973).

Figure 2.9 In outer space, the temperature is extremely cold and there is no oxygen. Astronauts wear special space suits to restrict heat loss and to maintain adequate oxygen pressure for brain function. On Earth, these functions occur automatically through the activity of the autonomic nervous system.

People who are not yogis can also learn to control various specific autonomic responses using a technique called biofeedback training. *Biofeedback* is a process by which a person receives information ('feedback') about the state of an internal bodily activity that normally occurs automatically, and then uses thought processes to exert control over that activity. The person learns a strategy, such as relaxation and/or visualisation, in order to control a particular autonomic response. Feedback about the state of the autonomic response being controlled is usually provided by a monitoring device connected to the person.

LEARNING ACTIVITY 2.4

Review questions

1. (a) Explain why the autonomic nervous system is described as autonomous.
(b) Is 'autonomous' a truly accurate term for describing this division of the nervous system? Explain with reference to an example.
2. Explain the relationship of the autonomic nervous system to the central nervous system with reference to a physiological response.
3. What is a key difference between skeletal muscles and visceral muscles?
4. How do we manage to keep alive, breathing and with the heart beating, while we are asleep?
5. Which is more important in maintaining our survival without conscious awareness or effort: the autonomic nervous system or the central nervous system? Explain with reference to an example.

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Practical activity
Testing conscious manipulation of autonomic activity through biofeedback

LEARNING ACTIVITY 2.5

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Word copy of table

Distinguishing between the somatic nervous system and the autonomic nervous system

Complete the following table to indicate which division of the peripheral nervous system is more likely to be primarily involved in each of the following responses: the somatic nervous system (S), the autonomic nervous system (A) or both (B)?

Response	Somatic nervous system (S), Autonomic nervous system (A), Both (S & A)
pressing a key to send an email	
eating dinner	
sweating before having to give an important speech	
clenching your fists while watching a scary movie	
crouching on the blocks awaiting the starting siren before swimming in a 50-metre freestyle final	
washing the dog	
blinking	
talking on the phone	
laughing at a joke	
feeling your heart race when startled by a loud noise	

Divisions of the ANS

The ANS consists of two distinct subdivisions that complement and 'counterbalance' each other's activities but generally have opposite effects. These are:

- the sympathetic nervous system, which is responsible for *increasing* the activity of most visceral muscles, organs and glands in times of vigorous activity, stress or threat
- the parasympathetic nervous system, which is responsible for *decreasing* the activity of most visceral muscles, organs and glands, and restoring body functioning to its normal state.

The complementary actions of the sympathetic and parasympathetic nervous systems occur without conscious effort and are demonstrated when you engage in an activity requiring physical exertion over a period of time. For example, when playing tennis vigorously, your sympathetic nervous system speeds up your heart rate to pump more blood and oxygen to your muscles. It causes your liver to release sugar (glucose) into your bloodstream for energy, and induces sweating to keep your skin cool and prevent you from overheating. Because the body is pumping more blood and oxygen to the muscles, these are diverted from non-essential functions such as digestion, so this is inhibited. After the game, your parasympathetic nervous system takes over. Your heart rate slows, constricting the blood vessels in your muscles so the blood flow is diverted to the internal organs. Your sweat glands gradually slow down the production of sweat as the body returns to its normal state.

The sympathetic and parasympathetic nervous systems do not function in an 'on/off' or 'either/or' way. They are both active at the same time. However, one system is usually *dominant* at any given time. For example, the sympathetic division dominates and is more active during emotional arousal, whereas the parasympathetic division is dominant and more active during rest and digestion.

The sympathetic nervous system

The **sympathetic nervous system** activates internal muscles, organs and glands to prepare the body for vigorous activity or to deal with a stressful or threatening situation. It is activated by a stressor or fear stimulus and enhances survival by providing an immediate response, in a split second, to any kind of emergency.

When you perceive an emergency or experience a crisis, the sympathetic nervous system activates specific organs and glands to respond. Glands that are activated include the adrenal glands, which are located just above your kidneys and release hormones (such as adrenaline) into the bloodstream. These circulate throughout your body, enhancing the effects of the sympathetic nervous system by activating various muscles, organs and other glands in preparation for dealing with the stressor or potential threat.

The result is that your heart rate and blood pressure increase, and your breathing rate increases so more oxygen can be taken in. Sugar and fat are released from storage to provide instant energy to the skeletal muscles. Your pupils dilate ('expand') to allow more light to enter the eye and enhance vision. Your sweat glands increase production of sweat to cool the body. In addition, digestion is slowed down. The sympathetic nervous system is also involved when you blush or get goosebumps, making the hairs on your body stand on end (see Box 2.3 opposite).

Figure 2.10 The sympathetic nervous system is activated in both these animals.

BOX 2.3 Goosebumps

Goosebumps appear when the fine hairs on your skin stand on end. Tiny muscles at the base of the hairs pull them upright. Their appearance is controlled by the sympathetic nervous system.

Human body hairs are so short that when they become erect, nothing much happens. The response of goosebumps has been described as an evolutionary response linked to our early ancestors, who had hairier bodies. Erecting the hairs helps non-human mammals conserve their body warmth in a cold environment by increasing insulation around their bodies. In several species it also serves as a defence against enemies in emergency situations. Consider, for example, a frightened cornered cat. By erecting its hairs, it looks larger and by doing so may deter its opponent. A strong emotional response by a person to a significant event may also trigger goosebumps (Bubenik, 2003).

The echidna's quills, which are an effective defence against potential predators, are actually modified body hairs. In an emergency situation, sympathetic nervous system activity leads to erection of the quills, just as it leads to erection of hairs in other mammals. The behaviour that makes the quills so useful (their erection in response to fear) is believed to have evolved before the quills themselves did.

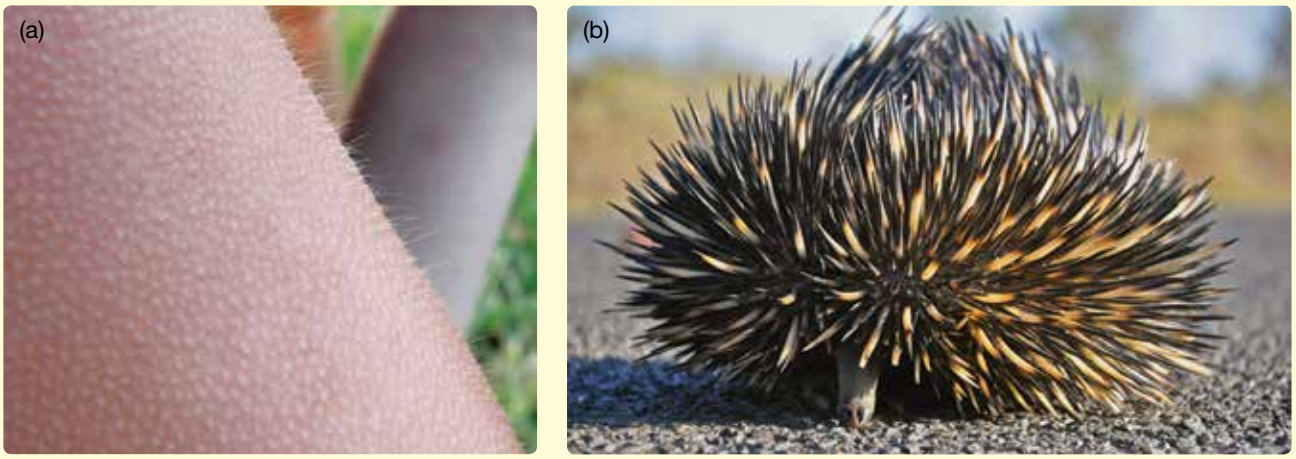

Figure 2.11 (a) Human goosebumps on the skin of an adult male's forearm (b) An echidna with erect quills

The parasympathetic nervous system

In times of minimal stress and in the absence of threat, the **parasympathetic nervous system** helps to maintain the internal body environment in a steady, balanced state of normal functioning. The parasympathetic nervous system generally has the effect of counterbalancing the activities of the sympathetic nervous system. It restores the body to a state of calm, once the need for sympathetic nervous system activation has passed.

The parasympathetic nervous system dominates the sympathetic nervous system most of the time. It is involved in routine, everyday activities. For example, when you eat, the parasympathetic nervous system stimulates the stomach and intestines to digest food. It is also involved in the elimination of wastes and the protection of the visual system through the production of tears and through automatic pupil constriction in conditions of bright light. In addition, when returning the body to a balanced state (called homeostatic), the parasympathetic nervous system reduces heart and breathing rates, and minimises the release of sugar and fats into the bloodstream.

If you had to jump out of the way of an oncoming car, your sympathetic nervous system would immediately be activated. Once the danger had passed, your parasympathetic nervous system would take over and the various bodily systems and functions activated by the sympathetic nervous system would gradually begin to return to normal. The parasympathetic nervous system takes longer to return the body to its normal state compared with the sympathetic nervous system's immediate activation. This is because of the lingering presence of the hormones that are released when the sympathetic nervous system is activated. These hormones remain in the bloodstream for some time after the threat has passed.

Figure 2.12 Riding on a roller-coaster activates the sympathetic nervous system. After the ride is over, the parasympathetic nervous system restores the body to a state of calm.

TABLE 2.1 The activities of the sympathetic and parasympathetic nervous systems

Bodily organ	Bodily function	Sympathetic nervous system action	Parasympathetic nervous system action
Pupils	Regulate the amount of light entering the eye	Dilate (expand)	Contract
Salivary glands	Digestion	Decrease salivation	Increase salivation
Heart	Pumps blood	Accelerate heart rate	Slow heart rate
Bronchioles of lungs	Breathing	Dilate (expand)	Contract
Stomach	Digestion	Decrease contractions	Increase contractions
Liver	Produces bile to aid digestion Maintains blood-sugar (glucose) level	Increase the release of glucose (sugar)	Decrease the release of glucose (sugar)
Gall bladder	Stores bile	Inhibit the release of bile	Stimulate the release of bile
Adrenal glands	Secrete the hormones adrenaline (epinephrine) and noradrenaline (norepinephrine) from the medulla	Stimulate hormone secretion resulting in increased heart rate, blood pressure and breathing rate, and relaxation of intestinal muscles	Inhibit hormone secretion
Bladder	Stores urine	Relax	Increase contractions
Intestine	Digestion	Relax	Increase contractions
Genitals	Reproduction	Excite	Relax
Sweat glands	Regulate temperature	Increase production of perspiration	Decrease production of perspiration

LEARNING ACTIVITY 2.6

Review questions

1. In what main way do the sympathetic nervous system and the parasympathetic nervous system differ?

2. (a) What is the role of the sympathetic nervous system in enhancing survival?
(b) Give three examples of bodily functions that increase their activity as a result of sympathetic nervous system activation.
(c) Give three examples of bodily functions that decrease their activity as a result of sympathetic nervous system activation.

3. (a) Describe the main roles of the parasympathetic nervous system.
(b) Give three examples of bodily functions that are affected as a result of the action of the parasympathetic nervous system. Briefly explain the purpose of these changes if resulting from parasympathetic nervous system activation.

4. Explain why it can take longer for the parasympathetic nervous system to 'slow down' bodily functions than it does for the sympathetic nervous system to 'speed up' bodily functions.

5. Compare and contrast the central, peripheral, somatic, autonomic, sympathetic and parasympathetic nervous systems in terms of their anatomical relationships and major functions.

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Practical activity
Measuring heart rate restoration

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LEARNING ACTIVITY 2.7

Sympathetic versus parasympathetic nervous systems

1. Which division of the autonomic nervous system is likely to be dominant if you are in each of the following situations?
(a) lying on the beach reading a book
(b) waiting for the delivery of your VCE results
(c) feeling anxious about a blind date
(d) hearing an unexpected loud knock on the window at 2 am while watching TV alone
(e) eating dinner
(f) watching a terrifying scene in a movie

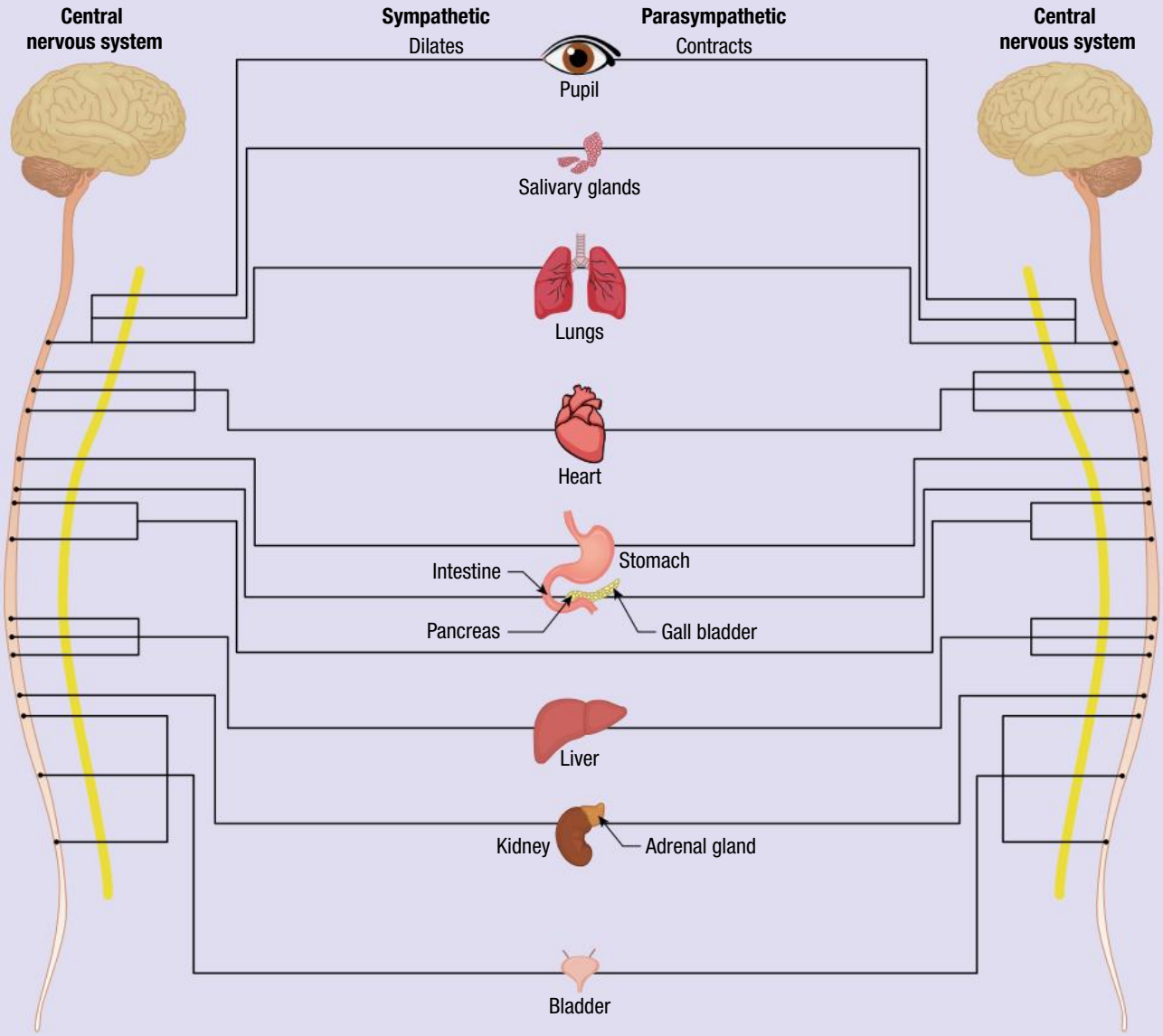
2. Which division of the autonomic nervous system is likely to be dominant when each of the following physiological responses is observed?
(a) increased rate of digestion
(b) decreased salivation
(c) increased pulse rate
(d) decreased pupil size
(e) increased perspiration
(f) increased hormone secretion
(g) decreased glucose secretion

LEARNING ACTIVITY 2.8

eBookplus
Word copy of diagram

Summarising the activities of the sympathetic and parasympathetic nervous systems

Using the diagram below, summarise the activities of the sympathetic and parasympathetic nervous systems. Insert your answers on the lines connecting the various organs and glands, as shown in the example for the pupil.



LEARNING ACTIVITY 2.9

Visual presentation: putting it all together

Construct a diagram to show and explain how the different divisions of the nervous system respond to, integrate and coordinate their activities when a person interacts with the external world in some way; for example, a relatively simple action such as shaking hands with someone, picking up a phone and pressing a key to answer a call, or switching on the TV. The explanation may be in point form.

CONSCIOUS AND UNCONSCIOUS RESPONSES TO SENSORY STIMULI

Some people believe that we use only 10% of our brain and the rest is a huge reservoir of untapped potential for some kind of remarkable 'power'. The reality is that we ordinarily use virtually every part of the brain, and that the brain is active almost all the time. In neurosurgery, where it is possible to observe the functions of a patient's brain under local anaesthetic while the patient is awake, electrical stimulations in virtually all parts show activity at the neuronal level, even when no sensory experience, movement or any other reaction is being observed. Moreover, no areas of the brain are completely inactive, even during sleep. If they were, it would indicate a serious functional disorder (CERI, 2007; Horstman, 2009; Kolb & Whishaw, 2014).

Our brain and nervous system are constantly processing sensory stimuli detected by sensory receptors and organs that respond to the different types of information received from both our internal and external environments. Our responses to these stimuli may be conscious or unconscious. Psychologists distinguish between these reactions primarily in terms of whether or not there is awareness.

A **conscious response** to a sensory stimulus is a reaction that involves awareness. You will have paid attention to the stimulus and therefore know about it. The response will usually be a voluntary, 'intentional' reaction. The reaction, even if momentary, is also likely to be goal directed ('purposeful') and you will be able to exercise some degree of control over it.

In the course of a typical day we make numerous conscious responses of varying complexity to all kinds of external sensory stimuli that bombard our senses. For example, when you step outside and feel the air temperature you will make a conscious response when you decide whether to put on a jacket. Similarly, if the sun is shining brightly, you may choose to wear sunglasses, a hat or both.

A conscious response may also be made to an internally sourced stimulus, as might occur if you feel a stomach ache in class at school. Depending on the severity of the ache, you may decide to ignore it, stroke your stomach, tell someone about it, excuse yourself and leave the room, or react in some other way that you believe is best.

An **unconscious response** to a sensory stimulus is a reaction that does not involve awareness. It is involuntary, unintentional, automatic and we cannot ordinarily control its occurrence. Bodily responses regulated by the ANS occur automatically without conscious effort. For example, in response to stimuli about the state of different bodily systems, your ANS is unconsciously regulating their functioning, pumping blood from your heart, digesting your food and so on. You do not consciously have to think about making your heart beat, your eyes blink or your lungs fill with oxygen. Many of these ANS functions are actually reflexive responses (called *autonomic reflexes*).

(a)

(b)

Figure 2.13 A reflex is an unconscious, automatic involuntary reaction to a stimulus that occurs in the same way each time. It requires sensory input and the reaction to stimulation is very quick. We are born with a large number of reflexes, but most of these disappear or are incorporated as parts of other behaviours within several months after birth. (a) The sucking reflex is an involuntary response that is important for survival as it enables the newborn infant to feed. (b) This newborn infant demonstrates the grasping reflex. Although it is strong enough to allow infants to support their own weight, this reflex disappears within the first few months of life, like many other reflexive behaviours we are born with.

Other reflexive responses also serve to help us avoid danger and minimise harm. Sometimes, we need to react so quickly that there is no time for conscious thought. These unconscious, automatically occurring responses are reflexes involving contraction of skeletal muscles. Most are very simple responses. They occur in the same way each time and do not require learning. Of course, we may sometimes become conscious of the stimulus that activated a reflex, and this awareness may enable us to correct or avoid a potentially dangerous situation, but awareness is *not* a part of the reflex itself. It may come after the reflex action has been completed, as may occur with a spinal reflex.

The spinal reflex

The spinal cord does more than provide pathways for messages to and from the brain. It can also initiate some simple responses on its own independently of the brain. These responses include spinal reflexes.

A **spinal reflex** is an unconscious, involuntary and automatically occurring response to certain stimuli initiated within the spinal cord without any involvement of the brain. It is often referred to as a *reflex arc* because the response to an incoming stimulus is automatically 'reflected back' from the spinal cord without any initial input from the brain and before the brain processes a conscious perception of the stimulus.

For example, if you were to touch the hot metal handle of a frying pan, you would automatically withdraw your hand to release the handle before the sensory information travels all the way to your brain and therefore before pain is actually experienced. The sensory receptor cells within the skin of your fingers would detect the heat and send neural messages via one or more sensory neurons to your CNS, but the first point of contact in the CNS is the spinal cord. It responds with a message via one or more motor neurons to move the appropriate muscles in your hand to release the hot object and withdraw the hand and is therefore called a *withdrawal reflex*.

The immediate response at the spinal cord enables a faster reaction time, a fraction of a second before the sensory information reaches the brain. Consequently, this type of spinal reflex involving a withdrawal reaction is believed to be an adaptive response. The spinal reflex is considered adaptive as it saves time in a situation that may be very harmful to the organism. While the transmission of information from the spinal cord to the brain only takes a fraction of a second, this saved time may be important in terms of minimising harm, or even saving the life of the organism. Other examples of this type of spinal reflex are jerking your bare foot up from a hot pavement and withdrawing your hand if you touch a sharp object.

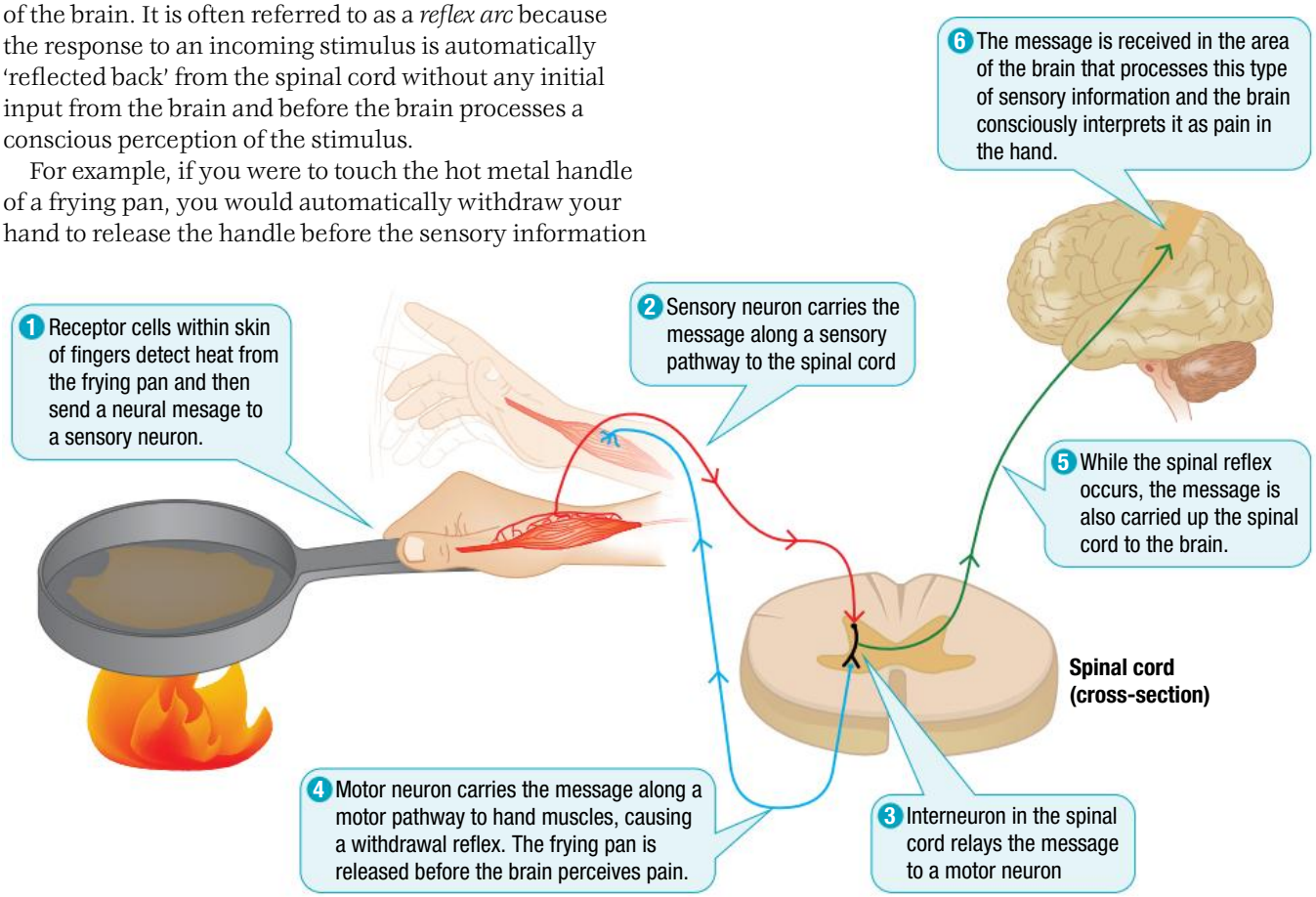


Figure 2.14 This sequence shows a spinal reflex involving a withdrawal response. Sensory receptors within the skin respond to the stimulation and initiate a neural message that is carried by a sensory neuron to an interneuron in the spinal cord. The interneuron acts as a link between sensory and motor neurons, relaying information from one to the other (because sensory and motor neurons rarely connect directly). The interneuron sends the message to a motor neuron that carries a message back to the appropriate muscles, which stimulates and causes them to contract and pull away from the stimulus. The spinal cord will also carry the message to the brain, including information about the action taken. The hot and potentially harmful pan handle is released before the brain processes the conscious perception of pain. Figure 2.21 on page 165 shows another spinal reflex involving a withdrawal response.

Because reflexes are normally so predictable, they provide useful information about the functioning of the nervous system and greatly assist in the diagnosis of neural disorders. Damage or disease anywhere along the reflex arc can cause a reflex to be absent or abnormal. For example, when the knee is tapped on the patellar ligament, the sensory nerve that receives this stimulus carries the information to the spinal cord, where it is relayed to a motor nerve. This normally causes the quadriceps muscle at the front of the thigh to contract and jerk the leg up. The leg begins to jerk up while the brain is just becoming aware of the tap. Absence of this patellar reflex could indicate damage within sensory or motor pathways, or a spinal cord injury in the lower back area (Jenkins, Kemniz & Tortora, 2010).

The spinal reflex demonstrates that a response to a particular sensory stimulus can have both an unconscious and conscious component, one occurring before the other. For each reflex action, a relatively small number of neurons simply convert a sensory stimulus into action. Many involve only three neurons — a sensory neuron, a motor neuron and an interneuron that relays messages between them. The simplest of spinal reflexes (such as the patellar 'knee jerk' reflex) can involve as few as two neurons — a sensory neuron and a motor neuron. The different types of neurons involved in a spinal reflex are described in Figure 2.14 on page 159. We consider their specific roles in the next section.

Note that a spinal reflex typically involves muscle contraction and does not represent all types of reflexes. Nor do all type of reflexes involve muscle contractions. For example, reflexes can involve glandular secretions, such as fluid secretion in the mouth by salivary glands in response to taste stimulation, and tear secretion from lacrimal glands when stimulated by eye irritation, bright light, or an emotion. Our extensive repertoire of reflexes may also include some learned responses that are acquired as the result of experience, such as the salivation of a dog in response to a sound they have come to associate with food, first studied by Ivan Pavlov and called a *conditioned reflex*. This type of conditioned reflex is now referred to as a conditioned response (see Chapter 5).

Figure 2.15 The lacrimal reflex involves release of tears in response to stimulation by eye irritation, bright light or an emotion.

LEARNING ACTIVITY 2.10

Review questions

1. (a) Distinguish between a conscious and unconscious response by the nervous system to a sensory stimulus with reference to three key points.
(b) Give an example of when you may respond to an external stimulus before you know that you have responded.

2. (a) Define reflex.
(b) List four key properties or characteristics of a reflex.

3. (a) Explain what a spinal reflex is.
(b) Why is it also called a reflex arc?
(c) Why may a spinal reflex be considered to have an 'adaptive' or 'survival' role?
(d) Give an example of a reflex response that you believe may *not* be involved in a spinal reflex arc. Explain your choice of example.

4. Draw a simple diagram to name the three types of neurons involved in a spinal reflex and show the sequence in which they contribute to the response.

5. How might damage to interneurons affect the spinal reflex?

6. Sam is using a wet knife to remove a broken piece of toasted bread that is jammed in the toaster. She experiences an electric shock and spontaneously releases the knife and pulls her hand away from the stimulus.
(a) Will Sam experience pain? When? Explain your answers.
(b) List, in their correct order, the steps that enabled Sam's spinal reflex.

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Demonstrations
- Spinal reflex
- Neural processing time

LEARNING ACTIVITY 2.11

Visual presentation

Barefooted Jake steps on the sharp end of a drawing pin and immediately jerks up his foot before completing the step.

Create a flow chart that outlines the sequence of events in Jake's spinal reflex response and refers to the relevant anatomical features.

You may present your flow chart in a digital format, for example, as a Powerpoint slide with SmartArt graphics. The flow chart may include a copy of the stimulus event shown on the right.

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LEARNING ACTIVITY 2.12

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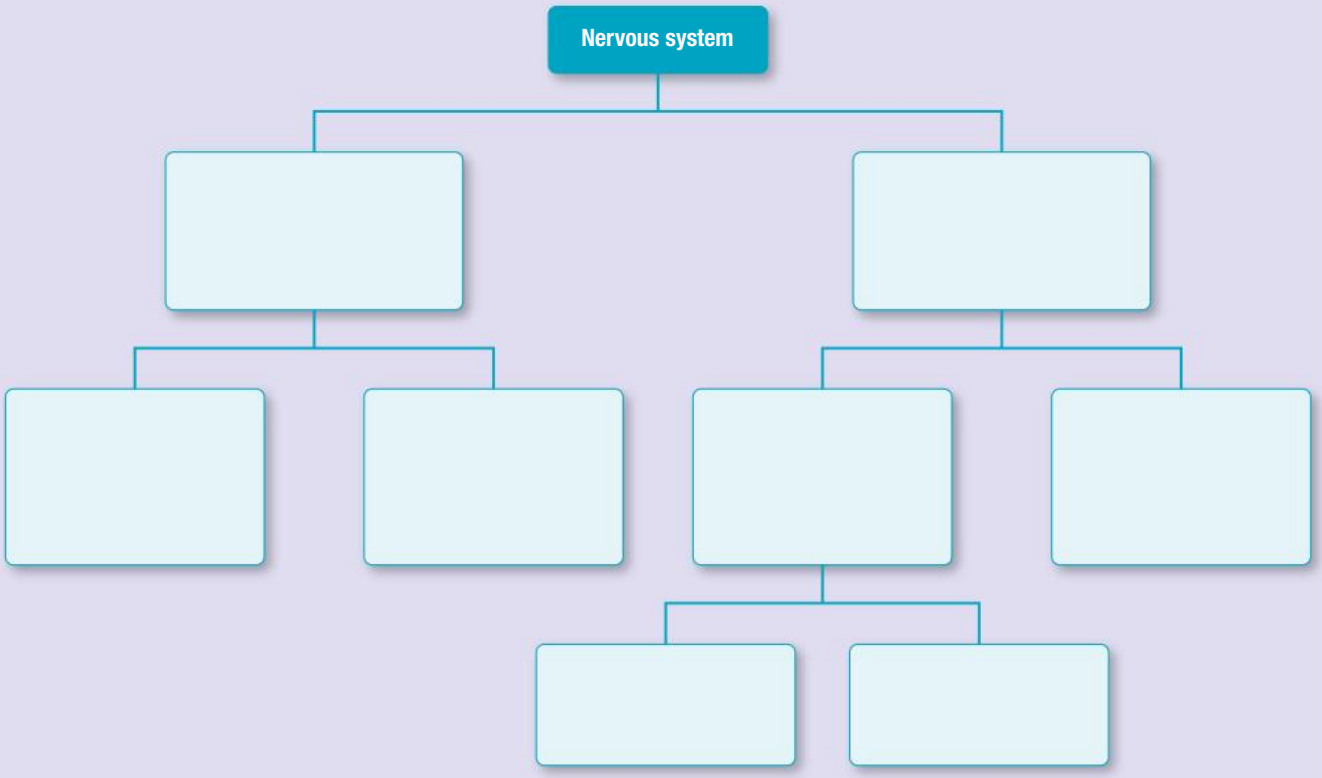
Word copy of flow chart

Main divisions and subdivisions of the human nervous system

Complete the following chart to show the main divisions and subdivisions of the human nervous system.



ROLE OF THE NEURON

The human nervous system consists of billions of neurons and glia (glial) cells. The neuron is the primary cell involved in the reception and transmission of information throughout the nervous system and different types of glia support neuronal function.

When even one part of the process breaks down, the results can be devastating. Many brain disorders and nervous system diseases, including Parkinson's disease, Alzheimer's disease, schizophrenia, epilepsy, multiple sclerosis and even botulism that causes paralysis, have been linked to problems with neurons and communication within and between neurons. Glia are also implicated in most neurological disorders and diseases given their numbers and crucial roles (Fields, 2011; Miller, Cookson & Dickson, 2004).

A **neuron** is an individual nerve cell that is specialised to receive, process and/or transmit information. Neurons not only communicate with each other, but also with muscles and glands. They are crucial building blocks of the brain and nervous system. The entire nervous system is comprised of neurons organised into networks that form neural pathways or circuits of varying complexity through which information is continuously transmitted. With support from glia, communication throughout the nervous system is an extremely fast and efficient process.

Neurons are also described as the 'primary functional units' of the nervous system because of their vital role in enabling the nervous system to function as it does. They carry information ('neural messages') in the form of an *action potential* (or *neural impulse*) to the appropriate part of the nervous system to interpret the message and enable a response. This function is enabled through two characteristic properties of all neurons: *irritability*, which is the ability to be stimulated, and *conductivity*, which is the ability to transmit or carry neural information.

Neurons have specialised functions and vary in shape and size depending on where they are located and on their specific function. Some neurons specialise in transmitting (carrying) information from sensory receptors, sensory organs, tendons or muscles *to* the CNS. Other neurons specialise in carrying information to cells in bodily organs, muscles or glands *from* the CNS. Some neurons simply serve as communication links and carry information *between* neurons (see Box 2.4 on page 165). However, most neurons typically have several structural features in common. These include dendrites, an axon, myelin and axon terminals.

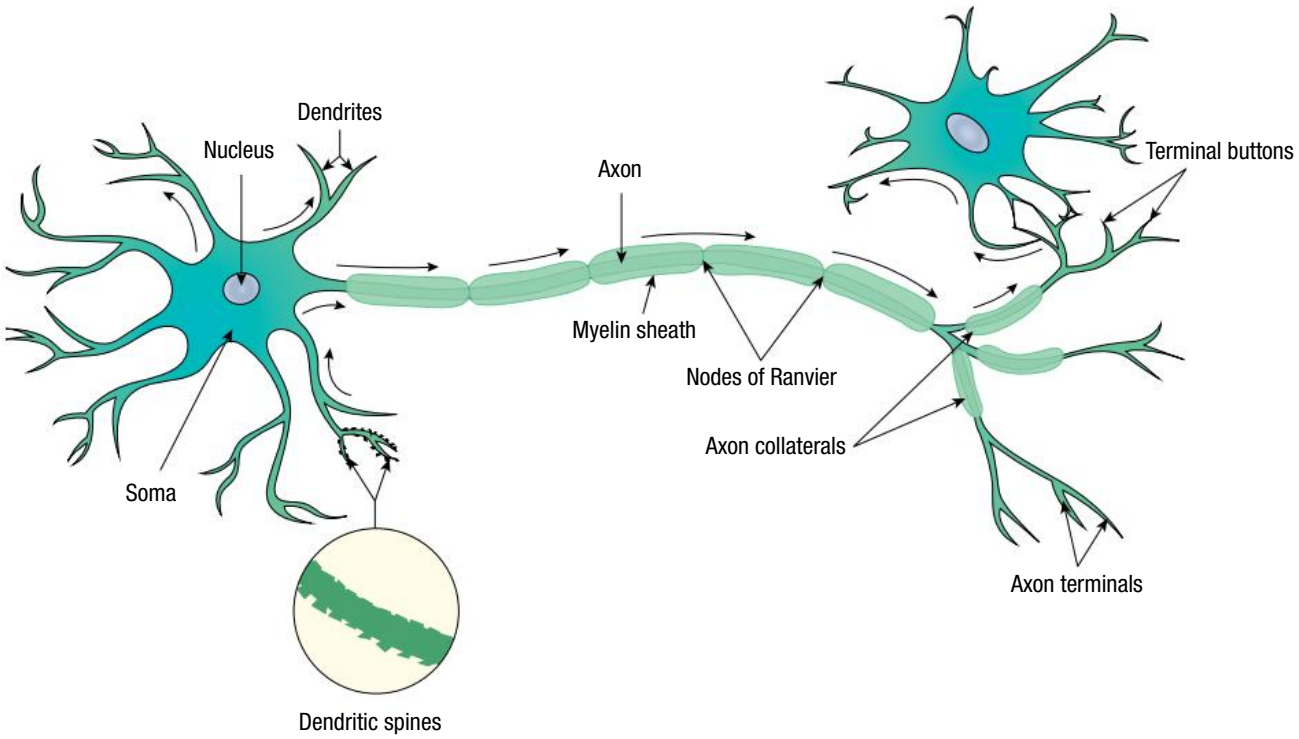


Figure 2.16 Incoming neural messages are received by the dendrites and transmitted to the soma (cell body) where the information is integrated. Outgoing information is transmitted from the soma to the axon terminals and on to dendrites of other neurons. Within the neuron, the message is in an electrical form called an action potential (or neural impulse).

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Measuring the speed of a neural impulse

Dendrites

A **dendrite** is an extension of a neuron that detects and receives information *from* other neurons. As shown in various diagrams throughout this chapter and the photo in Figure 2.17 below, dendrites separate out like the branches of a tree. Most dendrites have tiny protrusions, or outgrowths like knobs, called *dendritic spines*. Each spine provides a site with receptors where a neuron can connect with and receive information from a neighbouring neuron. The neuron's capability to form ('grow') new dendritic spines is associated with and demonstrates neuroplasticity.

A neuron may have from one to 20 or so dendrites, each dendrite may have from one to many branches, and the total number of spines on the branches may be in the hundreds or thousands. This means that a single neuron can have many thousands of connections to other neurons through its dendritic branches and spines. Each spine may have multiple kinds of receptors to gather different types of chemical messages from other neurons. Consequently, a single neuron can have the capability to receive, virtually simultaneously, many and various kinds of information from dozens, hundreds, or even thousands of other neurons.

When the dendrites receive information from other neurons, they pass it on to the neuron's *soma* (cell body) where it is integrated. The soma may collect and integrate information from thousands of other neurons. Once the incoming information from other neurons has been integrated in the soma, it is transmitted along the axon.

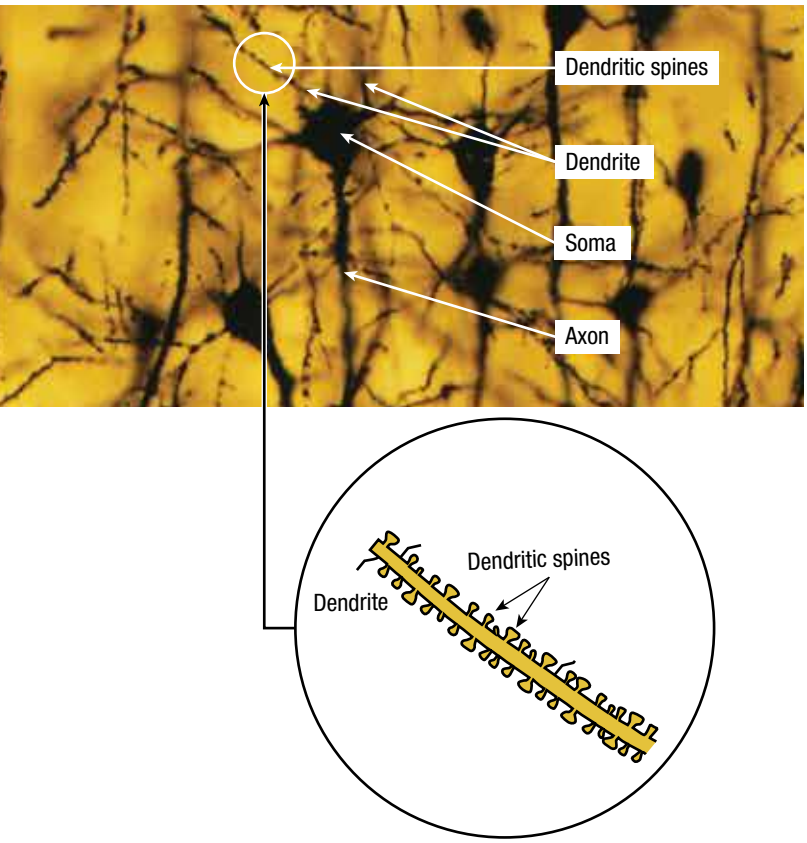


Figure 2.17 Key anatomical features of a neuron

Axon

An **axon** is a single, tubelike extension that transmits neural information *to* other neurons (or cells in muscles and glands). Most neurons have only one axon but many axons have branches that allow a message to be sent to multiple cells. Axons vary in length; for example, some axons extend over a metre from your spine to your big toe, others are as small as the width of a single hair. They are sometimes referred to as *nerve fibres*. Nerves are actually cable-like bundles of multiple axons (as shown in Figure 2.19 on the next page).

Myelin

The axons of many, though not all, neurons are myelinated. **Myelin** is a white, fatty substance (made up of certain types of glia) that surrounds and insulates the axon, much like the plastic tubing around copper wires in an electrical cord. Without the coating, called the *myelin sheath*, interference from the activity of other nearby axons may occur. In addition, the myelin sheath allows for the rapid movement of the message along the axon without being interrupted or distorted. Messages travel much faster through neurons wrapped in myelin than unmyelinated neurons.

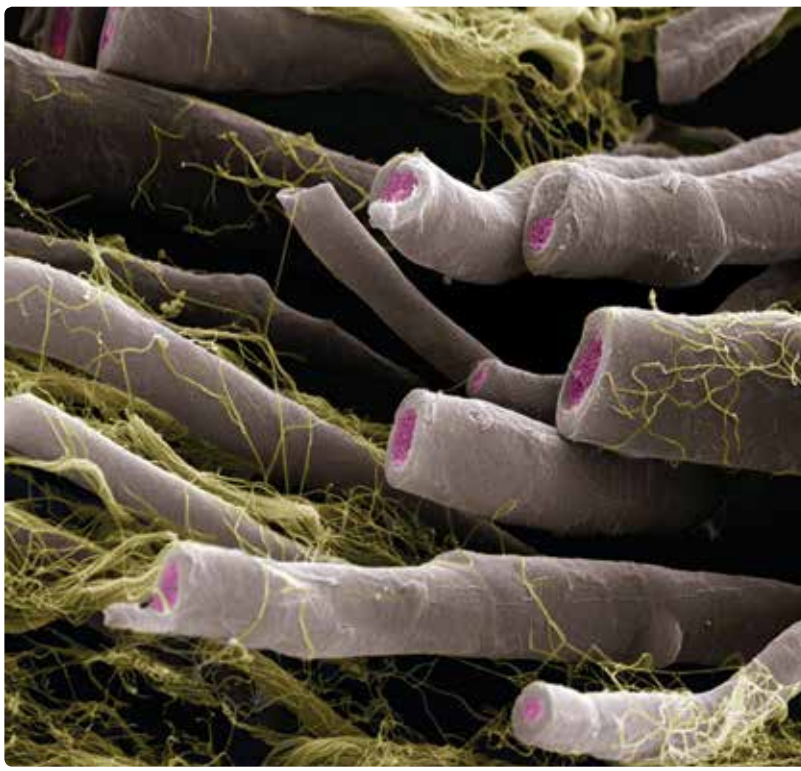


Figure 2.18 Myelin surrounds and insulates the axon, as well as allowing for the rapid movement of the message along the axon. This photo shows the myelin sheaths surrounding axons (pink) within a bundle of myelinated axons. The axons may also be called 'nerve fibres', whether myelinated or unmyelinated. Myelin makes up the 'white matter' of the brain (and spinal cord areas), whereas 'grey matter' is made up primarily of the somas and dendrites of neurons rather than myelinated axons.

The myelin sheath is not continuous along the full length of the axon. It occurs in segments that are separated by small unmyelinated gaps (called *nodes of Ranvier*). The neural message jumps from node to node and this is believed to speed up transmission.

The importance of the myelin sheath is evident in people with multiple sclerosis. In this CNS disease, the body's immune system attacks the myelin or the glia that produce and maintain it. Recurrent attacks by antibodies break down the myelin (called demyelination) and the axons themselves may also be damaged. The cause is still unknown. It may be due to something which causes the immune system to react in this way, or because there are issues with the myelin and that the immune system attempts to clean up the damage.

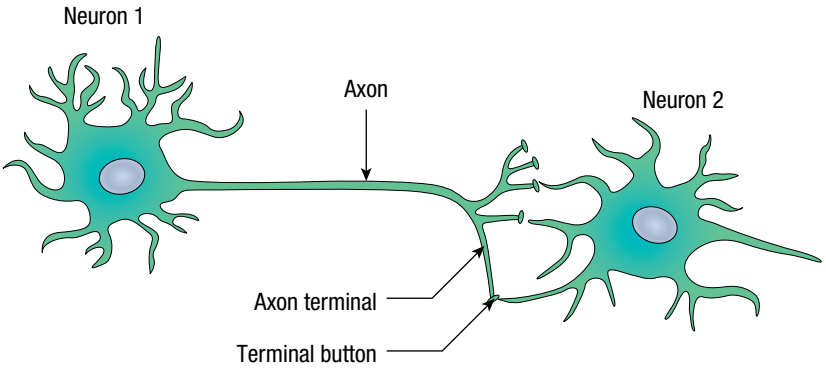
Demyelination ultimately creates areas of scarring ('sclerosis') which disrupt the transmission of neural messages within the CNS (including the optic nerve). This can result in impairment of motor, sensory and cognitive functions to a greater or lesser extent, depending on which part of the CNS is damaged and the severity of the damage (MS Australia, 2017).

Axon terminals

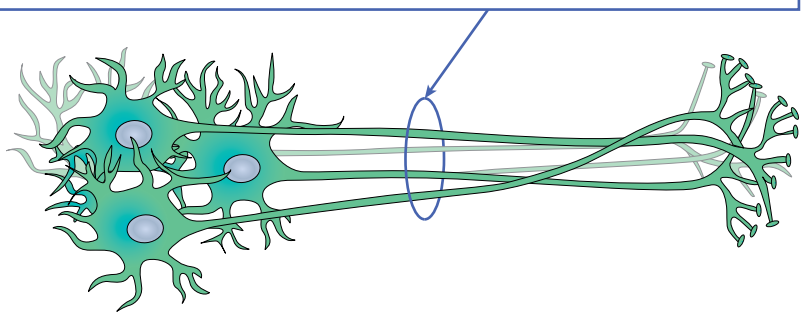
There are small branches at the end of an axon called *axon collaterals*. At the end of the collaterals are **axon terminals**. Each axon terminal has a small knoblike swelling at its tip called a *terminal button* (sometimes called a *synaptic vesicle, synaptic knob* or *synaptic button*). The terminal button is a small structure like a sac that stores and secretes neurotransmitter that is manufactured by the neuron and carries its chemical message to other neurons or cells.

Information always travels in one direction through a neuron. It is received by dendrites, passes through the soma and exits from the axon. The neural message to be sent by a neuron originates at the soma. It is in the form of an electrical signal. When it reaches the axon terminals, it stimulates the release of neurotransmitter from the terminal buttons. The neurotransmitter will carry the message to the next neuron in a chemical form. Although each neuron has only one axon, the collaterals and axon terminals allow its message to be sent to many other neurons simultaneously.

(a) Neural pathways are formed by interconnected neurons.



(b) A bundle of axons running together form a nerve.



(c) The image below shows a bundle of myelinated axons that have formed a nerve. Connective tissue (called perineurium) surrounds the bundle and binds the bundle together. Anywhere from a few nerve fibres (axons) to more than million can form a nerve.

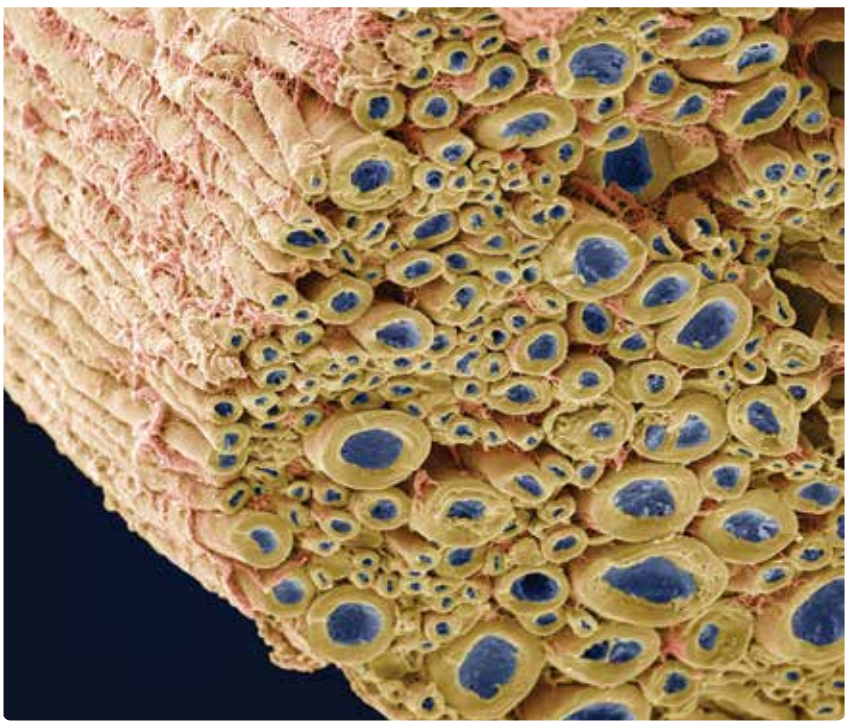


Figure 2.19 The term 'nerve' is commonly used for a neural pathway or circuit outside the CNS and 'tract' for a pathway within the CNS.

BOX 2.4 Three type of neurons

The neuron is the primary cell involved in the reception and transmission of information within the nervous system.

Neurons can be classified in terms of their specific function and the direction that they send information. Three classes are sensory neurons, motor neurons and interneurons.

Sensory and motor neurons are found throughout the nervous system, whereas interneurons are found only in the CNS. Figure 2.21 below shows the interaction between the three types of neurons to enable a spinal reflex initiated by a painful prick to the finger.

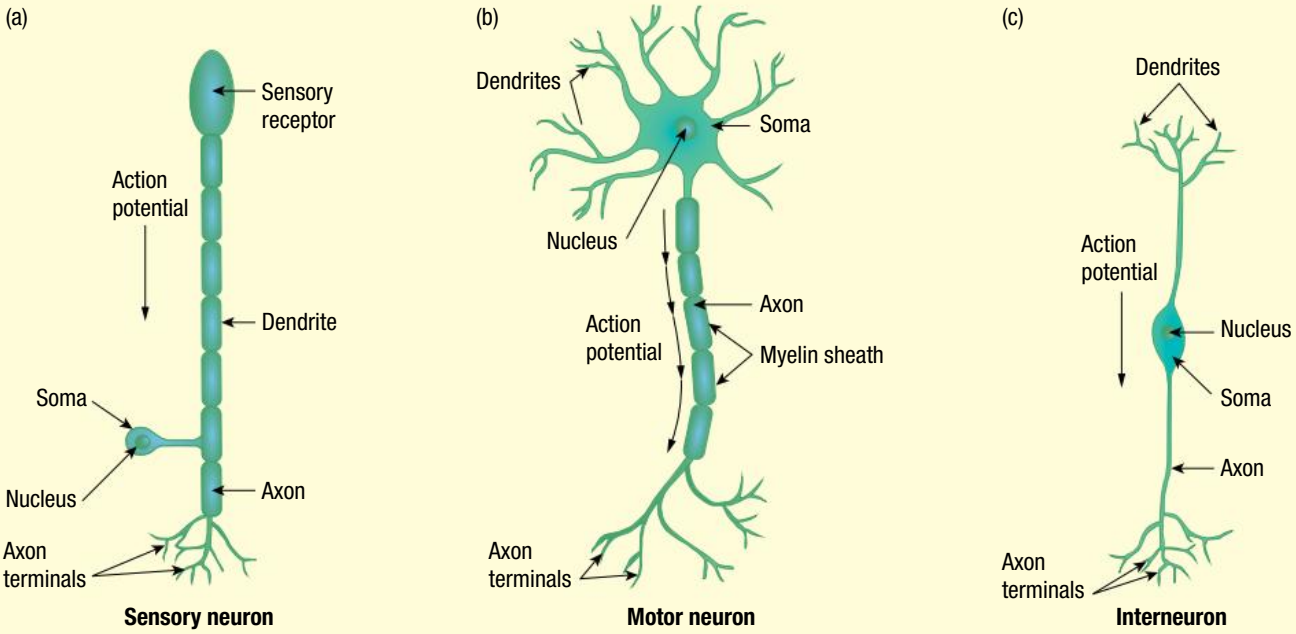


Figure 2.20 (a) A sensory neuron receives and carries sensory information from both the external and internal environments and transmits *to* the CNS. It is also called an afferent neuron or affector. As the name suggests, it is activated by sensory input. Note that is has a short axon, a long dendrite and one or more receptor cells that detect sensory information. (b) A motor neuron carries messages *from* the CNS to cells in skeletal muscles, organs and glands to stimulate activity. It is also called an efferent neuron, effector or motoneuron. Note that it has a longer axon than the sensory neuron and many shorter dendrites. (c) An interneuron sends messages *between* sensory and motor neurons within the CNS, relaying information from one to the other (because sensory and motor neurons rarely ever connect directly). It is also called a connecting or association neuron. It generally has relatively short axons and dendrites.

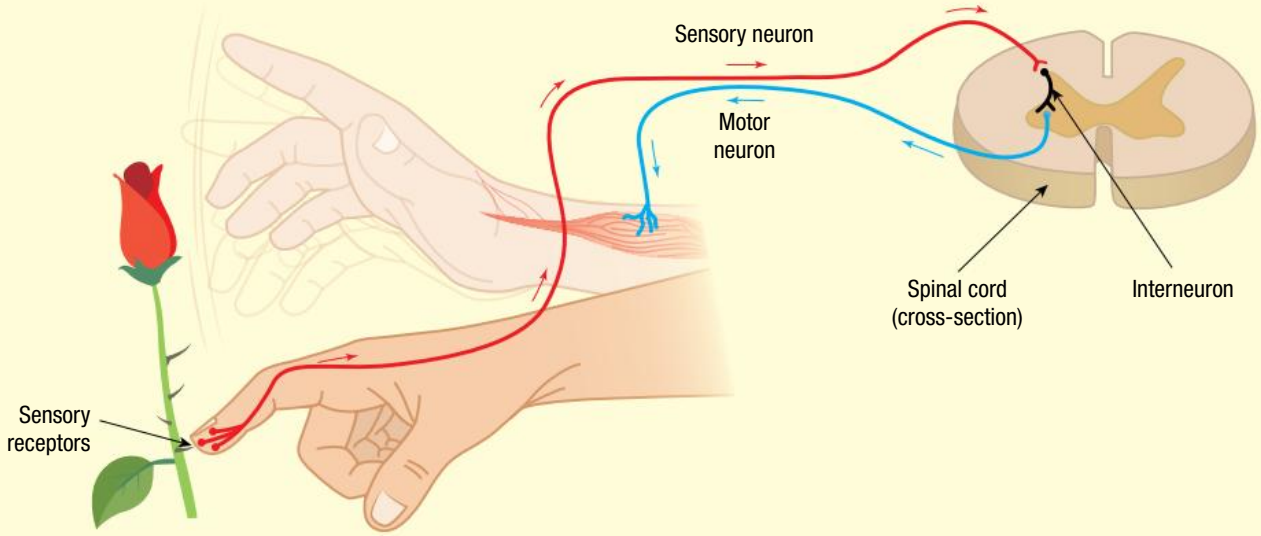


Figure 2.21 Interaction between the three types of neurons to enable a spinal reflex initiated by pain to the finger.

LEARNING ACTIVITY 2.13

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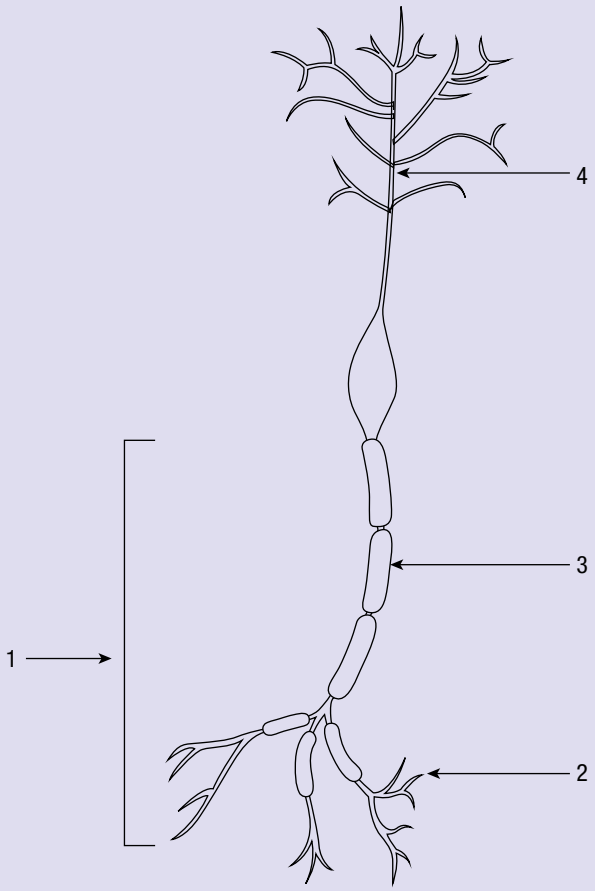
Word copy of diagram

Review questions

1. What is a neuron?
2. Explain the meaning of the statement 'Neurons are the primary functional units of the entire nervous system'.
3. In what way are the structure and functions of a dendrite different from those of axon terminals?
4. (a) Label the diagram of a neuron at right.
(b) Draw each of the following on the diagram:
i dendrites of an adjacent neuron
ii axon of an adjacent neuron
iii an arrow to show the direction of the action potential (neural impulse).
5. Match the part of the neuron in the list with its role in the transmission of a neural message.

(a) myelin
(b) terminal button
(c) dendrite
(d) axon
(e) axon terminal
(f) dendritic spine
(g) axon collateral
(h) soma

___ integrates information received by dendrites
___ receives information from another neuron
___ provides a specific receptor site for neural information
___ transmits neural information to another neuron
___ white, fatty substance surrounding an axon that insulates the neuron and increases the speed of neural communication
___ small branch at the end of an axon
___ extension of an axon collateral
___ stores and secretes neurotransmitter



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ROLE OF NEUROTRANSMITTERS

When neurons communicate with one another, they typically do so by sending neurotransmitter across the tiny space between the terminal buttons of one neuron, which release the neurotransmitter, and the dendrites of another, which receive the neurotransmitter. This tiny space is called the **synaptic gap** *(or synaptic cleft)*. The synaptic gap is about 500 times thinner than a strand of hair. It is one component of the synapse. The **synapse** is the site where communication occurs between adjacent neurons. The other two components of most synapses are the terminal buttons of the *presynaptic* ('sending') *neuron* and the dendrites of the *postsynaptic* ('receiving') *neuron*. The three components of this chemical synapse may also be referred to more generically; for example, as an axon terminal, a dendrite and a synaptic gap.

Neurotransmitter is a chemical substance produced by a neuron that carries a message to other neurons or cells in muscles, organs or other tissue. When carrying a message to another neuron, neurotransmitter works by attaching itself ('binding') to receptor sites of postsynaptic neurons that are specialised to receive that specific neurotransmitter. Therefore, receptors on dendrites play a vital role in the communication process.

Neurotransmitter that does not bind to receptors in the postsynaptic neuron is absorbed back into the terminal buttons by the presynaptic neuron in a process called *reuptake*. Once the postsynaptic neuron has received the neurotransmitter, any additional neurotransmitter left in the synapse will also be reabsorbed by the presynaptic neuron. Many medications work by affecting the process of reuptake in order to increase or reduce the availability of particular neurotransmitter(s) in the brain.

Generally, a specific type of neurotransmitter will have either of two effects. Some neurotransmitters have an **excitatory effect** and consequently stimulate or activate postsynaptic neurons to perform their functions. Other neurotransmitters have an **inhibitory effect** and block or prevent postsynaptic neurons from firing.

Some neurotransmitters also occur as hormones. For example, *noradrenaline* (also called *norepinephrine*) is a neurotransmitter and a hormone. It is secreted as a hormone by the adrenal glands into the blood, and as a neurotransmitter from neurons.

Glutamate and GABA are the most common neurotransmitters in the CNS. Neurons in virtually every brain area use these two chemical messengers to communicate with each other. They are considered the 'workhorses' of the CNS because so many synapses use them (Kolb & Whishaw, 2014).

Glutamate (Glu) is the main *excitatory* neurotransmitter in the CNS. This means that glutamate enhances information transmission by making postsynaptic neurons more likely to fire. It is the second most abundant neurotransmitter in the brain and involved in most aspects of normal brain function, including perception, learning, memory, thinking and movement. The release of glutamate is strongly associated with enhanced learning and memory.

Despite its importance, too much or too little glutamate can actually be harmful to neurons and brain functioning as a whole. For example, abnormally high concentrations of glutamate can result in overexcitation of receiving neurons. This overexcitation can lead to effects that can cause neuronal damage and/or death by overstimulating them.

Gamma-amino butyric acid (GABA) is the primary *inhibitory* neurotransmitter in the CNS. It works throughout the brain to make postsynaptic ('receiving') neurons less likely to fire (i.e. it 'inhibits' firing). One of its roles is to fine-tune neurotransmission in the brain and maintain neurotransmission at an optimal, or 'best possible', level.

Without the inhibitory effect of GABA, activation of postsynaptic neurons might get out of control. Their uncontrolled activation could spread throughout the brain, causing seizures similar to those of epilepsy and other problems. Anxiety symptoms such as those experienced by people with phobias have been connected to a low level of GABA in the brain, thereby impacting on the regulation of neuronal transmission in the brain. The link between anxiety and a dysfunctional GABA system is examined in Chapter 13 on page 636.

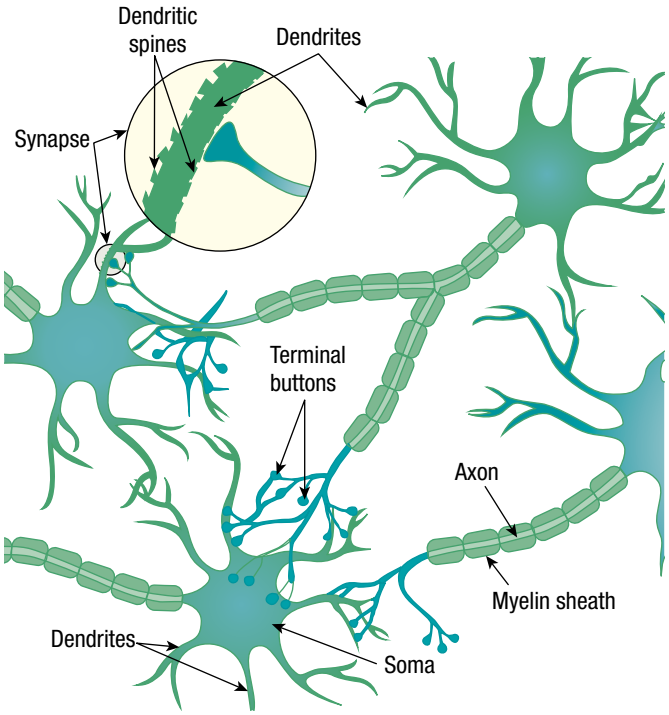

Figure 2.22 Neurons do not link together like a chain. The branches of an axon almost touch the dendrites of an adjacent neuron, leaving a tiny space called a synaptic gap.

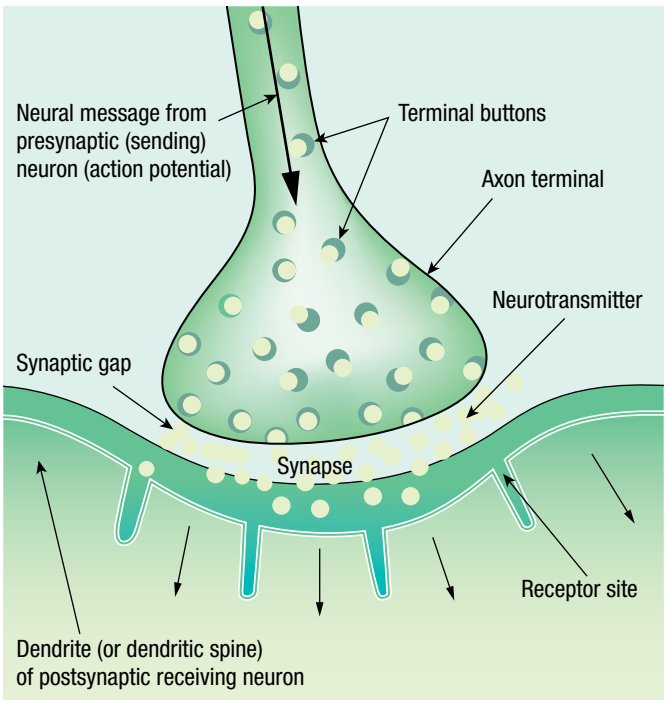

Figure 2.23 When the neural message reaches the axon terminal, neurotransmitter is released from the terminal buttons, which carries the message across the synaptic gap to the receiving neuron.

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Tutorial on synaptic neurotransmission 1m 51s

In sum, the inhibitory action of GABA counterbalances the excitatory activity of glutamate and vice versa. Consequently, GABA and glutamate have important roles in regulating central nervous system arousal.

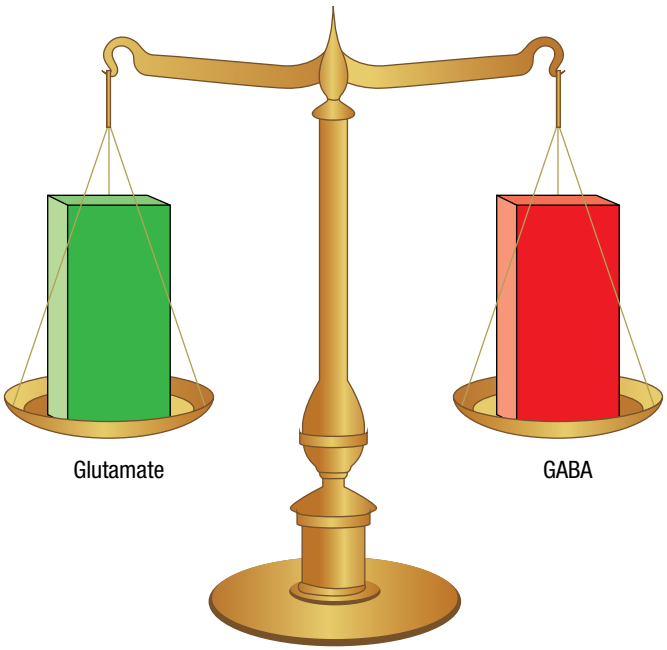


Figure 2.24 Glutamate is an excitatory neurotransmitter and makes receiving neurons more likely to fire. GABA is an inhibitory neurotransmitter and makes receiving neurons less likely to fire. The inhibitory action of GABA normally counterbalances the excitatory activity of glutamate and vice versa.

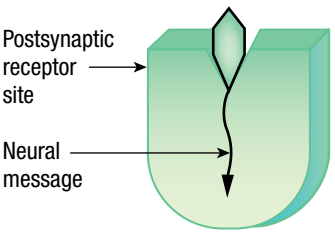
Neurotransmission as a lock-and-key process

Each type of neurotransmitter has a chemically distinct shape. When released by the presynaptic neuron, neurotransmitter searches for the correctly shaped receptor site on the dendrites of the postsynaptic neurons. Like a key in a lock or a piece of a jigsaw puzzle, a neurotransmitter's shape must precisely match the shape of the receptor site on the postsynaptic neuron's dendrites in order to bind ('attach') to its receptors. The binding 'unlocks' the postsynaptic neuron's response so that the neurotransmitter causes changes to the neuron, resulting in an excitatory or inhibitory effect. This is why chemical neurotransmission is often referred to as a **lock-and-key process**. The neurotransmitter is the key and the receptor site is the lock but only for a specific key. This is similar to the lock for the front door of a house. If you do not have the right key, you will not be able to open the door and enter the house.

A postsynaptic neuron can have many different shaped receptor sites on its dendrites and may therefore be able to receive several different neurotransmitters. The effects of a neurotransmitter are not entirely caused by the chemical. Its effects are also due to the receptor to which the neurotransmitter binds. The same neurotransmitter can be excitatory or inhibitory, depending on the properties of the receptor and on the receptor's location in the brain.

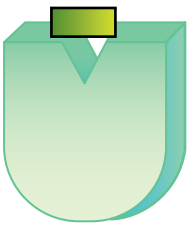
The number of neurotransmitters that a neuron can manufacture varies. Some neurons manufacture only one type of neurotransmitter, whereas other neurons manufacture two or more and therefore contain more than one type of neurotransmitter at their axon terminals. This means that a single neuron may secrete one neurotransmitter at one synapse and a different neurotransmitter at another synapse. In some cases, more than one type of

(a) Normal neurotransmitter activation



Somewhat like a key fitting into a lock, receptor sites on receiving neurons' dendrites recognise neurotransmitters by their particular shape. When the shape of the neurotransmitter matches the shape of the receptor site, neurotransmission of the message has occurred.

(b) Blocked neurotransmitter activation



Neurotransmitters without the correct shape will not fit the receptors, so they cannot stimulate the dendrite, and that neurotransmitter's message is blocked.

(c) Many 'lock and key' combinations are complex.

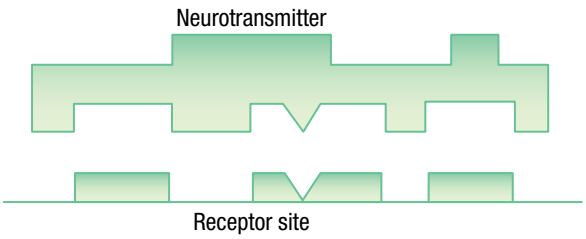


Figure 2.25 Each neurotransmitter has a chemically distinct shape. Like a key in a lock, a neurotransmitter's shape must precisely match the shape of the receptor site on the receiving neuron in order to communicate its message.

neurotransmitter may coexist in the same terminal button. Although estimates vary depending on the source, researchers have identified the presence of at least 60 different neurotransmitters in the human brain. Some researchers have estimated far more than this number. All this complexity allows for a very large number of neurotransmitters and receptor sites for them (Gross, 2016; Kolb & Whishaw, 2014; Seal, 2008).

Furthermore, while communication between one neuron and another is usually a chemical process involving neurotransmitters, communication between neurons also occurs in other ways. In some instances, communication between neurons is electrical; for example, when axons transmit messages directly to other axons or directly to the cell body (soma) of other neurons and when dendrites of one neuron communicate directly with the dendrites of other neurons.

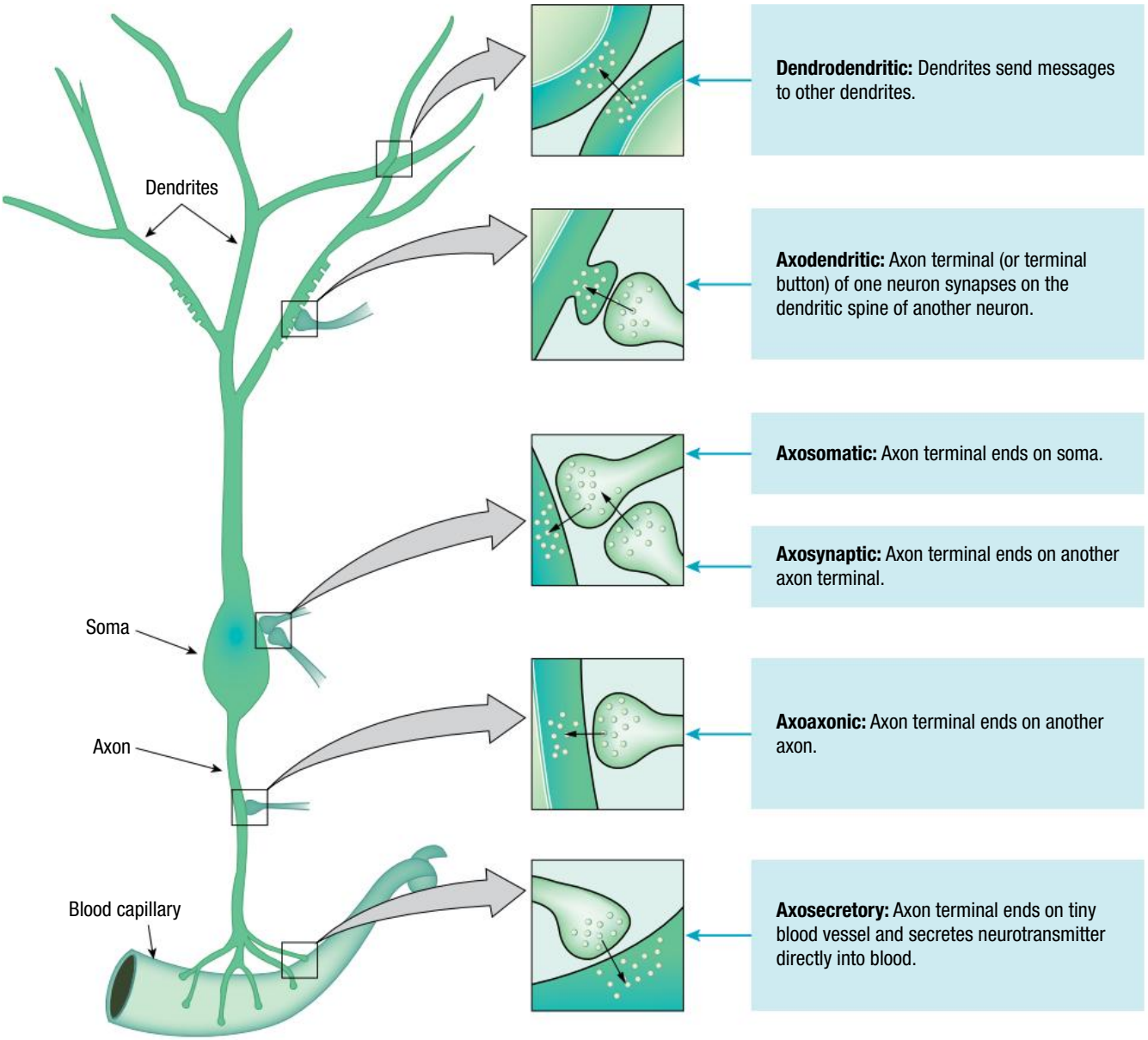


Figure 2.26 Synapses vary widely within the central nervous system. This diagram gives examples of the diversity using a single hypothetical neuron. For example, an axon terminal can end on a dendrite, on another axon terminal, on a soma, on an axon, or on a blood capillary. Dendrites may also form synaptic connections with each other.

Based on Kolb, B., & Whishaw, I.Q. (2014). *An introduction to brain and behavior* (4th ed.). New York: Worth. p.147.

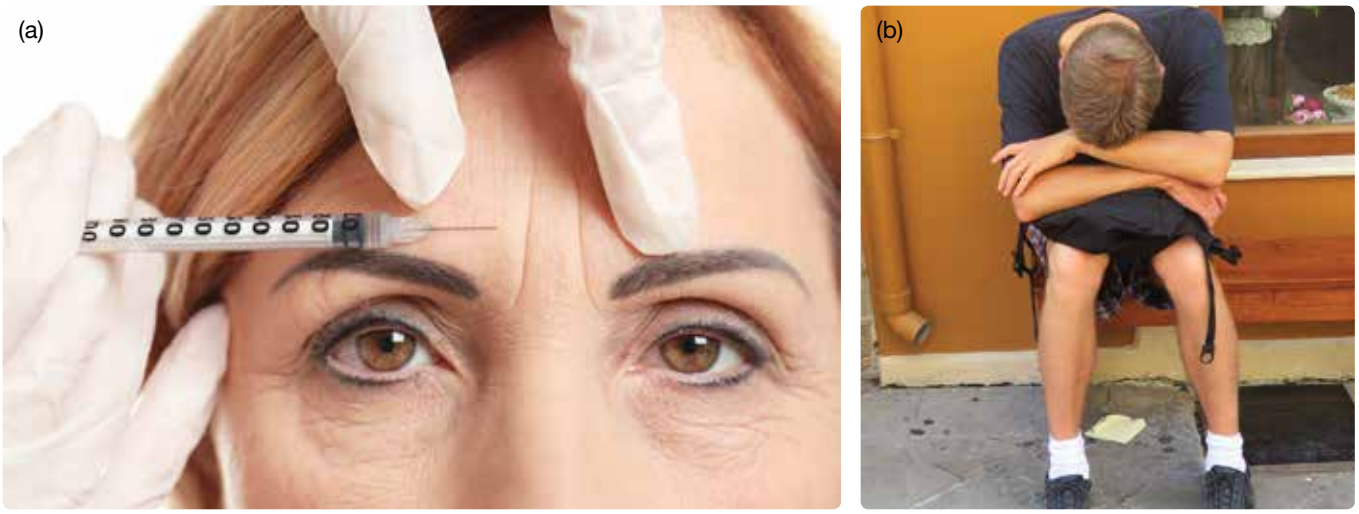


Figure 2.27 (a) Acetylcholine (ACh) is an excitatory neurotransmitter that is found throughout the nervous system. Among other functions, ACh is released by motor neurons onto muscle cells to activate muscle contraction. The image on the left shows the use of Botox in a cosmetic procedure to remove wrinkles from the forehead. However, the Botox will also inhibit the release of ACh and paralyse muscles. (b) A low level of the neurotransmitter serotonin in the brain is associated with depression. Antidepressant medication such as Prozac® and Zoloft® is used to help alleviate mood-related symptoms by increasing the level of serotonin or maintain it in greater supply (although antidepressant medications do not necessarily work for everyone). Like most other neurotransmitters, serotonin has been found to also be involved in a wide range of other psychological activity, including anxiety, sleep and wakefulness, dreaming, eating, sexual behaviour and aggressive behaviour.

LEARNING ACTIVITY 2.14

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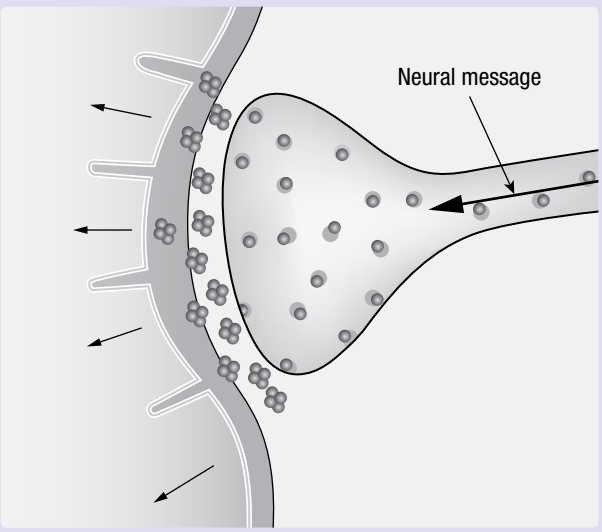
Word copy of diagram

Review questions

1. (a) What is neurotransmitter?
(b) What role does neurotransmitter play in neural communication at a synapse?

2. (a) What is a synapse?
(b) Name the three components of a synapse and outline their roles in communication between neurons.

3. Mark each of the following on the diagram below.
(a) synaptic gap
(b) synapse
(c) terminal button
(d) postsynaptic neuron
(e) neurotransmitter
(f) axon terminal
(g) receptor site
(h) presynaptic neuron



4. Distinguish between excitatory and inhibitory effects of a neurotransmitter with reference to glutamate and GABA.

5. Outline the chemical neurotransmission process with reference to the lock and key model.

6. Match each neurotransmission term with its correct description.
(a) presynaptic neuron
(b) reuptake
(c) receptor site
(d) glutamate
(e) neurotransmitter
(f) inhibitory effect
(g) gamma-amino butyric acid (GABA)
(h) synaptic gap (cleft)
(i) binding
(j) excitatory effect
(k) synapse
(l) terminal button
(m) postsynaptic neuron

___ tiny space between the terminal buttons of a sending neuron and the dendrites of receiving neuron
___ receiving neuron
___ when terminal buttons 'take back' neurotransmitter
___ where neurotransmitter is received
___ an excitatory neurotransmitter in the CNS sending neuron
___ neural message in a chemical form
___ point of communication between adjacent neurons
___ where neurotransmitter is released
___ block or prevent a postsynaptic neuron from firing
___ stimulate or activate a postsynaptic neuron
___ attachment of neurotransmitter to a receptor site
___ an inhibitory neurotransmitter in the CNS
___ sending neuron

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LEARNING ACTIVITY 2.15

Reflection

'Everything the brain does can ultimately be explained in terms of the electro-chemical interaction of its neurons.'

Comment on this statement with reference to an example of a specific thought, feeling or behaviour.

HOW INTERFERENCE TO NEUROTRANSMITTER FUNCTION CAN AFFECT NERVOUS SYSTEM FUNCTIONING

The vital role played by neurotransmitters in communication between neurons makes it clear that we are crucially dependent on them. More specifically, our ability to do virtually anything depends on the neurotransmitters in our nervous system functioning as they should, as well as having them in the biologically correct amounts. For example, there is compelling research evidence that too little or too much of a specific neurotransmitter can have a significant impact on how we think, feel or behave because of its effect on nervous system functioning.

Abnormal levels of specific neurotransmitters have been linked to various problems with mental processes and behaviour. This is illustrated by the role of dopamine in Parkinson's disease.

Parkinson's disease

Parkinson's disease is a chronic and degenerative neurological condition that affects both motor and non-motor functions. It is chronic because it persists over a long period of time, and degenerative because the disease and its symptoms progressively get worse over time. Although classified as a 'movement disorder' and diagnosis is based on the presence of movement abnormalities, it impairs other functions, which contribute to disability and loss of independence (Parkinson's Australia, 2018a; The Florey Institute, 2018).

Role of dopamine

Motor symptoms such as slowness of movement, tremors, muscle rigidity, and unstable posture are believed to primarily result from the degeneration and loss of neurons in the **substantia nigra**, a structure located within the basal ganglia in the midbrain, around the top of the spine in the brain stem.

Neurons in the substantia nigra produce the neurotransmitter dopamine, so when the substantia nigra is diseased or damaged, the amount of

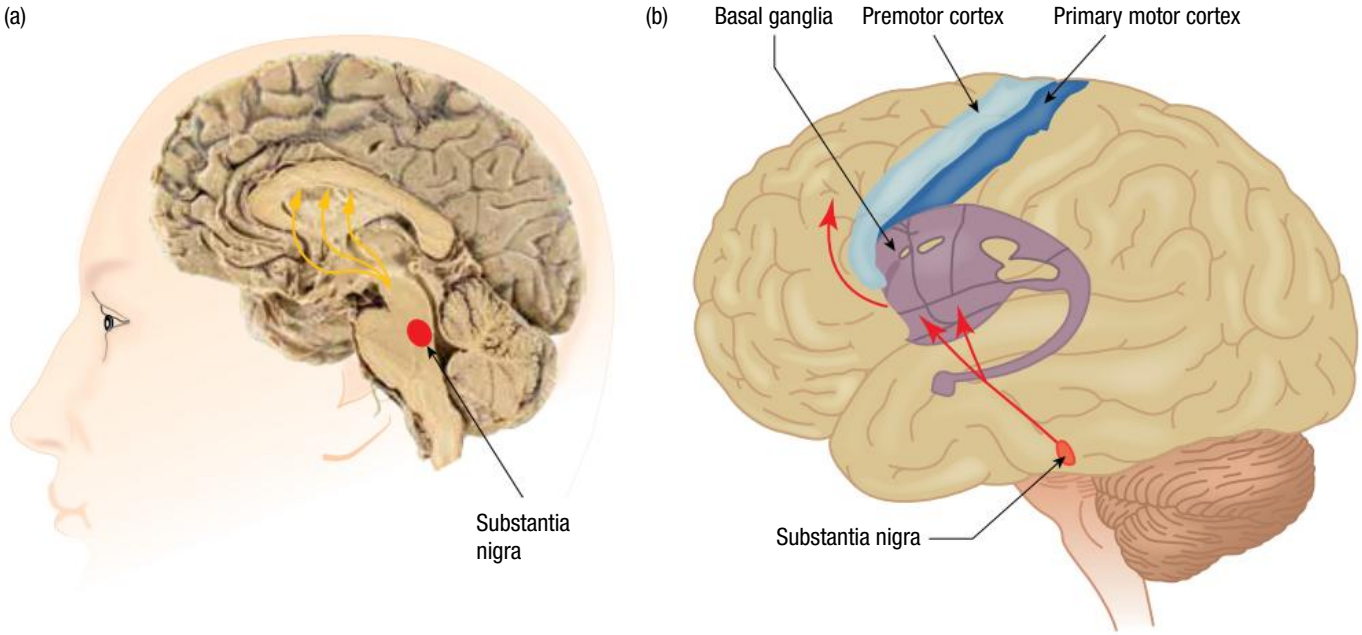

Figure 2.28 (a) Parkinson's disease is a CNS neurological disorder with motor symptoms largely attributable to degeneration of dopamine-producing neurons in the substantia nigra. These neurons are partly responsible for starting a circuit of messages that coordinate voluntary movement. (b) This diagram of the brain shows the substantia nigra, basal ganglia and motor cortex areas which interact with each other and other structures in planning, coordinating and initiating voluntary movements. The dopamine motor activity pathway from the substantia nigra is shown in red.

dopamine available is markedly reduced. **Dopamine** (**DA**) from the substantia nigra carries messages that allow smooth, coordinated function of the body's muscles and movements, when at rest and during periods of activity. These neural messages pass through the basal ganglia, and from there to motor cortex in the frontal lobes.

If there are fewer neurons in the substantia nigra, less dopamine will be produced. This means that brain structures such as the basal ganglia and motor cortex that are involved in planning, coordinating and initiating voluntary movements receive slower, fewer and/or irregular dopamine messages about motor activity.

Ultimately, the primary motor cortex, which initiates voluntary movements, receives inadequate information due to insufficient and impaired activation by dopamine. Movement commands are disrupted because essential information about how and when to move has gaps or has not been received. The level of dopamine continues to fall over many years, however, the decrease in dopamine does not necessarily account for all symptoms experienced with the disorder.

Motor symptoms begin to appear only after extensive neuronal death. As we age, we all experience a loss of neurons in the substantia nigra, but only after we have lost about 70% of them would we start to show motor symptoms like those of Parkinson's disease. It is currently not possible to predict exactly which symptoms will affect an individual. Nor does everyone with one or more of the motor symptoms have Parkinson's disease, as the symptoms appear in other diseases as well.

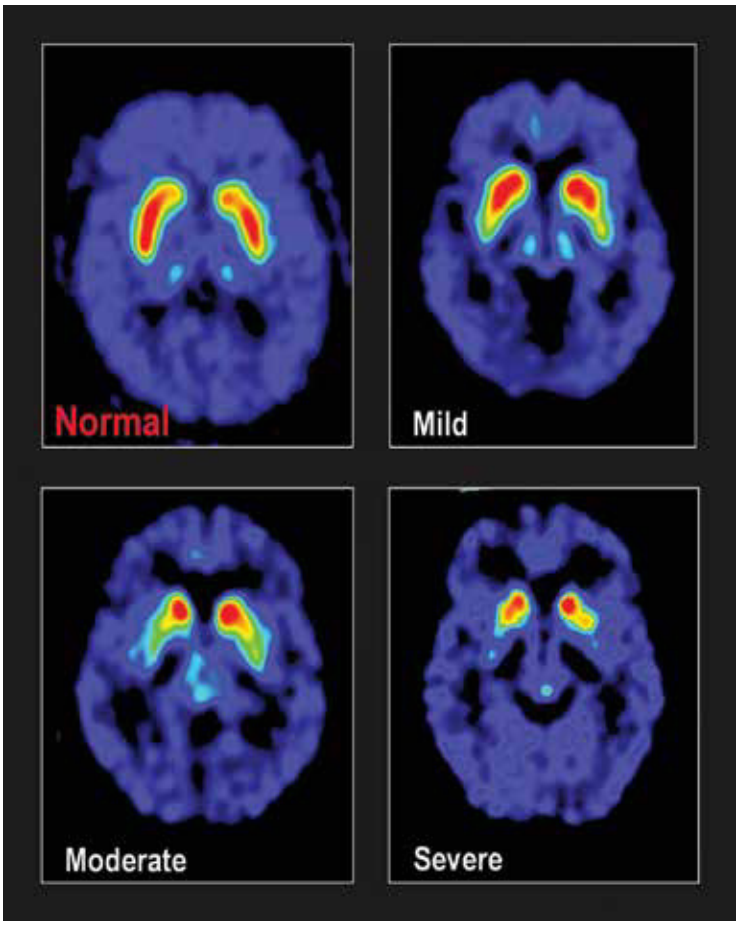

Figure 2.29 A variety of Parkinson's disease motor symptoms appear after extensive loss of dopamine-producing neurons in the substantia nigra. The PET scan at the top left shows a healthy substantia nigra, rich in dopamine-producing neurons. Compare this with the reducing size and activity of the subsantia nigra in the three PET scans taken over time of the individual with Parkinson's disease.

Although Parkinson's disease is strongly linked to the degeneration of dopamine-producing neurons, it is not known what actually causes these neurons to become diseased and die. Therefore, it is described as *idiopathic*, which means 'having no known cause'.

Parkinson's disease is not considered to be genetic though there is a family history of the disorder in about 15% of cases. The only real risk factor seems to be age because the disease is most commonly found in adults over the age of 50 and the incidence rises significantly with advancing age. However, despite being age related, it is not necessarily a part of the natural ageing process. As with most disorders, it is thought that Parkinson's disease most likely results from a combination of genetic and environmental factors, with a low level of dopamine in the substantia nigra being a significant contributory factor (National Institute of Neurological Disorders and Stroke [NINDS], 2018; Parkinson's Australia, 2018a; The Florey Institute, 2018).

Symptoms of Parkinson's disease

The symptoms of Parkinson's disease develop slowly and gradually progress over years. They tend to vary greatly between individuals diagnosed with the disorder and no two people will be affected in the same way. In addition, both motor and non-motor symptoms also tend to vary in severity from day to day and at different times throughout the day.

According to Parkinson's Australia (2018b), four key symptoms are used for diagnostic purposes. These are all motor symptoms.

Motor symptoms

Motor symptoms typically begin on one side of the body, but the disease eventually affects both sides. Even after the disease involves both sides, the symptoms are often less severe on one side than the other (NINDS, 2018).

1. **Tremor** involving continuous, involuntary shaking (trembling) of the body is the best-known symptom, but is not necessarily experienced in all cases. Some 30% of people with the disease will not experience

tremor. Of those who do, it is usually the first symptom that causes them to seek medical attention.

Most often, tremors are 'resting tremors' and occur when the affected limb is not in use. These tend to be regular and rhythmic, occurring at the rate of about 4–6 times per second. Sometimes 'action tremors' are experienced. These occur when commencing some form of motor activity; for example, when the person walks, their hands may begin to shake.

'Restless legs' is also common. This is when the person's legs appear to move or feel as if they are moving constantly.

2. **Bradykinesia**, or slowness of voluntary movement, particularly when initiating and executing movement and in performing repetitive movements. A person will not be diagnosed with Parkinson's disease unless this symptom is present (The Florey Institute, 2018).

   Bradykinesia presents in a variety of ways, including difficulty starting new movements or stopping an ongoing movement. There is a decrease in fine motor coordination required for 'delicate' work with the hands, such as when doing up buttons, putting on makeup, shaving and hand writing.

   Bradykinesia also affects the more critical aspects of daily living, such as walking, talking, chewing, swallowing and speaking, and also contributes to a lack of facial expression. Initially, bradykinesia may be misinterpreted as slowing due to ageing, however, slowness of movement is out of proportion to what would be expected through normal ageing.
3. **Muscle rigidity**, or 'stiff muscles', whereby the muscles seem unable to relax and are tight, even when at rest, is another key symptom.

   Individuals report feeling that their muscles will not do what they want them to do. They may have difficulty performing automatic movements, such as swinging their arms when walking or rolling over in bed. They may feel their muscles are so tight that they have frozen and will not actually move.

   Rigidity can also lead to lack of facial expression through loss of facial muscle tone. This sometimes gives the face a mask-like appearance. Over time, muscle rigidity can lead to the characteristic stooped or 'forward bent' posture apparent in many people with the disease.
4. **Postural instability** involves difficulty maintaining an upright posture and a steady balanced position. This contributes to gait (walking) disturbances. An inability to maintain a steady, upright posture or to take a corrective action to prevent a fall often results in just that — falling. Individuals tend to go backwards as well, and a light shove may cause them to continue taking many steps backwards or to fall.

   Gait disturbance is apparent in the short, shuffling steps taken by individuals, and reduced arm swing. In advanced Parkinson's disease, there may be episodes of freezing in which the feet appear to be glued to the floor.

   Postural instability and gait disturbances often develop later in the progression of the condition.

Figure 2.30 A doctor is shown here testing the fingers for bradykinesia — slowness of voluntary movement. One of the more formal, standardised tests is called the Bradykinesia Akinesia Incoordination Test (or BRAIN test). This is a computer keyboard-tapping task for which the patient is asked to tap keys quickly on a keyboard with alternating fingers for one minute. Scoring is based on speed and accuracy, such as the number of correct keys hit, the number of wrong keys hit, the time it takes to hit the keys, and the time that lapses between hitting each key. This test has been found to be reliable for helping identify bradykinesia and its severity. A person will not be diagnosed with Parkinson's disease unless bradykinesia is present (Noyce, et al., 2014).

Non-motor symptoms

Although motor disturbances are the most prominent and disease-defining symptoms, there are a number of non-motor symptoms that cause disability and loss of independence. These symptoms can affect virtually any body system and arise at any time in the course of the disease.

Speech problems, especially change in verbal fluency, are a common non-motor symptom. The muscles involved in speech may be affected which can reduce the volume, clarity and speed of speech. For example, speech can become rapid, with the words crowded together, similar to the short, shuffling, 'propelling' steps when walking. The

muscles involved in swallowing can also be affected, making it difficult to chew or swallow.

Other non-motor symptoms may include a decrease or loss of sense of smell (called *anosmia*), disturbed temperature regulation contributing to increased sweating and increased sensitivity to temperature, pain and discomfort in an arm or leg, disturbed sleep, fatigue that is not relieved by resting, constipation, problems urinating, and mental health problems such as confusion, panic attacks, anxiety disorder and depression.

Problems with cognitive function such as slowness of thinking, impaired planning and decision making and memory loss may occur in up to 40–50% of people with Parkinson's disease, especially late in the disease and in older people. However, cognitive impairments are also associated with other age-related disorders (such as dementia) so it can be difficult to isolate the actual cause (Golbe, Mark & Sage, 2014; Parkinson's Australia, 2018b; The Florey Institute, 2018).

There is currently no known cure for Parkinson's disease, but motor symptoms such as tremor, muscle rigidity and slowness of movement may be relieved by medications that restore the deficiency of dopamine by increasing or maximising the level of dopamine in the brain (commonly called dopamine replacement therapy).

Two types of medications can be used for this purpose — those that can be *converted into dopamine* by neurons and those that *mimic the role of dopamine* and are able to effectively stimulate reception of dopamine by neurons within crucial motor areas by causing neurons to react as they would to dopamine. Not all motor symptoms respond equally to the medications.

The treatment of the non-motor symptoms is limited to the same therapies used when these problems occur in another context (The Florey Institute, 2018).

In time, complications and difficulties with treatment may lead to the need for a complex therapy, such as deep brain stimulation (see Box 2.5).

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Video
Parkinson's Australia: Living with Parkinson's 7m 32s

Podcast
ABC Radio: What happens when you're diagnosed with Parkinson's disease? 20m 27s

eGuide*plus*

Parkinson's disease video clips

Figure 2.31 Over time, muscle rigidity can lead to the characteristic stooped or 'forward bent' posture apparent in many people with the disease. These individuals with Parkinson's disease are participating in a physiotherapy session.

BOX 2.5 Diagnosis and treatment of Parkinson's disease

The average age of a person diagnosed with Parkinson's disease is between 55 and 65 years, though it can affect anyone at any time, including adolescents. It is estimated that about 1 in 350 people in Australia have the disorder, which makes it the second most common neurodegenerative disorder (Parkinson's Australia, 2018b).

Generally, diagnosis is based on an individual's presenting symptoms, a neurological examination and a review of their past medical history, and their response to Parkinson's medication if the disease is suspected. However, there is currently no really adequate or specific biological or neuroimaging test available for a diagnosis that would confirm the presence of the disorder.

At present, there is also no known cure for Parkinson's disease. It is not contagious, life span is not necessarily shortened and medication can help treat symptoms and improve quality of life for a very long time. Because of the complex nature of the disease, for each individual the disease's management requires a biopsychosocial approach (see page 565). This holistic approach takes account of how the disease is impacting on all aspects of the individual's life, not just their motor problems. Given that no two people are affected in the same way, treatment and management will vary (Parkinson's Australia, 2018d; The Florey Institute, 2018).

Motor symptoms such as tremor, muscle rigidity and slowness of movement *may* be relieved by medications that can restore the brain's dwindling supply of dopamine or mimic the effects of dopamine. The most commonly used and effective medications are made from levodopa, a chemical that is converted to dopamine by neurons and thereby replaces dopamine that is lost in Parkinson's disease. Levodopa is usually taken with carbidopa. Carbidopa delays the conversion of levodopa into dopamine until it reaches the brain.

Tremor is also related to a low level of the neurotransmitter acetylcholine, which contributes to voluntary movement (see Figure 2.27a on page 170). For this reason, tremor is often the least responsive symptom to dopamine replacement therapy. Bradykinesia and rigidity respond best to levodopa. Problems with balance may not be alleviated at all. Other medications that influence the activity of other neurotransmitters that can directly or indirectly affect motor symptoms may also be used (NINDS, 2018; Parkinson's Australia, 2018d).

It is relatively common for people to require high doses of medication and therefore experience side effects as the disorder progresses and natural dopamine production is reduced. In many cases, medication has a maximum benefit for a period of 5–10 years. Neuron degeneration continues relentlessly and eventually too few dopamine-containing neurons remain in the substantia nigra, and levodopa stops being effective. However, in some cases levodopa can effectively help manage the motor symptoms for decades.

There is no 'one size fits all' for the treatment of Parkinson's disease. For example, some non-motor symptoms may actually be aggravated by dopamine-boosting medications and many people with Parkinson's disease report that some of the side effects are as disabling as the disorder itself. Side effects may include nausea, vomiting, dizziness, confusion, anxiety, hallucinations and additional involuntary muscle movements (dyskinesia) (American Parkinson Disease Association, 2018; Parkinson's Victoria, 2016).

In some cases, the *deep brain stimulation* (DBS) procedure may be a treatment option, depending on the symptoms. This is a surgical procedure to enable electrical stimulation of the brain. In the most commonly used procedure, patient is conscious during the surgery so that responses to stimulation can be assessed. Very fine wires with electrodes at their tips are implanted in the brain, usually in or near the basal ganglia. These are connected to a pulse generator (a device like a heart pacemaker), which is placed under the skin around the chest or stomach area. When the device is switched on, the electrodes stimulate the targeted area with tiny amounts of electric current, thereby blocking the abnormal neural messages that cause motor symptoms.

As a result, some of the motor symptoms may be alleviated and the individual may be able to reduce the amount of medication previously required. However, not all motor symptoms will necessarily respond to the electrical stimulation. At present, the procedure is used only for individuals with debilitating motor symptoms that cannot be adequately controlled with medications. The treatment has been found to improve motor symptoms (particularly tremor) and reduce the need for levodopa, but it carries the risk of side effects such as impulsive behaviour and difficulties with decision making. In addition, some people experience increased depression and anxiety (Frank, et. al., 2007; Parkinson's Australia, 2018c).

Researchers are working to improve the existing DBS devices and surgical procedures with the goal of making the therapy beneficial for more symptoms and therefore for a greater number of people. For example, some are developing a 'smart' DBS, in which the device will record a person's unique brain activity and deliver electrical stimulation only when needed, such as when symptoms return, rather than continuously, as the current systems do (The Michael J. Fox Foundation, 2018).

Other surgical options for treating Parkinson's' disease involve cutting ('lesioning') specific parts of the brain to alleviate targeted motor symptoms. However, none of the drugs or other interventions can prevent the progression of the disease (Parkinson's Australia 2018a).

(continued)

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(a)

(b)

Figure 2.32 (a) The most commonly used and effective medications for Parkinson's disease are made from levodopa, a chemical that is converted to dopamine by neurons. Levodopa is usually taken in combination with carbidopa which helps prevent the breakdown of levodopa before it can reach the brain and take effect. (b) The surgical procedure involving deep brain stimulation may also be a treatment option to reduce the need for medications or when they are no longer effective, especially in the later stages of the disease when motor symptoms are very debilitating.

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Weblink
60 Minutes report on DBS surgery for movement disorders
5m 40s

BOX 2.6 Neuroimaging techniques used for brain research

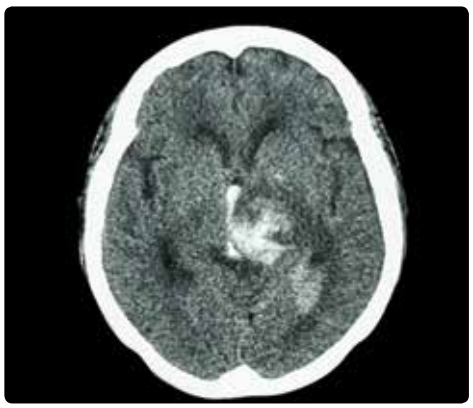
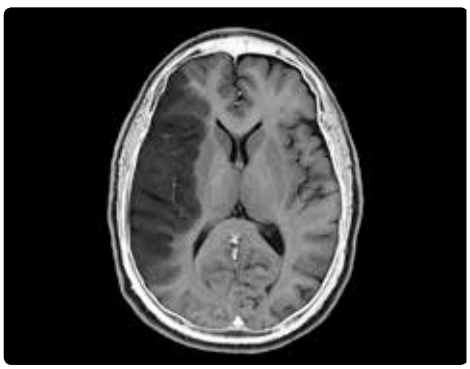
A major problem confronting early researchers interested in studying the brain was the lack of technology to directly observe a normal intact human brain in action. Consequently, early researchers, most of whom were medical doctors, often studied the brains of dead animals and those of dead people who had donated their bodies to medical science.

Living people and animals were also studied. Studies with animals often included experiments. Many animal experiments involved the destruction or surgical removal of a specific brain structure or area to study the effects on behaviour. Studies with people were often case studies of individuals who had experienced brain damage due to an accident, crime or disease.

Although early research provided useful information about the brain, this was mainly limited to the *structure* of the brain. Relatively little was known about the *function* of the brain; that is, how the brain actually 'works' when we are thinking, feeling or behaving. The development of new brain recording and imaging technologies during the latter half of the 20th century helped advance understanding of the brain in significant ways.

Neuroimaging, commonly called 'brain scanning', can capture detailed images of the living intact brain as people engage in different mental processes or make behavioural responses. Importantly, neuroimaging techniques are 'non-invasive'. This means that researchers can use them without entering the brain. Therefore, the risk of harm to participants is minimal, if not negligible. Table 2.2 below and on the following page summarises some of the better known neuroimaging techniques used for brain research conducted by psychologists.

TABLE 2.2 Examples of neuroimaging techniques for brain research

Neuroimaging technique	Description	Research applications
Computed tomography (CT)/Computed axial tomography (CAT)  **Figure 2.33** CT/CAT scan showing brain damage (dark areas) in a stroke patient	Produces computer-enhanced cross-sectional images of the brain from X-rays taken at different angles	• Useful diagnostic tool that shows brain structures or areas affected by disease or injury • Images are much more detailed than standard X-rays • Cannot reveal brain function
Magnetic resonance imaging (MRI)  **Figure 2.34** MRI scan showing brain damage (dark areas) in a stroke patient	Harmless magnetic fields and radio waves are used to produce computer-enhanced black and white or colour images in 2D or 3D. Does not involve x-rays and therefore exposure to radiation.	• Useful diagnostic tool that shows brain structure more clearly and in greater detail than CT/CAT e.g. can detect tiny changes in structure, can differentiate between the brain's white and grey matter • Cannot reveal brain function

(continued)

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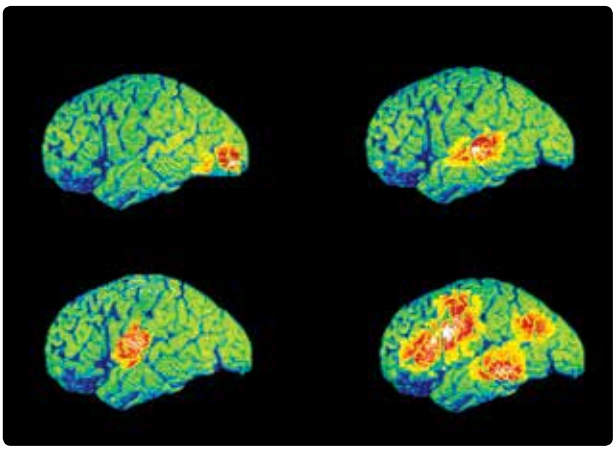
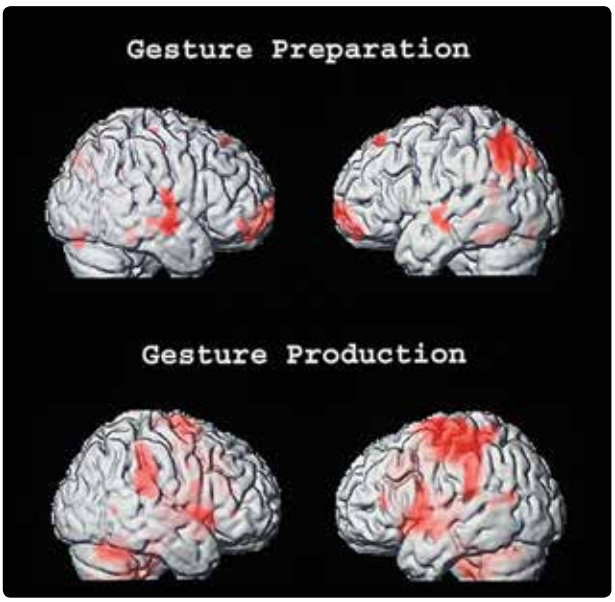
TABLE 2.2 *(continued)*

Neuroimaging technique	Description	Research applications
Positron emission tomography (PET)  **Figure 2.35** PET scans of left hemisphere areas activated during sight, hearing, speaking and thinking. The colour-coded scans show brain activity varying from blue (lowest) through green and yellow to red (highest). Shown upper left, sight activates visual cortex in the occipital lobe at the back of the brain. Shown upper right, hearing activates auditory cortex in the temporal lobe. Shown lower left, speaking activates speech production areas in frontal and temporal lobe areas. At lower right, thinking about verbs and speaking them generates widespread activity, including in frontal, temporal and parietal lobe areas.	• Radioactive tracer is injected into the bloodstream (or taken orally) and attaches to and acts like glucose, which is used when the brain is active. When it reaches the brain, the amount used during a given task is detected and recorded. • Produces computer-generated colour-coded images showing areas of high and low activity.	• Widely used for experimental research on brain function • Shows areas of brain activity (and inactivity) during a wide variety of tasks such as speech, selective attention, daydreaming, limb movement, planning, problem solving, speech, learning and remembering
Functional magnetic resonance imaging (fMRI)  **Figure 2.36** fMRI image showing areas of brain activity when thinking about an activity (top) and when performing the same activity (bottom)	• An enhanced version of MRI that detects brain activity during a given task through changes in oxygen levels in blood flowing through the brain • Produces computer-generated colour-coded 2D or 3D images showing areas of high and low activity.	• Like PET but more precise and detailed images of brain activity • Shows brain structure and brain activity as it happens in highly detailed images

LEARNING ACTIVITY 2.16

Review questions

1. Explain what Parkinson's disease is with reference to three key motor symptoms and examples of non-motor symptoms.
2. Why can Parkinson's disease be described as a
   (a) neurological disorder?
   (b) a degenerative disorder?
3. (a) In which brain structure of people with Parkinson's disease is dopamine found to be at a depleted level?
   (b) Where is this structure located?
   (c) Explain how a low level of dopamine in this specific structure is believed to impair control of voluntary movements.
4. (a) What two changes at the neurotransmitter level might be targeted by medications designed to treat Parkinson's disease motor symptoms?
   (b) Explain the meaning of the term dopamine agonist.
   (c) What change to dopamine action is targeted by deep brain stimulation?
5. Explain how the psychological experience of motor symptoms can worsen or contribute to the development of non-motor symptoms.

LEARNING ACTIVITY 2.17

Reflection

Parkinson's disease is commonly described as a disorder that impairs the *control* of voluntary movements rather than the *production* of voluntary movements (as in paralysis).

Comment on the accuracy of this description with reference to Parkinson's disease motor symptoms.

LEARNING ACTIVITY 2.18

Media analysis/response

View a 6-minute TED talk proposing a test for Parkinson's disease with a phone call.

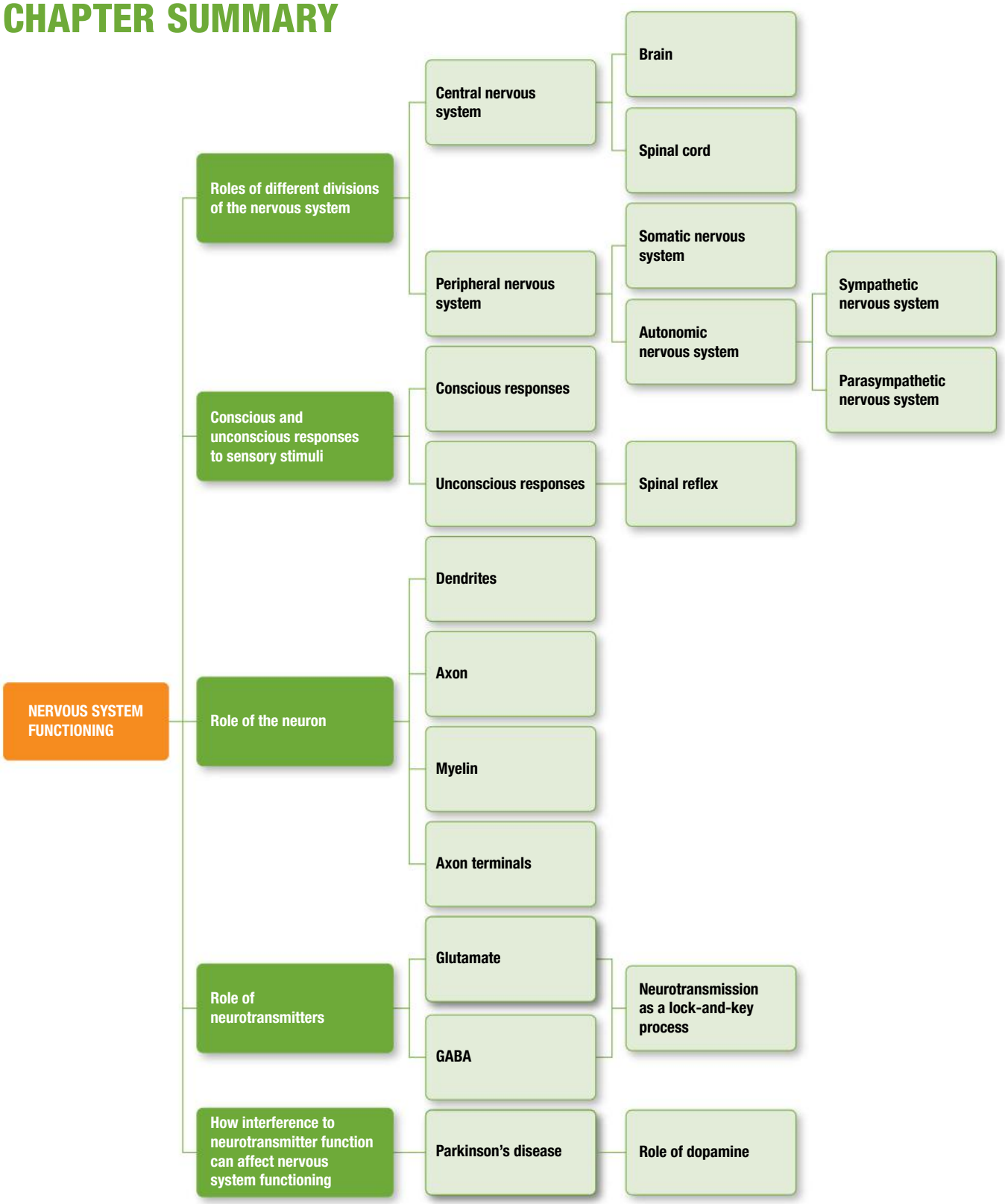
1. Outline the proposal.
2. Comment on the extent to which the proposal is evidence-based.
3. Comment on whether the proposal adopts a simplified view of the disease and its symptoms or whether it is valid.

Access at ted.com by entering 'Max Little' in the search filter or use the link in your eBook.

eBook*plus*

Weblink
TED talk: Max Little – A test for Parkinson's with a phone call
5m 57s

CHAPTER SUMMARY



KEY TERMS

afferent p. 150
autonomic nervous system p. 151
axon p. 163
axon terminal p. 164
brain p. 145
central nervous system p. 145
conscious response p. 158
dendrite p. 163
dendritic spine p. 163
dopamine p. 172
efferent p. 150
excitatory effect p. 167
gamma-amino butyric acid (GABA) p. 167
glutamate p. 167
inhibitory effect p. 167
interneuron p. 165
lock-and-key process p. 168
motor neuron p. 165
myelin p. 163
myelin sheath p. 163
nerve p. 163
neural pathway p. 145
neuron p. 162
neurotransmission p. 168
neurotransmitter p. 166
parasympathetic nervous system p. 155
Parkinson's disease p. 171
peripheral nervous system p. 149
postsynaptic neuron p. 166
presynaptic neuron p. 166
receptor pp. 166, 168
receptor site pp. 166, 168
reflex p. 158
reflex arc p. 159
sensory neuron p. 165
sensory receptor p. 159
somatic nervous system p. 150
spinal cord p. 147
spinal reflex p. 159
substantia nigra p. 171
sympathetic nervous system p. 154
synapse p. 166
synaptic gap p. 166
synaptic transmission pp. 166, 167
tract p. 148
unconscious response p. 158

LEARNING CHECKLIST

Complete the self-assessment checklist below, using ticks and crosses to indicate your understanding of this chapter's key knowledge (a) before and (b) after you attempt the chapter test on pages 183–188. Use the 'Comments' column to add notes about your understanding.

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Word copy of checklist

Key knowledge I need to know about nervous system functioning	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
Roles of different divisions			
Central nervous system			
• brain			
• spinal cord			
Peripheral nervous system			
• Somatic nervous system			
• Autonomic nervous system			
– Sympathetic nervous system			
– Parasympathetic nervous system			
Conscious and unconscious responses to sensory stimuli			
• Conscious vs unconscious responses			
• reflex			
• spinal reflex			
Role of the neuron			
• Role in receiving and transmitting information			
• Role as a nervous system building block			
• Types of neurons			
• Structure of the neuron			
– dendrites			
– axon			
– axon terminals			
– myelin			
Role of neurotransmitters			
• Synapse and synaptic transmission			
• Roles of receptors and receptor sites			
• Roles of glutamate and GABA			
• Roles of presynaptic and postsynaptic neurons			
• Neurotransmission as a lock-and-key process			
How interference to neurotransmitter function can affect nervous system functioning			
Parkinson's disease			
Symptoms			
Role of dopamine			

study*on*

Unit 3 › Area of study 1 › Topic 1

Concept screens and practice questions

CHAPTER 2 TEST

SECTION A — Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Question 1

A major function of the spinal cord is to

A. protect the spinal column.
B. initiate voluntary muscle movements.
C. connect the brain and central nervous system.
D. connect the brain and peripheral nervous system.

Question 2

You are working quietly in the library when a friend sneaks up from behind and scares you, making your heart race. At this time, your _____ nervous system would be dominant.

A. parasympathetic
B. sympathetic
C. somatic
D. central

Question 3

Sensory pathways carry information to the _____ and motor pathways carry information from the _____ .

A. somatic nervous system; peripheral nervous system
B. central nervous system; somatic nervous system
C. central nervous system; central nervous system
D. peripheral nervous system; peripheral nervous system

Question 4

A mosquito lands on your arm. You watch it carefully then move your hand to swat it. Your sensation and response are due to _____ activity.

A. spinal reflex
B. autonomic nervous system
C. somatic nervous system
D. parasympathetic nervous system

Question 5

Parkinson's disease motor symptoms are most commonly associated with

A. an excessive amount of dopamine in motor pathways.
B. loss of dopamine as it travels along motor pathways.
C. overproduction of dopamine in the substantia nigra.
D. a depleted amount of dopamine in the substantia nigra.

Question 6

Sensory information is best described as _____ information.

A. afferent
B. efferent
C. internal
D. external

Question 7

The _____ nervous system automatically restores bodily systems to their normal level of functioning after the need for heightened activity has passed.

A. somatic
B. central
C. sympathetic
D. parasympathetic

Question 8

Jana was diagnosed with paraplegia after a horse riding accident and can no longer walk. She is unable to do so because her _____ nervous system cannot communicate with her _____ nervous system.

A. central; autonomic
B. somatic; central
C. somatic; sympathetic
D. autonomic; sympathetic

Question 9

The autonomic nervous system

A. controls movements of skeletal muscles.
B. initiates movements of skeletal muscles.
C. controls the activities of visceral muscles, organs and glands.
D. controls virtually all thoughts, feelings and behaviours.

Question 10

A synapse is

A. a neural connection.
B. a type of neurotransmitter.
C. the place where neurons communicate.
D. the part of the neuron on which small extensions grow.

Question 11

The _____ nervous system initiates skeletal muscle movement, whereas the _____ nervous system regulates the activity of visceral muscles.

A. somatic; autonomic
B. parasympathetic; sympathetic
C. autonomic; somatic
D. peripheral; sympathetic

Question 12

The neurons in the spinal cord are part of the _____ nervous system.

A. central
B. peripheral
C. somatic
D. autonomic

Question 13

The peripheral nervous system transmits information between the _____ and the _____.

A. central nervous system; spinal cord
B. spinal cord; muscles, organs and glands
C. sensory receptors, muscles, organs and glands; central nervous system
D. somatic nervous system; muscles, organs and glands

Question 14

The two major divisions of the central nervous system are the _____ and the two major divisions of the peripheral nervous are the _____.

A. somatic and autonomic systems; brain and spinal cord
B. brain and peripheral system; somatic and sympathetic systems
C. somatic system and spinal cord
D. brain and spinal cord; autonomic and somatic systems

Question 15

The substantia nigra is located in the _____ region of the brain.

A. midbrain
B. forebrain
C. hindbrain
D. motor

Question 16

An important role of an axon is to

A. carry a neural message towards a neighbouring neuron.
B. carry a neural message away from a neighbouring neuron.
C. integrate neural information and speed up its transmission.
D. insulate a neuron to speed up its transmission.

Question 17

A major function of the somatic nervous system is to

A. carry neural messages between the CNS and internal organs and glands.
B. maintain the body's internal states.
C. carry motor messages to the CNS.
D. transmit information from sensory receptors to the CNS.

Question 18

The division of the nervous system that is generally self-regulating is called the _____ nervous system.

A. central
B. somatic
C. autonomic
D. peripheral

Question 19

Which of the following bodily functions results from parasympathetic nervous system action?

A. increased salivation
B. increased perspiration
C. increased respiration
D. decreased stomach contractions

Question 20

A neurotransmitter will have its effect when it

A. reaches an axon terminal.
B. binds to its receptor.
C. contacts a dendrite.
D. enters the synapse.

Question 21

The single projection from a neuron's soma is the

A. dendrite.
B. axon.
C. collaterals.
D. terminal.

Question 22

A single neuron may connect with several different target neurons through its

A. receptor sites.
B. dendrites.
C. dendritic spines.
D. axon collaterals.

Question 23

The chemicals that carry messages to target neurons are stored in

A. vesicles.
B. myelin sheaths.
C. the cell body.
D. the synaptic gap.

Question 24

A neurotransmitter that has an inhibitory effect causes postsynaptic neurons to

A. fire.
B. reuptake.
C. excitatory.
D. not fire.

Question 25

The _____ carries a neural message within a neuron.

A. soma
B. action potential
C. neurotransmitter
D. myelin sheath

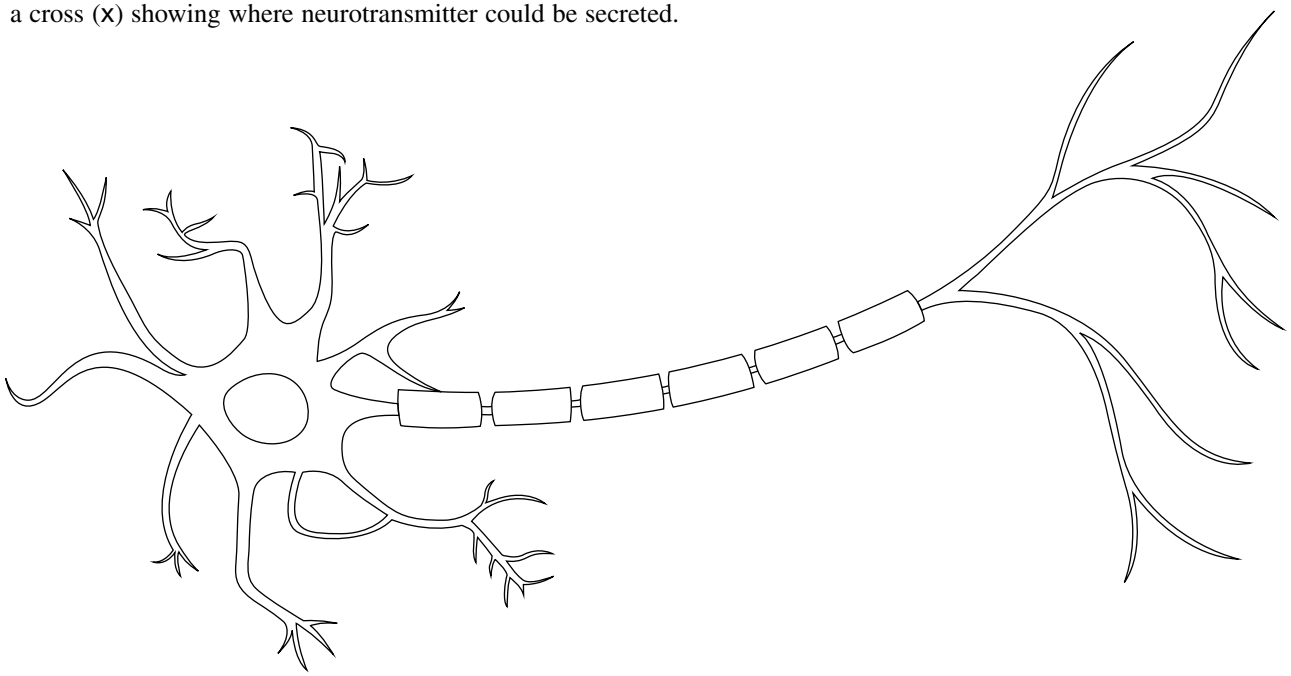
SECTION B

Answer **all** questions in the spaces provided. Write using black or blue pen.

Question 1 (6 marks)

Label the following drawing of a neuron. Include:

(a) axon
(b) axon terminal
(c) myelin sheath
(d) dendrite
(e) an arrow showing the direction of the neural message through the neuron
(f) a cross (x) showing where neurotransmitter could be secreted.



Question 2 (2 marks)

(a) Give an example of an unconscious response to an internal sensori stimulus. 1 mark

(b) Name the source of the stimulus for **(a)** 1 mark

Question 3 (2 marks)

The synaptic gap is one component of a chemical synapse. Name the other two components.

Question 4 (3 marks)

Describe the interrelationship of the sympathetic and parasympathetic nervous systems with reference to an example.

Question 5 (2 marks)

Distinguish between the roles of the autonomic and somatic nervous systems.

Question 6 (5 marks)

(a) What is Parkinson's disease? 1 mark

(b) Describe two motor symptoms that may be used in the diagnosis of Parkinson's disease. 2 marks

(c) Explain the contributory role of dopamine in Parkinson's disease. 2 marks

Question 7 (5 marks)

(a) List the key steps in the spinal reflex sequence of activity that enables a withdrawal response to occur before the brain processes the conscious perception of pain. 3 marks

(b) Explain why a spinal reflex involving a withdrawal response is considered to be an adaptive response with reference to conscious and unconscious responses to sensori stimuli. 2 marks

Question 8 (2 marks)

Explain why someone in a comatose state with severe brain damage may still be able to remain alive for a prolonged period without artificial life support.

Question 9 (8 marks)

(a) Within the central nervous system, the neurotransmitter _____ has an inhibitory effect on neurons and the neurotransmitter _____ has an excitatory effect. 1 mark

(b) Explain the meaning of excitatory and inhibitory effects of neurotransmitters. 2 marks

(c) What primarily determines whether or not a neurotransmitter will have an excitatory or inhibitory effect? 2 marks

(d) Explain how chemical neurotransmission occurs as a lock-and-key process. 3 marks

Question 10 (10 marks)

A researcher conducted a clinical trial to investigate the effects of a new dopamine enhancing medication on bradykinesia. She designed an ethically approved experiment that used two groups. Group A used the new medication for a trial period of six months, whereas Group B used a look-alike inert substance over the same period. Neither the researcher nor the participants knew who was using the real trial medication and who was not. Participants were assigned to each group by chance, and all had their bradykinesia symptoms assessed at the beginning and end of the experiment. Assessments were based on number and severity of symptoms involving walking, talking, swallowing, speaking, blink rate in the eyes and facial expression.

(a) Identify the experimental design. 1 mark

_____

(b) Identify the operationalised independent and dependent variables. 2 marks

independent variable: _____

dependent variable: _____

(c) Group A is the _____ group, and Group B is the _____ _____ group. 2 marks

(d) What is the technical term for the inert substance used by Group B? 1 mark

_____

(e) What is the technical term for the assessment of symptoms at the start of the experiment? 1 mark

_____

(f) The researcher used a _____ procedure in the experimental design to control for expectancy effects. 1 mark

(g) Participants ended up in Group A or B on the basis of _____. 1 mark

(h) Participants were most likely drawn from an adult population diagnosed with the disorder called 1 mark

_____.

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The answers to the Section A multiple-choice questions are in the answer section at the back of this book and in eBookPLUS. The answers to the Section B questions are in eBookPLUS.

3 STRESS AS A PSYCHOBIOLOGICAL PROCESS

KEY KNOWLEDGE

- sources of stress (eustress and distress) including daily pressures, life events, acculturative stress, major stress and catastrophes that disrupt whole communities
- models of stress as a biological process, with reference to Selye's General Adaptation Syndrome of alarm reaction (shock/counter shock), resistance and exhaustion, including the 'fight–flight–freeze' response and the role of cortisol
- models of stress as a psychological process, with reference to Richard Lazarus and Susan Folkman's Transactional Model of Stress and Coping (stages of primary and secondary appraisal)
- context-specific effectiveness, coping flexibility and use of particular strategies (exercise and approach and avoidance strategies) for coping with stress.

Source: ©VCAA, VCE Psychology Study Design (June 2017 update), p. 25.

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Sources of stress 193
Daily pressures 193
Life events 196
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Fight–flight–freeze response 214
Role of cortisol 217
Selye's General Adaptation Syndrome 222
Strengths and limitations of Selye's GAS 224
Stress as a psychological process 228
Lazarus and Folkman's Transactional Model of Stress and Coping 228
Strengths and limitations of the Lazarus and Folkman model 230
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Coping flexibility 234
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Exposure to stressful situations or events is a common human experience. These can range from daily pressures or hassles that are relatively minor events, such as forgetting a locker key or missing the bus, through to ones that are longer lasting and much more challenging or even life-changing, such as the loss of a significant relationship or being the victim of a violent crime or catastrophic event. These situations and events can bring about stress; however, they do not describe or explain stress. They are examples of **stressors** — stimuli that cause or produce stress and challenge our ability to cope.

Psychologists often classify stressors as having an internal or external source. An *internal stressor* originates within the individual; for example, a personal problem that causes concern about the potential consequences or the experience of physical pain that may be perceived as signalling an untimely illness. An *external stressor* originates outside the individual from situations and events in the environment; for example, having too much homework, being nagged by parents, being in an overcrowded train or being threatened by someone outside a nightclub.

Stress has both biological and psychological components and consequences. It is therefore considered to be a *psychobiological process*. This is reflected in the definition of **stress** as a state of physiological ('biological') and psychological arousal produced by internal or external stressors that are perceived by the individual as challenging or exceeding their ability or resources to cope. Note the role of the individual in influencing a stress response. From a psychological perspective, stress is a subjective experience and therefore substantially depends on our personal interpretation of a potential stressor.

Internally and externally sourced events are usually interpreted in a way that produces stress when we believe that we may not or do not have the ability or resources to cope with their demands or consequences. If we believe we can cope, these events may be perceived as difficult or 'unsettling' experiences, but not necessarily as stressors. For example, some people find speaking to a large group of people highly stressful, whereas others find it challenging but enjoyable rather than stressful. Similarly, some people experience a high level of stress when they are forced to make a significant change in their lives, whereas others may simply view change as an opportunity for a new experience.

Figure 3.1 Exposure to stressful situations or events is a common human experience.

The stress we experience can sometimes be brief and specific to the demands of a particular situation, such as a deadline, a performance, or when dealing with a difficult challenge or traumatic event. This is commonly called *acute stress* and tends to produce a very high arousal level for a relatively short time. When acute stress occurs over and over again, this may be referred to as *episodic acute stress*. These kinds of repetitive short-term stress episodes may be due to a series of life challenges; for example, the death of a loved pet, then developing a health problem, followed by difficulties at school or work. *Chronic stress* involves ongoing demands, pressures and worries that are long-lasting. It can seem to go on forever, with little hope of letting up. This type of stress produces an increased arousal level that persists over a relatively long time and is likely to be harmful in some way to our health and wellbeing, both psychologically and physically (APA, 2018a; APS, 2012).

EUSTRESS AND DISTRESS

When we think about stress we often focus on the negative effects it has on our lives. However, not all stress is necessarily negative, or 'bad'. In fact, stress can have positive effects. The notion that stress could be either a negative ('bad') or positive ('good') state was first proposed by the Canadian doctor Hans Selye (1907–1982) who was a pioneering researcher on the harmful physiological effects of stress.

The excitement of a first date, an 18th birthday party, riding on a roller-coaster, meeting a celebrity, or getting an A+ for an exam can all cause what Selye (1974) called positive stress, or eustress. **Eustress** is a positive psychological response to a stressor, as indicated by the presence of positive psychological states such as feeling enthusiastic and motivated, excited, active and alert. Eustress is typically short-term and can provide the energy and motivation needed to achieve a goal or peak performance. Furthermore, it is not considered to be harmful or damaging to the body.

In contrast, **distress** is a negative psychological response to a stressor, as indicated by the presence of negative psychological states such as anger, anxiety, nervousness, irritability or tension. Distress can result from such situations as being in a long queue when in a hurry, losing an important sports match, watching a horror movie, financial pressures and ongoing problems in a relationship. Distress can be short-term but, for some stressors, can also persist for weeks, months or even years if it is not addressed and managed. Prolonged distress can have serious and debilitating consequences for our physical and mental health.

Generally, eustress is a good kind of stress because it is associated with positive feelings and a healthy bodily state, whereas distress is the bad kind, associated with negative feelings and a disturbed bodily state. When stress is beneficial or desirable it can be described as eustress. When stress is objectionable or undesirable, it can be described as distress. However, Selye also noted that the human body does not recognise the distinction between eustress and distress.

Figure 3.2 Eustress is a positive psychological response to a stressor; distress is a negative psychological response to a stressor.

According to Selye (1974), all stressors produce a *non-specific* stress response. This means that regardless of whether a stressor involves positive eustress or negative distress, our body undergoes virtually the same physiological changes. For example, consider the scenarios of unexpectedly being told by your parents that they will separate immediately then divorce as soon as possible, and being minutes away from seeing a very special person you have not seen for over a year. Both situations are likely to cause you to experience physiological arousal involving changes such as increased heart and breathing rates despite one being a 'negative' event and the other being a 'positive' event.

Although both positive and negative events result in virtually the same physiological responses, whether a situation or event is experienced as 'eustressful' or 'distressful' varies from individual to individual. It depends on psychological factors such as an individual's personality, prior experience with the stressor, and, most importantly, their perception and interpretation of the stressor; that is, whether they judge the stressor as positive or negative in relation to themself. For example, an outgoing person might look forward to participating in extracurricular activities at school or attending social events (eustress), whereas a shy person might dread the same situations (distress). In addition, the same situation or event can be 'eustressful' or 'distressful' for the same person at different times. For example, if you are well prepared for a SAC test, taking that test might cause eustress. However, taking a test for which you are not at all prepared might cause distress.

studyon

Figure 3.3 The same stressor may produce eustress in one person and distress in another.

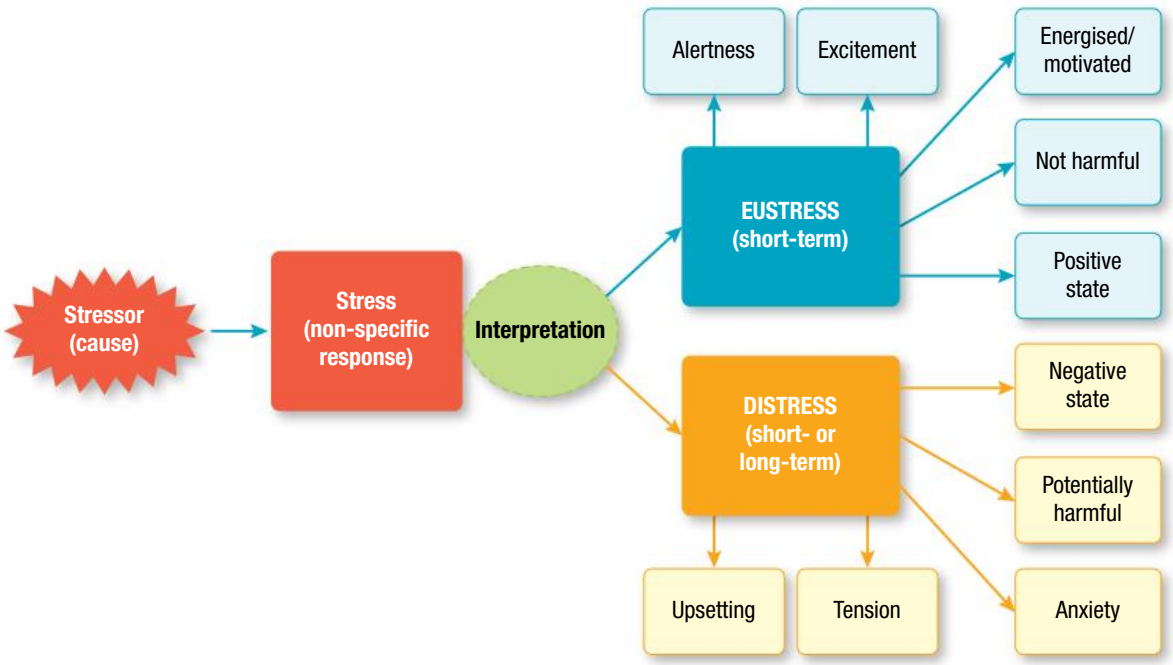

Figure 3.4 The relationship between stressors, stress, eustress and distress from a psychological perspective.

LEARNING ACTIVITY 3.1

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Word copy of table

Review questions

1. (a) How is stress commonly defined in psychology?
(b) Why is stress described as a psychobiological process? Explain with reference to an example.

2. (a) Distinguish between a stressor and stress with reference to an example not used in the text.
(b) Explain the relationship between a stressor and stress with reference to an example not used in the text.

3. (a) Explain the difference between internal and external stressors with reference to one or more examples not used in the text.
(b) Give an example of an internally sourced stressor that is not psychological.
(c) Explain how a physical stimulus in the environment such as noise or temperature may be a stressor.

4. Distinguish between acute and chronic stress with reference to relevant examples.

5. (a) Distinguish between eustress and distress.
(b) Describe two key characteristics of eustress and two of distress.
(c) Complete the following table on eustress and distress stressors you have experienced. In the first column, briefly describe three stressors that resulted in eustress and three stressors that resulted in distress. In the second column, classify each stressor as either predominantly eustress or distress. In the last column, explain your choice of classification.

Stressor	Eustress = E Distress = D	Reason for classification

6. Outline three events and/or situations (other than examples used in the text) that could cause eustress in one person and distress in another. Explain why the different responses can occur.

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Practical activity
Types of stressors in everyday life

LEARNING ACTIVITY 3.2

Reflection

Comment on whether we experience more or less eustress or distress as a direct result of how we think about situations and events in our lives.

SOURCES OF STRESS

Virtually anything can be a source of stress and therefore a stressor. It may be internally or externally sourced. It may be psychological or physical in nature. It may be a person, object, situation, event or a combination of these. We consider sources of stress involving daily pressures, life events, acculturative stress, major stressors and catastrophes that disrupt whole communities.

Daily pressures

A lot of our stress is sourced from relatively minor troubles or concerns that arise in day-to-day living, such as having an argument with a friend, the sudden appearance of an unwanted pimple, waiting in a queue, looking for keys when in a hurry, and having too many things to do at once. These **daily pressures** or *hassles* as they are commonly called in psychology, are little problems of everyday living that are irritants — events that annoy or bother us and which can make us upset or angry. Some

hassles occur on a fairly regular basis and others are relatively rare. Some have only a slight effect, others have a strong effect. They are not necessarily significant in themselves or distressing for a prolonged time, but they can pile up to become a major source of stress (DeLongis, Folkman & Lazarus, 1988; Kanner, et al., 1981).

Often, hassles are not readily identified as stressors because they are such a part of everyday life that they may be taken for granted. Table 3.1 below lists hassles that have been identified through self-report research as being common causes of stress for people in each of three lifespan stages. Box 3.1 on the next page shows an example of a rating scale used to collect hassles data reported in the table.

Research studies have found that daily hassles (or 'pressures') are a strong predictor of both physical and psychological wellbeing. In addition, experiencing more hassles also tends to lead to more symptoms for people who are already suffering from a disease or disorder. Generally, the more hassles we experience, the more symptoms of physical and mental health problems we are likely to have (Sanderson, 2013).

When hassles persist or accumulate, physical health problems such as sore throat, headaches, backaches, colds and flu are commonly reported. In relation to mental health, mood disturbance is common, especially when the stress level due to hassles increases. There are, however, significant individual differences. For example, people with low self-esteem and who also perceive that they lack access to supportive social relationships tend to be more likely to experience physical and psychological problems than individuals with high self-esteem and a belief that they have lots of opportunities for support from others when required (DeLongis, Folkman & Lazarus,1988; Sanderson, 2013).

Studies have also found that the stress due to the accumulation of daily hassles can contribute more to physical and/or psychological ill-health than the stress due to a single, significant life event such as getting divorced or the death of a loved one (Kohn, Lafreniere & Gurevich, 1991). However, people who experience such disruptive life events are also likely to experience more daily hassles. For example, divorce is very stressful, but its stress effects may also be tied up in the increased number of hassles it creates, such as child care arrangements and concerns about money. It can therefore be difficult to isolate the effects of daily hassles and more significant stressors.

Figure 3.5 Waiting in a queue that is progressing slowly and dissatisfaction with some aspect of your physical appearance are examples of daily pressures or hassles. Individually, they are irritants, but they may accumulate and the overall impact can have the same effect on wellbeing as the more significant life stressors.

TABLE 3.1 Common daily hassles

Children and early adolescents	Middle–late adolescents	Adults
• Having to clean up your room • Being bored and having nothing to do • Seeing that another child can do something better • Being punished for doing something wrong • Having to go to bed when you don't want to • Being teased at school	• Conflicts with a boyfriend or girlfriend • Dissatisfaction with your athletic skills • Having your trust betrayed by a friend • Struggling to meet your own academic standards • Not having enough leisure time • Gossip concerning someone you care about • Dissatisfaction with your physical appearance	• Concerns about weight • Health of a family member • Social obligations • Concerns about money • Misplacing or losing things • Home maintenance • Job security

Source: Kanner, et al. (1991); Kohn, Lafreniere & Gurevich, M. (1990)

LEARNING ACTIVITY 3.3

Reflection

Consider the stressors in Table 3.1 at the left derived from research conducted over 25 years ago.
(a) Which stressors for middle–late adolescents do you believe are still relevant or are no longer relevant?
(b) Which stressors do you believe might be included in the list if the studies were to be replicated by contemporary researchers?
(c) Outline a research design that could be used to test the contemporary relevance of the stressors for different age groups.

BOX 3.1 Measuring 'daily pressures' using the Hassles Scale

The following scale includes items that have been used in many research studies to identify everyday pressures or hassles that can be stressors. Responses have been used to collate data like that in Table 3.1 at the left, to compare groups based on characteristics such as age, sex, occupation, income or cultural differences, and to identify how hassles change over time. Generally the higher the score, the greater the hassle. You may consider creating a hassles scale for your own research investigation, using instructions and items such as those below.

The Hassles Scale

Following is a list of experiences which many people have some time or other. Please indicate for each one that you have most recently experienced, its degree of severity in your life using the following scale. Put a '1' in the space provided next to an experience if it had a somewhat severe effect; '2' for an experience that had a moderately severe effect; and '3' if it had an extremely severe effect. If you have not had the experience, put a '0' in the space provided.

Severity of the most recent experience
0 = Not experienced **1 = Somewhat severe** **2 = Moderately severe** **3 = Extremely severe**

1. Conflicts with a boyfriend or girlfriend ____
2. Dissatisfaction with your athletic skills ____
3. Having your trust betrayed by a friend ____
4. Struggling to meet your own academic standards ____
5. Not having enough leisure time ____
6. Gossip concerning someone you care about ____
7. Dissatisfaction with your physical appearance ____
8. Conflict with a teacher ____
9. Social rejection ____
10. Too many things to do at once ____
11. Being taken for granted ____
12. Being let down or disappointed by a friend ____
13. Concerns about weight ____
14. Concerns about money ____
15. Misplacing or losing things ____
16. Loneliness ____
17. Separation from people you care about ____
18. Having your contributions overlooked ____
19. Disliking a school subject ____
20. Being taken advantage of ____
21. Dissatisfaction with an ability ____
22. Struggling to meet the academic standards of others ____
23. A lot of responsibilities ____
24. Dissatisfaction with school ____
25. Decisions about intimate relationship(s) ____
26. Not enough time to meet your obligations ____
27. Financial burdens ____
28. Lower grades than you hoped for ____
29. Not enough time for sleep ____
30. Conflicts with your family ____
31. Heavy demands from extracurricular activities ____
32. Conflicts with friends ____
33. Getting 'ripped off' or cheated in the purchase of services ____
34. Difficulties with transportation ____
35. Disliking fellow student(s) ____
36. Interruptions of your school work ____
37. Social isolation ____
38. Long waits to get service (e.g. at banks, stores, etc.) ____
39. Being ignored ____
40. Social conflict over alcohol, smoking or drugs ____

Sometimes a researcher will identify the above scale as a 'Hassles' scale but for other studies the researcher may use a relatively neutral label for the scale to control participant expectations. For example, in one study that investigated hassles experienced by American college students, the researchers gave the scale the title *Inventory of College Students'*

(continued)

(continued from previous page)

Recent Life Experiences (ICSRLE). Also, rather than having participants rate each item for its severity, the researchers had them rate the extent of their experience with it over the past month using the following explanation and scale:

Following is a list of experiences which many students have some time or other. Please indicate for each experience how much it has been a part of your life *over the past month*. Put a '1' in the space provided next to an experience if it was *not at all part* of your life over the past month (e.g., 'trouble with mother in law — *1*'); '2' for an experience which was *only slightly* part of your life over that time; '3' for an experience which was *distinctly* part of your life; and '4' for an experience which was *very much* part of your life over the past month.

Intensity of experience over past month

1 = *not at all* part of my life
2 = *only slightly* part of my life
3 = *distinctly* part of my life
4 = *very much* part of my life

Source: Kohn, P.M., Lafreniere, K., & Gurevich, M. (1990). The inventory for college students' recent life experiences: A decontaminated hassles scale for special populations. *Journal of Behavioural Medicine, 13*(6), 619–630.

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Word copy of the Hassles Scale

Life events

In addition to irritating daily pressures or hassles, we experience other life events that cause stress. A key feature of this type of **life event stressor** is that it involves *change* that forces us to adapt to new circumstances; for example, the loss of a significant relationship, leaving home to live with a friend, beginning a new career and changing schools. Such events typically have immediate consequences and also require longer term adjustments.

Life events that are stressors include choices we make as individuals, not just things that happen to us. The events may therefore be pleasant ('positive') or unpleasant ('negative'). For example, most people choose to get married but many also report that marriage is a stressful event. Similarly, most parents choose to have their first child but many also report that the first week following the birth is one of the most joyful and stressful periods in their lives.

Figure 3.6 Parenthood may be a life event stressor for most people as it involves change requiring adjustment to new circumstances.

The idea that change associated with a life event can cause stress was first proposed by American doctor Thomas Holmes and his psychologist colleague Richard Rahe (1967). They examined more than 500 patient interviews and medical histories to identify the kinds of events that people found stressful. Holmes and Rahe then developed the *Social Readjustment Rating Scale (SRRS)* to measure stress in terms of life events. In their view, any event that required an individual to adjust their lifestyle, and therefore their established ways of thinking, feeling and behaving, would cause stress in varying amounts, depending on the event (stressor) and the level of readjustment required.

As shown in Table 3.2, the scale included 43 life events that involve change and are therefore likely to require some level of adaptation. Each life event was assigned a numerical rating that estimates its relative impact in terms of life change units. Ratings range from a score of 100 for the life event causing the most stress (death of a spouse) through to 11 for the event causing the least stress (a minor violation of the law such as 'jaywalking' ie. walking across the street in an unsafe or illegal way). Note that the scale includes both negative items (e.g. death of a spouse) and positive items (e.g. marriage) as events that can produce stress.

Research conducted by Holmes and Rahe found that people who score 200 life change units or more within a 12-month period are more prone to physical and psychological stress-related illnesses or diseases. The likelihood of a stress-related disorder diminishes with the value of the score. For example, a person who is divorced, has a friend die and remarries all in a year is more likely to develop an illness or disease than a person who gets married, falls pregnant and dramatically changes the way they dress all in the same year.

The *Social Readjustment Rating Scale* has since been revised and, along with similar scales, is still commonly used for stress research. For example, researchers have used variations of the scale to establish links between the number, types and duration of life events and stress. However, the experience of one or more of the Holmes-Rahe life events or similar does not necessarily predict stress.

Researchers have confirmed that the death of a marital partner is one of the most stressful Holmes-Rahe type life events any individual can experience, regardless of their cultural background. However, the death of a child can be equally stressful and impose the same level of adjustment demands. Research studies of people who lost a spouse or child in a car accident have found that a significant number of the bereaving individuals are distressed for as long as seven years after a sudden loss. Many experience depression, anxiety disorders, fatigue and loneliness (Burton, Westen & Kowalski, 2012).

TABLE 3.2 The Holmes and Rahe (1967) Social Readjustment Rating Scale

Life event	Life change unit
Death of a spouse	100
Divorce	73
Marital separation	65
Detention in jail	63
Death of close family member	63
Personal injury or illness	53
Marriage	50
Dismissal from work	47
Marital reconciliation	45
Retirement from work	45
Change in health of family member	44
Pregnancy	40
Sexual difficulties	39
Gain of new family member	39
Business readjustment (merger, reorganisation)	39
Change in financial state (much worse off or much better off than usual)	38
Death of a close friend	37
Change to a different line of work	36
Change in number of arguments with spouse (many more or many less than usual)	35
Mortgage or loan	31
Foreclosure of mortgage or loan	30
Change in responsibilities at work (promotion, demotion, lateral transfer)	29
Son or daughter leaving home	29
Trouble with in-laws	29
Outstanding personal achievement	28
Spouse begins or stops work	26
Beginning or ending school	26
Change in living conditions (building new house, renovating, deterioration of home or neighbourhood)	25
Revision of personal habits (dress, manners)	24
Trouble with boss	23
Change in working hours or conditions	20
Change in residence	20
Change in school or college	20
Change in recreational habits	19
Change in church activities	19
Change in social activities	18
Mortgage or loan for a minor purchase (car, television)	17
Change in sleeping habits (much more or much less)	16
Change in number of family get-togethers	15
Change in eating habits	15
Vacation	13
Christmas	12
Minor violations of the law (jaywalking, disturbing the peace, traffic fine)	11

Source: Holmes T.H., & Rahe, R.H. (1967). The social readjustment rating scale. *Journal of Psychosomatic Research, 11*, 213–218.

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Practical activity
Rating stressful life events

Figure 3.7 In the Social Readjustment Rating Scale, death of a spouse is the life event that causes the greatest social readjustment and stress. However, the death of a spouse who has been abusive to their partner throughout the relationship may also alleviate the stress of the abused person.

One Finnish study tracked more than 158 000 adults aged 35 to 84 years for a five year period after the death of a spouse. The researchers found that a high proportion were at a substantially increased risk of death from accidental, violent, and alcohol-related causes, heart disease and lung cancer. The risk was greater at short (< 6 months) rather than long durations of bereavement and among younger rather than older bereaved persons for most causes of death (Martikainen & Valkonen,1996).

Within Australia, the Australian Psychological Society (APS) has conducted research (by online survey) for five successive years to assess the stress and wellbeing of the Australian population. Its most recent survey results were published in 2015. As shown in Figure 3.8 on the next page, the leading causes of stress among Australians in 2015 involved financial, family and health issues. These were consistently reported as the leading stressors in each of the previous five years in which the survey has been conducted. In addition, 72% of participants reported that their current stress was having at least some impact on their physical health, with 64% believing it is having an impact on their mental health. Of those experiencing stress, about 4 in 10 reported that it was having a moderate to very strong impact on their physical health (39%) and mental health (37%). Table 3.3 on the next page shows that the prevalence of most causes of stress significantly decreases as people got older.

Unemployment is also reported by numerous studies as being one of the more significant life events that causes stress. The research consistently finds that unemployment-related stress can impair physical and mental health, and that the longer the period of unemployment the greater the risk. However, the effects on people experiencing this stressor tend not to be as dramatic as those among people bereaving the death of a spouse. Key findings for unemployed participants in the APS research in 2014 and 2015 include:

- significantly higher levels of stress than participants who were employed (both full-timers and part-timers) or retired, with 91% of the unemployed reporting that current stress was having at least some impact on physical health and 27% reporting that their current stress was having a strong to very strong impact on physical health
- 87% of the unemployed reported that current stress was having at least some impact on mental health, with 36% reporting that their current stress was having a strong to very strong impact on mental health
- the unemployed had the highest levels of depression and anxiety symptoms compared with employed participants.

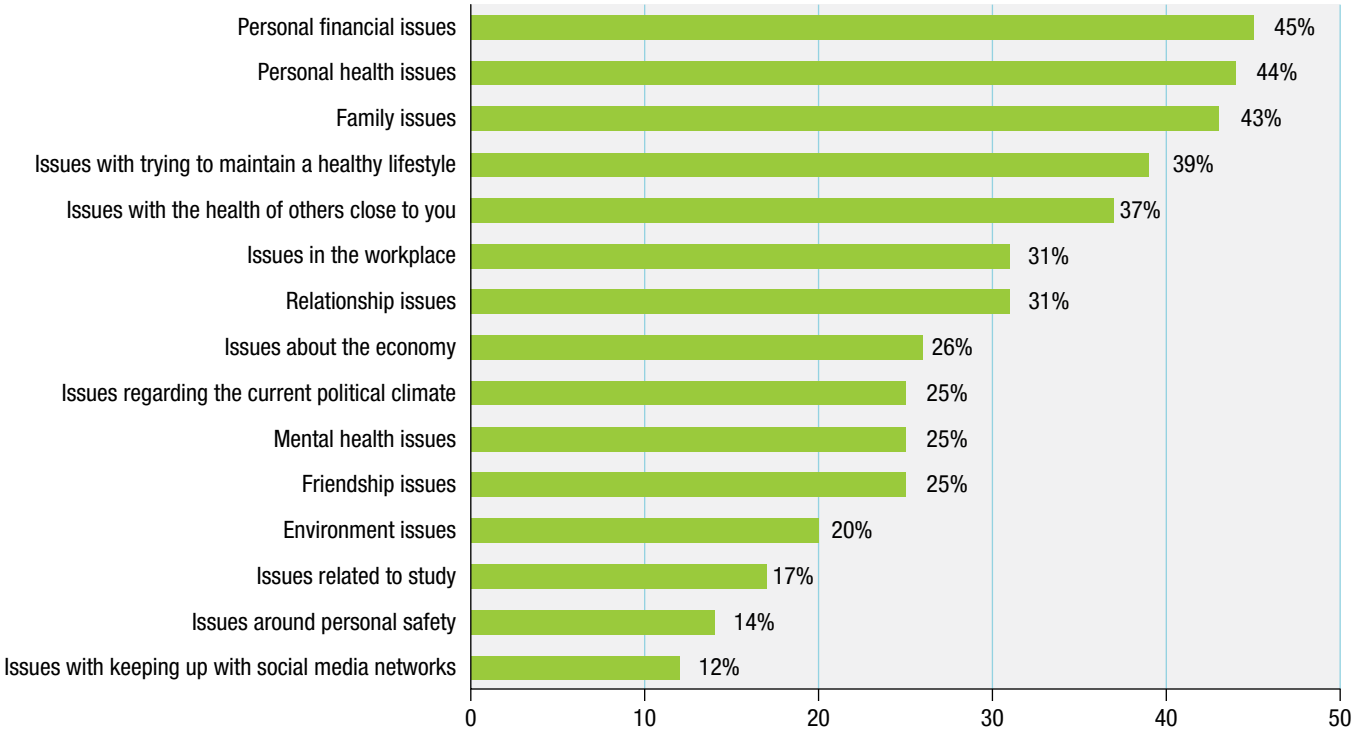

Figure 3.8 Prevalence of stressors

Source: Australian Psychological Society (2015a). *Stress & wellbeing: How Australians are coping with life*. Retrieved from https://www.psychology.org.au/Assets/Files/PW15-SR.pdf

TABLE 3.3 Prevalence of stressors among different age groups

	18–25	26–35	36–45	46–55	56–65	66 and above
Personal financial issues	59%	57%	58%	50%	38%	25%
Issues with trying to maintain a healthy lifestyle	54%	43%	37%	44%	32%	27%
Family issues	50%	48%	46%	50%	41%	32%
Friendship issues	50%	35%	25%	25%	14%	7%
Issues related to study	48%	24%	15%	8%	5%	3%
Relationship issues	42%	45%	35%	29%	16%	17%
Personal health issues	39%	39%	40%	45%	44%	43%
Issues with the health of others close to you	38%	33%	34%	37%	38%	40%
Issues in the workplace	38%	49%	38%	37%	20%	5%
Mental health issues	32%	28%	22%	25%	16%	11%
Issues about the economy	26%	29%	29%	33%	27%	31%
Issues around personal safety	21%	19%	16%	11%	8%	8%
Issues regarding the current political climate	21%	24%	25%	30%	35%	37%
Environment issues	16%	20%	17%	18%	17%	21%

Source: Australian Psychological Society (2014). *Stress and wellbeing in Australia survey 2014*. Retrieved from https://www.psychology.org.au/Assets/Files/2014-APS-NPW-Survey-WEB-reduced.pdf

The impact of any Holmes-Rahe life event, whether it is classified positive or negative, will depend on the individual, how they interpret the stressor, and their ways of coping. Different events can have different meanings for different individuals, so the stress-producing potential of an event can vary widely from one person to another. For example, changing schools tends to be less stressful to students who know someone at the new school and even less stressful if that person will be in the same class or year level. Similarly, consider a person who is in a marriage filled with conflict, tension and unhappiness, which means that their marriage is likely to be very stressful. For this individual, getting divorced (73 life change units in the SRRS scale) might be significantly less stressful than remaining married, so divorce might actually have the effect of alleviating their stress.

Consequently, some researchers have tended to study specific life-changing events in more depth and measure an individual's *perceived stress* — the extent to which an individual considers the experience they have undergone as either exacerbating ('worsening') or alleviating ('lessening') stress in their lives. Box 3.2 below gives an example of a widely used perceived stress assessment device.

Research studies based on perceived stress measures have provided considerable evidence that significant life-changing events, both positive and negative, can produce, exacerbate or alleviate stress, depending on the individual and their personal circumstances. Furthermore, although there is a link between negative life events (such as getting hurt, divorced or retrenched from a job) and stress-related disorders, research evidence does not support positive life events (such as taking a vacation, graduating, winning a lottery, starting a new career or getting married) as being similarly harmful.

BOX 3.2 The Perceived Stress Scale

The *Perceived Stress Scale (PSS)* is the most widely used self-report instrument for measuring perception of stress; more specifically, the degree to which situations in one's life are assessed as stressful. Items are designed to tap how unpredictable, uncontrollable and overloaded respondents find their lives. The 10-item scale also includes a number of questions about the levels of stress currently being experienced.

The PSS was designed for use in samples with at least a junior secondary school education. The items have been found to be easy to understand, with response alternatives that are simple to grasp.

The questions in the PSS ask about feelings and thoughts during the last month. In each case, respondents are asked how often they felt a certain way.

You may consider using the PSS for your own research investigation. Note the provision for recording personal details of participants that may be relevant to the research.

Perceived Stress Scale

The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate by circling *how often* you felt or thought a certain way.

Age _____ Gender (*Circle*): **M F** Other _____

0 = Never 1 = Almost Never 2 = Sometimes 3 = Fairly Often 4 = Very Often

1	In the last month, how often have you been upset because of something that happened unexpectedly? ..	0	1	2	3	4
2	In the last month, how often have you felt that you were unable to control the important things in your life? ..	0	1	2	3	4
3	In the last month, how often have you felt nervous and 'stressed'?	0	1	2	3	4
4	In the last month, how often have you felt confident about your ability to handle your personal problems? .	0	1	2	3	4
5	In the last month, how often have you felt that things were going your way? .	0	1	2	3	4
6	In the last month, how often have you found that you could not cope with all the things that you had to do? .	0	1	2	3	4
7	In the last month, how often have you been able to control irritations in your life? .	0	1	2	3	4
8	In the last month, how often have you felt that you were on top of things? .	0	1	2	3	4
9	In the last month, how often have you been angered because of things that were outside of your control? ..	0	1	2	3	4
10	In the last month, how often have you felt difficulties were piling up so high that you could not overcome them? .	0	1	2	3	4

Scoring: PSS scores are obtained by reversing responses (e.g. 0 = 4, 1 = 3, 2 = 2, 3 = 1 & 4 = 0) to the four positively stated items (items 4, 5, 7, & 8) and then summing across all scale items. A short 4 item scale can be made from questions 2, 4, 5 and 10 of the PSS 10 item scale.

Source: Cohen, S. & Williamson, G. (1988). Perceived stress in a probability sample of the United States. In S. Spacapan, & S. Oskamp (Eds.) *The social psychology of health*. Newbury Park, California: Sage.

The PSS Scale is reprinted with permission of the American Sociological Association, from Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, *24,* 386–396.

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Word copy of PSS

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Weblink
PSS normative data

BOX 3.3 Heavy use of social media and the Fear of Missing Out on good times as a stressor

The Australian Psychological Society (2015b) has examined our use of social media on wellbeing and behaviour, with a particular interest in 'Fear of Missing Out' as a potential stressor. *Fear of Missing Out* (FOMO) was defined as a 'pervasive apprehension that others might be having rewarding experiences that you are not part of'. In relation to social media, this experience is 'characterised by the desire to stay continually connected with what others are doing'.

The study found that 'social media is both a cause of stress and a means of managing stress'. For example, more than one in 10 (12%) of the survey respondents reported 'issues with keeping up with social media networks' as a source of stress.

Among young adolescents aged 13–17 years, about one in two (50%) reported that they experience stress due to FOMO, with those who connect five or more times a day and are therefore 'heavy users' experiencing higher levels. Heavy adolescent users are significantly more likely to experience aspects of FOMO such as:

- feeling it is important that they understand their friends' in-jokes (78%)
- fearing their friends are having more rewarding experiences than they are (54%)
- worrying when they find out their friends are having fun without them (60%)
- being bothered when they miss out on planned get-togethers (63%).

In contrast, FOMO was reported by one in four adults. Heavy adult users are significantly more likely to experience the same aspects of FOMO as adolescent users, but at much lower levels. For example, fearing their friends are having more rewarding experiences than them was reported by 26% and worrying when they find out their friends are having fun without them was reported by 17%.

According to the APS, the overall heavier use of social media by young adolescents means that 'teens are significantly more likely to experience all aspects of FOMO than adults', which 'suggests that social media has a greater impact on teens and plays a role in their identity formation and their search for a sense of self'.

Figure 3.9 Heavy social media users are more likely to experience stress due to a fear of missing out on the good times their friends are having.

LEARNING ACTIVITY 3.4

Reflection

Read Box 3.3 on Fear of Missing Out, then comment on possible FOMO stressor experiences of someone you know or may have been told about (without giving details that would reveal their identity). Also comment on whether FOMO should be included in an update of Table 3.1 on page 194 or one or more of the stress scales described in this chapter, and, if so, which ones?

LEARNING ACTIVITY 3.5

Review questions

1. (a) Define the meaning of daily pressure (hassle) as a stressor.
(b) Give an example of an internally sourced and an externally sourced stressor of this type.
2. How do daily pressures or hassles contribute to stress?
3. Explain how daily pressures or hassles may be a confounding variable in research that uses a Holmes-Rahe life event as an independent variable.
4. (a) Define the meaning of 'life event' as a stressor.
(b) Give an example of an internally sourced and an externally sourced 'life event' stressor.
(c) Give an example of a 'positive' and a 'negative' 'life event' stressor.
5. (a) In what way is a 'life event' stressor alike and unlike a 'daily pressure' stressor?
(b) How are life events and 'daily pressure' stressors best distinguished?
6. Suggest a Holmes-Rahe life event stressor which you believe is over-rated or under-rated in relation to twenty-first-century life as you know it. Give a reason for your suggestion.

LEARNING ACTIVITY 3.6

Reflection

Comment on whether the Holmes-Rahe scale in Table 3.2 (page 197) would provide a valid measure of 'life event' related stress you experience and explain why you hold this view. What are your views of the units assigned to each life event in the scale? Do you generally agree with both the rank ordering and units assigned to each event?

LEARNING ACTIVITY 3.7

Analysis of data

Consider the APS data in Figure 3.8 on page 199 and Table 3.3 on page 199 and answer the following questions.

1. (a) What were the top five stressors in Australia in 2015 and the percentages reporting these?
   (b) Use the APS weblink in your eBookPLUS to access the current APS research report. Use this to identify and describe change that may have occurred in the top five in previous surveys and the explanation of any change. Consider also more recent data if the APS has conducted the survey again.
   (c) In 2015, the APS broadened their annual stress and wellbeing research to include a study of FOMO (see Box 3.3 on page 201). What is another significant change to the aims and/or scope of the APS research since 2015?

2. Formulate a research hypothesis that would be supported by the 2014 results for 18–25 year olds shown in Table 3.3. Identify the operationalised independent variables relevant to your hypothesis.

3. Table 3.3 compares stressors across age groups in 2014. These results were not available in 2015 but the data has been consistent across all previous years in which the research has been conducted.
   (a) Describe, in one sentence, the overall relationship between stress and age that is apparent in the data.
   (b) How do the top five stressors vary according to age?
   (c) What is the most common stressor across all age groups?
   (d) What significant age differences, if any, have been identified in the most recent research report?

4. According to the APS, the 2015 sample consisted of 1521 participants who were representative of the Australian adult population (18 and above) for age, gender, geographical location and work status. Are the results generalisible to:
   (a) the study's population?
   (b) other populations?
   Explain your answers.

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Weblink
APS stress and wellbeing survey reports

Acculturative stress

For international students, immigrants, refugees and asylum seekers coming to Australia and other countries, departure can be a means of escaping social injustice, persecution, civil unrest, political turmoil, torture, war famine or poverty. Therefore, moving to another country, either temporarily or permanently, can be a means of reducing stress. However, the demands of adjusting to a new culture can be extremely stress-producing.

Establishing a new life in one's adopted country is usually a very difficult and challenging adjustment, especially when there are significant cultural differences. Inevitably, there is a need to become *acculturated*; that is, to adopt the values, customs and language preferences of the new dominant culture. **Acculturative stress** refers to the stress people experience in trying to adapt to a new culture when living in it for a considerable period of time (Berry, 2005; Poyrazli, Thukral & Du, 2010).

Acculturative stress can occur whether people willingly relocate or emigrate for better opportunities or flee as refugees or asylum seekers. People entering new cultures frequently encounter language difficulties, racial or ethnic discrimination, lower socioeconomic status (such as overseas-trained engineers or doctors working in Australia as labourers or as taxi or Uber drivers because their qualifications are not recognised), and loneliness and homesickness due to separation from friends, family and other people, objects and experiences associated with the original home environment. Immigrants also face conflicts over preserving their old values and beliefs and adapting to the customs of their new culture. Many refugees and asylum seekers must also come to terms with torture they have endured or with the torture or murder of loved ones back home. All of these can be significant stressors that have debilitating effects (Burton, Westen & Kowalski, 2012; Jatrana, Pasupuleti & Richardson, 2014; Travis & Meltzer, 2008).

Research findings indicate that belonging to an ethnic or cultural minority group significantly increases the risk of developing stress-related physical or mental health problems. Box 3.4 on page 204 summarises some of the experiences

reported by ethnic or cultural minority groups in Australia that produce the most stress.

Many factors can influence how much acculturative stress an individual experiences. For example, when the new society is one that accepts ethnic and cultural diversity, acculturative stress is reduced. The ease of transition is also enhanced when the person has some familiarity with the new language and customs, advanced education, and social support from friends, relatives, and organisations formed by and for members of the cultural group. The individual's attitudes are also important in determining the degree of acculturative stress. For example, individuals who continue to value their original cultural customs but also seek to integrate by becoming part of the dominant culture of the new society tend to experience a low level of acculturative stress, whereas individuals who follow a pattern of separation or withdrawal by maintaining their cultural identity and avoiding contact with the dominant new culture tend to experience a very high level of acculturative stress. Age, education, religion and gender have also been all significantly associated with differences in the frequency of experiencing racial discrimination (Berry, 2005; Ferdinand, Paradies & Kelaher, 2015; Hockenbury & Hockenbury, 2006).

Figure 3.10 Acculturative stress is experienced by many international students, immigrants, refugees and asylum seekers struggling to meet the demands of adjusting to a new dominant culture. However, many factors influence the degree of stress that is experienced, including the individual's attitudes to becoming part of the dominant culture.

BOX 3.4 Ethnic and race-based experiences that produce stress

A survey of more than 4000 Victorians conducted by researchers for VicHealth found that people who were born in a country in which the main language spoken was not English were:

- more than twice as likely as Australian-born people to report being treated with disrespect because of their ethnicity or race (42% compared with 18%)
- about 2.5 times as likely to report being treated with distrust on the basis of their ethnicity or race (33% compared with 13%)
- nearly twice as likely to report experiences of name-calling and/or insults on the basis of their ethnicity or race (43% compared with 22%)
- twice as likely to experience discrimination either at a shop, restaurant or at a sporting or other large public event
- three times as likely to experience discrimination in the workplace
- twice as likely to experience discrimination in education
- about four times as likely to experience discrimination from police and when seeking accommodation.

A more recent study obtained similar results from 1139 Australians living in metropolitan and rural areas. Data collected included types of racial discrimination experienced, settings for these incidents, and the level of 'psychological distress' caused by the incidents. The majority of participants were born in the Middle East (25.6%), followed by Africa (21.7%), East Asia (13.9%), South Asia (10.2%) and the Pacific Islands (9.7%). The mean age of the sample was 36 years and the most common religion was Islam (38.2%), followed by Christianity (30.8%).

Figures 3.11 and 3.12 show data on the settings of racist experiences and the specific types of racist experiences. The researchers found that experiencing discrimination in certain settings was particularly associated with high or very high psychological distress and that poorer mental health was associated with the amount of discrimination experienced, rather than the type of experience (Ferdinand, Paradies & Kelaher 2015).

Experiences of racism

Nearly two-thirds of participants reported at least one discriminatory experience in the preceding 12 months, with 23% reporting between one and five experiences, 22% reporting between six and eight experiences and 18% of all respondents reporting nine or more experiences. No experiences were reported by 37% of respondents.

As shown in Figure 3.11 below, the most frequent experience reported was being a target of racist names, jokes or teasing, or hearing comments that rely on stereotypes of the participant's racial, ethnic cultural or religious group. This experience was reported by 55% of participants. Having property vandalised was reported by more than one quarter of participants.

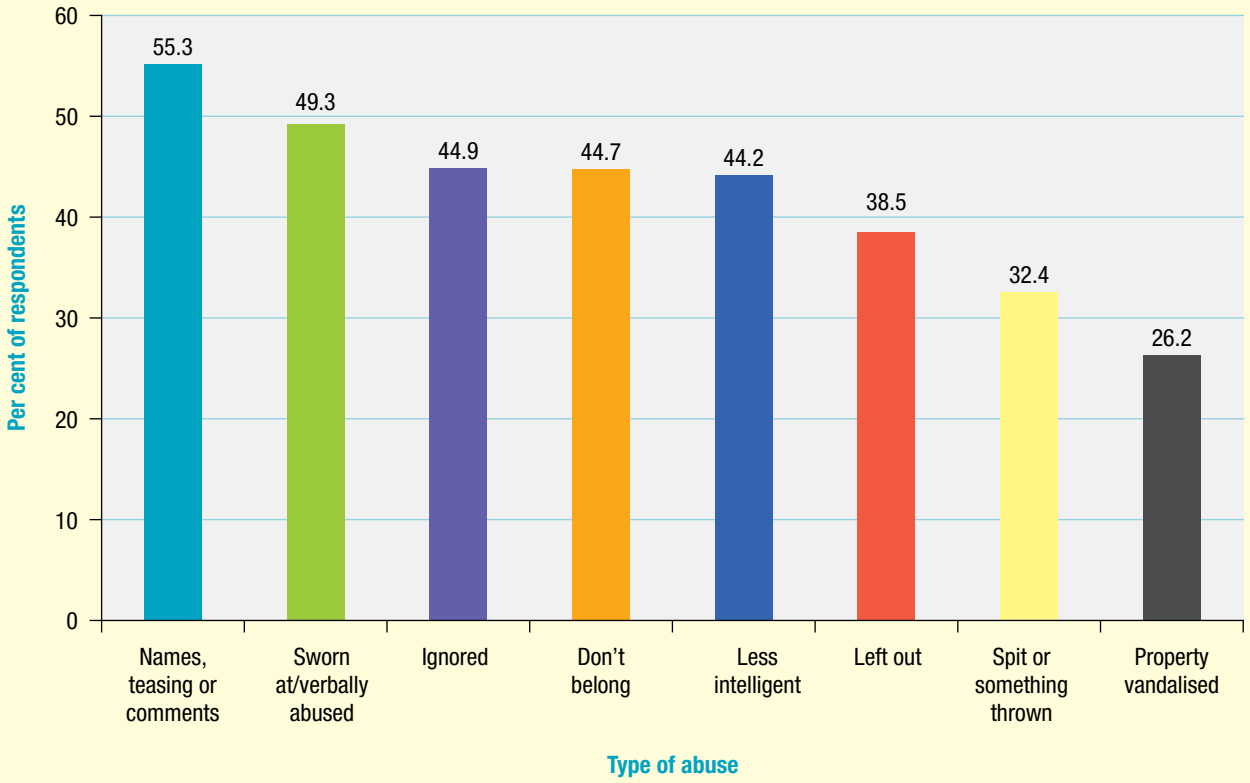

Figure 3.11 Experiences of racism for Victorians from racial/ethnic minority backgrounds

As shown in Figure 3.12 below, discrimination most commonly occurred in public spaces, with 35% of participants reporting that they had experienced a discriminatory incident in a public space in the previous 12 months, followed by employment (33%) and a further 30% each experiencing incidents in shops and public transport. Data were not collected on perpetrators in specific settings. Therefore, it could not be determined whether the racist behaviours in settings such as health care, local council, or justice settings were initiated by staff, clients or others.

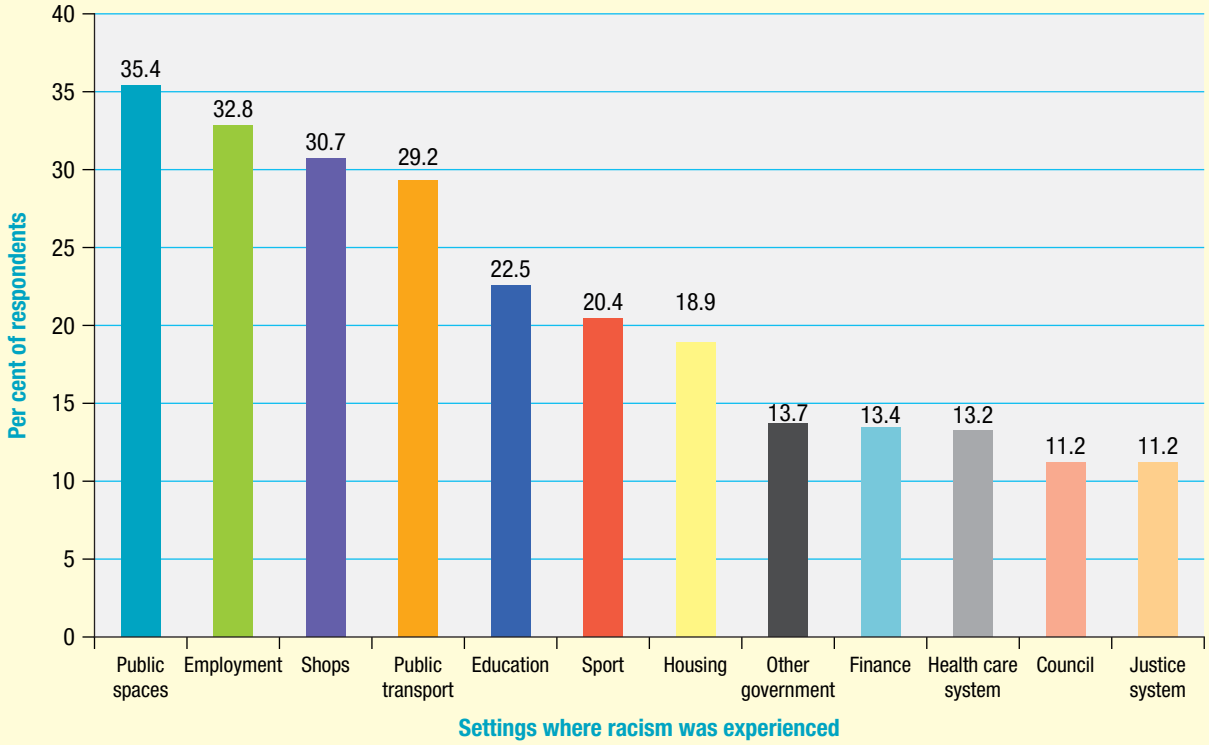

Figure 3.12 Settings where Victorians from racial/ethnic minority backgrounds experienced racism

Sources: Ferdinand, A. S., Paradies, Y., & Kelaher, M. (2015). Mental health impacts of racial discrimination in Australian culturally and linguistically diverse communities: a cross-sectional survey. *BMC Public Health, 15*, 401; VicHealth (2007). *More than tolerance: Embracing diversity for health*. Melbourne: Victorian Health Promotion Foundation.

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Acculturative issues of Muslims in Australia

BOX 3.5 The Acculturative Stress Scale for International Students (ASSIS)

More than one in five students studying in Australia are international students on a student visa. In 2017, China was the biggest source country for higher education enrolments, at 38%, ahead of India at 15%. Many international students are also enrolled in secondary schools, representing 3.2% of total enrolments in 2017. International students make a significant contribution to Australian society, diversifying and enriching communities. The decision to study in Australia also offers many benefits to international students, allowing them to gain an internationally recognised education, as well as the opportunity to experience life in Australia (Australian Government Department of Education and Training, 2017).

The *Acculturative Stress Scale for International Students* (*ASSIS*) has been designed to measure acculturative stress among international students. The 36 item scale was developed by Indian-born American psychologist Daya Sandhu and his mathematician colleague Badiolah Asrabadi in 1994. Responses are scored on a 5-point Likert-type rating scale (see Box 1.20 on pages 84–5), with a score of 1 being 'strongly disagree' and 5 being 'strongly agree'. Total scores range from 36 to 180, with high scores referring to higher acculturative stress.

(continued)

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Items are designed to measure stress level in relation to six subscales ('stressor categories') called *Perceived Discrimination, Homesickness, Perceived Hate, Fear, Stress Due To Change/Cultural Shock*, and *Guilt*. Following is a reproduction of the scale.

Acculturative Stress Scale for International Students

As foreign students have to make a number of personal, social, and environmental changes upon arrival in a strange land, this *cultural shock* experience might cause them acculturative stress.

This scale is designed to assess such acculturative stress you personally might have experienced. There are no right or wrong answers. However, for the data to be meaningful, you must answer each statement given below as honestly as possible. For each of the following statements, please circle the number that BEST describes your response.

1 = Strongly disagree, 2 = disagree, 3 = not sure, 4 = agree, 5 = strongly agree

Because of my different cultural background as a ***foreign*** student, I feel that:

1	Homesickness for my country bothers me.	1	2	3	4	5
2	I feel uncomfortable to adjust to new foods and/or to new eating habits	1	2	3	4	5
3	I am treated differently in social situations.	1	2	3	4	5
4	I feel rejected when people are sarcastic toward my cultural values.	1	2	3	4	5
5	I feel nervous to communicate in English.	1	2	3	4	5
6	I feel sad living in unfamiliar surroundings here.	1	2	3	4	5
7	I fear for my personal safety because of my different cultural background.	1	2	3	4	5
8	I feel intimidated to participate in social activities.	1	2	3	4	5
9	Others are biased toward me.	1	2	3	4	5
10	I feel guilty to leave my family and friends behind.	1	2	3	4	5
11	Many opportunities are denied to me.	1	2	3	4	5
12	I feel angry that my people are considered inferior here.	1	2	3	4	5
13	I feel overwhelmed that multiple pressures are placed upon me after my migration to this society.	1	2	3	4	5
14	I feel that I receive unequal treatment.	1	2	3	4	5
15	People from some ethnic groups show hatred toward me nonverbally.	1	2	3	4	5
16	It hurts when people don't understand my cultural values.	1	2	3	4	5
17	I am denied what I deserve.	1	2	3	4	5
18	I have to frequently relocate for fear of others.	1	2	3	4	5
19	I feel low because of my cultural background.	1	2	3	4	5
20	I feel rejected when others don't appreciate my cultural values.	1	2	3	4	5
21	I miss the country and people of my national origin.	1	2	3	4	5
22	I feel uncomfortable to adjust to new cultural values.	1	2	3	4	5
23	I feel that my people are discriminated against.	1	2	3	4	5
24	People from some other ethnic groups show hatred toward me through their actions.	1	2	3	4	5
25	I feel that my status in this society is low due to my cultural background.	1	2	3	4	5
26	I am treated differently because of my race.	1	2	3	4	5
27	I feel insecure here.	1	2	3	4	5
28	I don't feel a sense of belonging (community) here.	1	2	3	4	5
29	I am treated differently because of my color.	1	2	3	4	5
30	I feel sad to consider my people's problems.	1	2	3	4	5
31	I generally keep a low profile due to fear from other ethnic groups.	1	2	3	4	5
32	I feel some people don't associate with me because of my ethnicity.	1	2	3	4	5
33	People from some other ethnic groups show hatred toward me verbally.	1	2	3	4	5
34	I feel guilty that I am living a different lifestyle here.	1	2	3	4	5
35	I feel sad leaving my relatives behind.	1	2	3	4	5
36	I worry about my future for not being able to decide whether to stay here or to go back.	1	2	3	4	5

Source: Sandhu, D.S., & Asrabadi, B.R. (1994). Development of an acculturative stress scale for international students: Preliminary findings. *Psychological Reports, 75,* 435–448.

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Word copy of Acculturative Stress Scale for International Students

Major stressors

A **major stressor** is an event that is extraordinarily stressful or disturbing for almost everyone who experiences it. It may be a single, one-off event, such as being the victim of a violent crime, or it may be an ongoing, unrelenting event, such as a terminal illness. In either case, the event is highly likely to be a terrible experience that is very frightening or distressing. The event does not necessarily have to be directly experienced. For example, the stressor may involve witnessing the event as it occurs to someone else, or learning that a close family member or close friend experienced the event, especially if the event is one in which there was actual or threatened death or serious violence or injury (Schnurr, et al.,2002; Schnurr, Vielhauer & Findler, 1995).

Major stressors are often described as *psychologically traumatic* events because they typically involve experiences that are life threatening, or where there is a significant threat to the individual's physical or psychological wellbeing. There is an adverse emotional reaction that may result in a difficulty in coping or functioning as the person normally does. Potentially traumatic events are powerful and upsetting incidents that often affect individuals in ways that intrude into daily life.

Major stressors that can lead a person to experience psychological trauma include:

- acts of violence such as an armed robbery, war or terrorism
- natural disasters such as bushfire, earthquake or floods
- interpersonal violence such as rape, child abuse, or suicide of a family member or friend
- involvement in a serious motor vehicle or workplace accident (APS, 2016).

Many people have strong emotional or physical reactions following experience of a traumatic event. Immediately after the event, shock and denial are typical. Longer term reactions include unpredictable emotions, flashbacks, strained relationships and even physical symptoms like headaches or nausea. While these feelings are normal, some people have difficulty moving on with their lives (APA, 2015).

For most, these reactions subside after a few days or weeks. For some, the symptoms may last longer and be more severe. This may be due to several factors such as the nature of the traumatic event, the level of available support, previous and current life stress, personality and coping resources.

According to the Australian Psychological Society (2016), symptoms of psychological trauma due to a major stressor are physical, cognitive, behavioural and emotional in nature. These may include:

- physical: hypervigilance (i.e. excessive alertness, on the lookout for signs of danger); easily startled; fatigue/exhaustion; disturbed sleep; general aches and pains
- cognitive: intrusive thoughts and recurring memories of the event; visual images of the event; nightmares; poor concentration and memory; disorientation; confusion
- behavioural: avoidance of places or activities that are reminders of the event; social withdrawal and isolation; loss of interest in normal activities
- emotional: fear; numbness and detachment; depression; guilt; anger and irritability; anxiety and panic.

As long as they are not too severe or long lasting, the symptoms described above are considered normal reactions to trauma. Although these symptoms can be distressing, they will settle quickly in most people. They are part of the natural healing process of adjusting to an extraordinarily stressful or disturbing event, making some sense out of what happened, and putting it into perspective. With understanding and support from family, friends and colleagues, the stress symptoms usually resolve more rapidly. A minority of people will develop more serious conditions such as depression, acute stress disorder, posttraumatic stress disorder, an anxiety disorder, or alcohol and drug problems.

Figure 3.13 A major stressor is an event that is extraordinarily stressful or disturbing for almost everyone who experiences it. Many military personnel in combat zones experience posttraumatic stress disorder after their deployment.

Figure 3.14 Many people have strong emotional reactions following experience of a traumatic event.

BOX 3.6 Brief Trauma Questionnaire

The *Brief Trauma Questionnaire* (*BTQ*) is a 10-item self-report questionnaire that may be used to determine whether an individual has experienced a major stressor involving a psychologically traumatic event. It was originally designed to support the assessment of Posttraumatic Stress Disorder. Following is a reproduction of the questionnaire.

Instructions

The following questions ask about events that may be extraordinarily stressful or disturbing for almost everyone. Please circle 'Yes' or 'No' to report what has happened to you.

If you answer 'Yes' for an event, please answer any additional questions that are listed on the right side of the page to report: (1) whether you thought your life was in danger or you might be seriously injured; and (2) whether you were seriously injured.

If you answer 'No' for an event, go on to the next event.

Event	Has this ever happened to you?	Did your think your life was in danger or you might be seriously injured?	Were you seriously injured?
1. Have you ever served in a war zone or in a noncombat job that exposed you to war-related casualties (e.g., as a medic or on graves registration duty)?	No Yes	No Yes	No Yes
2. Have you ever been in a serious car accident, or serious accident at work or somewhere else?	No Yes	No Yes	No Yes
3. Have you ever been in a major natural or technological disaster, such as a fire, tornado, hurricane, flood, earthquake, or chemical spill?	No Yes	No Yes	No Yes
4. Have you ever had a life-threatening illness, such as cancer, a heart attack, leukemia, AIDS, multiple sclerosis, and so forth?	No Yes	No Yes	*N/A*
5. Have you ever been attacked, beaten up, or mugged by anyone, including friends, family members, or strangers?	No Yes	No Yes	No Yes
6. As a child, were you ever physically punished or beaten by a parent, caretaker, or teacher so that you were very frightened; or you thought you would be injured; or you received bruises, cuts, welts, lumps, or other injuries?	No Yes	No Yes	No Yes
7. Have you ever been in a situation in which someone made or pressured you into having some type of unwanted sexual contact?	No Yes	No Yes	No Yes
8. Have you ever been in any other situation in which you were seriously injured? Have you ever been in any other situation in which you feared you might be seriously injured or killed?	No Yes	*N/A*	No Yes
9. Have you ever witnessed a situation in which someone was seriously injured or killed? Have you ever witnessed a situation in which you feared someone would be seriously injured or killed?	No Yes	*N/A*	*N/A*
10. Have any close family members or friends died violently, for example, in a serious car crash, mugging, or attack? *Note:* Do not answer 'yes' for any event you already reported in questions 1–9	No Yes	*N/A*	*N/A*

Scoring:
Exposure to an event should be scored as positive if a respondent says "yes" to either:
- life threat or serious injury for events 1–3 and 5–7;
- life threat for event 4;
- serious injury for event 8, or;
- "Has this ever happened to you?" for events 9 and 10.

Source: Schnurr, et al., (2002). Trauma in the lives of older men: Findings from the Normative Aging Study. *Journal of Clinical Geropsychology, 81,* 175–187.

The *Brief Trauma Questionnaire* [Measurement instrument]. Retrieved from https://www.ptsd.va.gov/professional/assessment/documents/BTQ.pdf

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Word copy of Brief Trauma Questionnaire

Catastrophes

Sometimes a stressor can disrupt and affect an entire community all at once. This tends to occur when the stressor takes the form of a catastrophe. A **catastrophe** is an event that causes widespread damage or suffering. The event is a stressor of massive proportion — one that the majority of people involved would interpret as being stressful. It usually occurs suddenly, affects many people simultaneously and is completely out of their control. Sometimes referred to as a *cataclysmic event* or simply as a *disaster*, a catastrophe can be natural or attributable to humans.

Naturally occurring catastrophes (commonly called natural disasters) are relatively common events when considered from a global perspective. In Australia, these are mainly bushfires, major floods and cyclones. For example, in February 2009, bushfires throughout Victoria killed 173 people and destroyed more than 4500 homes and buildings in many areas. Entire towns and communities were devastated. Thousands of people were left homeless and suffered other significant personal losses for a prolonged period. Farmers lost thousands of livestock as a result of the fires and native animal populations were destroyed.

Other naturally occurring catastrophes include tsunamis, earthquakes, hurricanes and mudslides. These are more common elsewhere in the world. One of the deadliest ever recorded is the massive tsunami on Boxing Day 2004 that caused devastation around the Indian Ocean, resulting in the deaths of 230 000 people. The worst hit area was the province of Aceh on the west coast of Indonesia where the series of tsunami waves travelled about 2 kilometres inland in some areas, wrecking everything in their path. In some coastal villages, more than 70% of villagers were killed. Over 600 000 people lost their livelihoods following the destruction of much of the fishing and agricultural sectors.

One of the most disastrous earthquakes occurred in January 2010, hitting the Caribbean island of Haiti, devastating its capital Port-au-Prince and surrounding areas. The earthquake affected over two million Haitians, claimed more than 200 000 lives and left 300 000 injured. More than 1.5 million people were internally displaced in some 1500 spontaneous settlements in and around the capital and affected areas.

Figure 3.15 A catastrophe can occur naturally or be caused by humans.

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Videos
- 2011 Japanese tsunami 3m 34s
- 1984 India toxic gas contamination 3m 24s

Catastrophic events attributable to or caused by humans (sometimes called 'human-made') include terrorist attacks such as the assault on New York's World Trade Centre on September 11 2001, civil wars within nations and wars between nations. The New York terrorist attacks claimed the lives of more than 2500 people and were witnessed on live television by millions throughout the world. In a nationwide survey conducted later that week, 90% of the participants, whether present or a witness from afar, reported that they were experiencing stress-related symptoms, with 44% reporting 'substantial' symptoms such as recurring thoughts, dreams and memories; difficulty falling or staying asleep; difficulty concentrating at work; and unprovoked outbursts of anger. The closer the participants lived to the disaster area, the greater the number of problems reported and the more distressed they were from the experience (Kassin, Fein & Markus, 2008).

Some human-made catastrophes involve hazardous material incidents. These leave widespread contamination for prolonged periods that create a unique stress experience for victims and can make it harder for them to adapt to, in comparison with victims of most natural disasters. For example, with natural disasters, there is usually no one to blame, whereas with a human-made disaster, blame can often be assigned to some kind of system malfunction or negligence by someone. As shown in Table 3.4 below, additional stress-related reactions that can occur with hazardous material catastrophes include fear of invisible (or radiological) exposure, or, if exposed, worry and uncertainty about possible future health effects. Contamination can take years to clean up and render an area safe. Studies have found high levels of long-term stress in communities that have been affected by exposure to toxins (Baum & Fleming, 1993; Couch & Kroll-Smith, 1991).

Regardless of its cause, a catastrophe is a significant stressor and distressing experience for all involved. Any catastrophe will affect individuals, groups and entire communities directly as well as other people less directly, such as those who live nearby and witness the suffering of others or know a person who experienced the event.

The amount of exposure to the catastrophic event and whether exposure is first or second hand are highly related to risk of future mental health problems. At highest risk are those who go through the event themselves, especially if they are injured or their life is threatened. Next are those who are in close contact with victims. At lower risk of long-term impact are those who had only indirect exposure, such as news of the severe damage through media reports. Another important factor is the social response to the catastrophe — how widely the individual's social network is disrupted and how quickly outside support and aid arrived for the victims. Social support from family, friends or the community provides important resources for coping.

In the immediate aftermath of a catastrophic event, almost everyone will find themselves unable to stop thinking about what happened. They will also tend to exhibit high levels of physiological arousal. For most, fear, anxiety, re-experiencing events, efforts to avoid reminders, and arousal symptoms, if present, will gradually decrease over time.

Most survivors (including children and disaster rescue or relief workers) experience common stress reactions after a catastrophic event. These reactions may last for several days or even a few weeks and may include psychological and physical reactions. While most survivors of catastrophic events are able to gradually come to terms with their experience on their own, or with the support of family and friends, many develop chronic (long-lasting) stress-related symptoms and need more help. Some survivors (and witnesses) may also experience physiological and psychological symptoms that can last long after the event has passed. Psychologists have several names for these long-term reactions, including acute stress disorder (ASD) and posttraumatic stress disorder (PTSD).

TABLE 3.4 Psychological responses of communities to environmental contamination

Fear and uncertainty over the possible health effects of exposure
Feeling a loss of control over the present and future
Anger over the loss of security and safety within the community
Confusion brought about by trying to understand various government documents
Community conflict over who is to blame and what actions to take
Concerns over economic losses (e.g., property devaluation, doctor bills, and business losses)
Feelings of being stigmatised and isolated because of living near a hazardous waste site
Frustration of dealing with bureaucratic agencies
Frustration of being accused of 'overreacting'

Source: Agency for Toxic Substances and Disease Registry (2000). Report of the expert panel workshop on the psychological responses to hazardous substances. Atlanta, Georgia: US Department of Health and Human Services. In *Surviving Field Stress for First Responders Agency for Toxic Substances and Disease Registry Edition 1.0, May 2005*. Retrieved from http://www.atsdr.cdc.gov/emes/surviving_stress/documents/TrainingWorkbookstress-editp1.pdf

Figure 3.16 Working together following the experience of a catastropic event can make stress more bearable.

BOX 3.7 Common reactions and responses to a catastrophic event

Disasters such as bushfires, floods, cyclones, earthquakes, chemical spills, transportation accidents or terrorist attacks are typically unexpected, sudden and overwhelming. For many people, there are no outwardly visible signs of physical injury, but there can be nonetheless an emotional toll.

Following a catastrophic event, people frequently feel stunned, disoriented or unable to integrate distressing information. Once these initial reactions subside, people can experience a variety of thoughts, feelings and behaviours. Common responses can be:

- *Intense or unpredictable feelings*. May be anxious, nervous, overwhelmed or grief-stricken. May also feel more irritable or moody than usual.
- *Changes to thoughts and behaviour patterns*. Might have repeated and vivid memories of the event. These memories may occur for no apparent reason and may lead to physical reactions such as rapid heartbeat or sweating. It may be difficult to concentrate or make decisions. Sleep and eating patterns also can be disrupted — some people may overeat and oversleep, while others experience a loss of sleep and loss of appetite.
- *Sensitivity to environmental factors*. Sirens, loud noises, burning smells or other environmental sensations may stimulate memories of the disaster creating heightened anxiety. These 'triggers' may be accompanied by fears that the stressful event will be repeated.
- *Strained interpersonal relationships.* Increased conflict, such as more frequent disagreements with family members and co-workers, can occur. A person might also become withdrawn, isolated or disengaged from their usual social activities.
- *Stress-related physical symptoms.* Headaches, nausea and chest pain may occur and could require medical attention. Pre-existing medical conditions could be affected by disaster-related stress.

Source: American Psychological Association (2017). *Recovering emotionally from disaster: What are common reactions and responses to disaster?* [Psychology topics > Disasters]. Retrieved from http://www.apa.org/helpcenter/recovering-disasters.aspx

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APS disaster resources

BOX 3.8 Posttraumatic stress disorder (PTSD)

Some effects of a stressful event are not always immediately apparent. There may be a time delay between the stressful event and the appearance of psychological or behavioural symptoms such as unwanted recurring memories, avoidance of people or events that remind one of the original event, negative emotions and feelings of agitation. This is evident in the trauma- and stressor-related disorder called Posttraumatic stress disorder.

Posttraumatic stress disorder (PTSD) is a severe anxiety disorder that may develop after exposure to a traumatic or very stressful event, such as a catastrophe, physical assault, abuse, a serious car accident, combat duty or even a medical incident such as waking during surgery or anaphyplactic shock. The event may be directly experienced or witnessed. The disorder may even develop through indirect exposure such as learning about a violent experience or an unexpected, non-natural death of a close relative or family friend.

Symptoms of PTSD may begin shortly after the traumatic event, or months or years afterwards. Furthermore, the symptoms typically last for at least one month, but may persist for years or even a lifetime. If the symptoms begin within four weeks of the traumatic event and last for less than a month, then the person is likely to be diagnosed as having *acute stress disorder* rather than PTSD. The symptoms of PTSD (and acute stress disorder) generally fall into four categories. People with PTSD may experience some, many or all of the symptoms, and may experience them differently depending on factors such as their personality, temperament, past experiences, interpersonal relationships and access to support.

Common PTSD symptoms include:

- *Intrusive or recurrent memories of the trauma*. Individuals may find that the traumatic event constantly intrudes on everyday life as they relive the experience, again and again. These intrusions can take the form of sudden mental images of scenes from the event (flashbacks) or distressing dreams about specific experiences (nightmares). Intrusions can be so realistic that the person feels as if the traumatic event is actually happening again. Physiological reactions may also be experienced during intrusions or when reminded of the event; for example, sweating and having a 'racing heart'.
- *Avoidance of trauma reminders*. Individuals may avoid people or situations that remind them of the event (so they don't have to face potential triggers). Avoidance can include attempts to block out unpleasant memories, thoughts, feelings, conversations, or any other internally or externally sourced reminder associated with the traumatic event.
- *Feeling sad, angry or numb*. Individuals often experience more negative emotions than they did before the event, including sadness, anger and a loss of pleasure in things that used to make them happy. A person who has been exposed to a traumatic event may also experience emotional numbing. This means that they feel detached and distant from other people, lose their ability to feel any emotion (such as love or sadness) and lose their interest in participating in many activities.
- *Feeling 'on edge' or other changes in arousal or emotional reactivity*. Exposure to a traumatic event can result in heightened arousal and the feeling of being constantly in danger. People are likely to feel 'jumpy' and always on guard. These types of symptoms are called hyperarousal symptoms (and directly related to physiological changes that occur in response to trauma). They include difficulty falling or staying asleep (insomnia), irritability or outbursts of anger, difficulty concentrating and hypervigilance ('always on the lookout') for signs of danger.

Figure 3.17 First responders who are repeatedly exposed to traumatic events are at an increased risk of developing PTSD.

Source: American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, Virginia: Author.

LEARNING ACTIVITY 3.8

Review questions

1. (a) Define the meaning of acculturative stress with reference to relevant stressors.
(b) Give two examples of variables that can influence the degree of acculturative stress experienced by an individual.
(c) (i) Under what circumstances might indigenous people who do not migrate to another country experience acculturative stress?
(ii) Working independently or with a partner, construct a Venn diagram that shows similarities and differences in potentially stressful experiences of Indigenous Australians and people from other culturally different countries who choose to live in Australia (e.g. immigrants, refugees, asylum seekers).

2. (a) Distinguish between a major stressor, stressors attributable to daily pressures (hassles) and life events.
(b) Give two examples of commonly reported major stressors and explain why each one is considered to be a major stressor (rather than another type of stressor).

3. (a) What is a catastrophe?
(b) Explain whether a catastrophic event can act as a 'major stressor'.
(c) How is a catastrophic event (as a potential stressor) best distinguished from other stressor types?
(d) Distinguish between natural and human-made catastrophic events that become stressors, with reference to examples of each type.
(e) List key risk factors that impact on the potential severity of this type of stressor.
(f) In what ways can media coverage of a catastrophe impact on how the event affects individuals and the community in general?

LEARNING ACTIVITY 3.9

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Summarising different sources of stress

Complete the following table to summarise the different types of stressors.

Stressor	Description	Example(s)	Why it can cause distress	Key point(s) distinguishing from other stressor types
daily pressures (hassles)				
life events				
acculturative stress				
major stressor				
catastrophe disrupting a whole community				

LEARNING ACTIVITY 3.10

Reflection

Consider the stressors described in this section and comment on their relevance to your life experience. Include a reference to any significant stressor or stressor type which you believe may have been understated or overlooked.

STRESS AS A BIOLOGICAL PROCESS

Stress can affect different people in different ways, depending on the severity or intensity of the stressor, the nature of the stress response, the duration of the response and the individual involved. For example, acute stressors typically appear suddenly, produce a high level of physiological arousal and have immediate short-lasting effects. In contrast, chronic stressors typically last a long time and produce a high level of arousal that also tends to persist over a long period of time.

Two models for describing and explaining physiological responses to a stressor are called the *fight–flight–freeze response* and the *General Adaptation Syndrome*. Both models describe patterns of involuntary biological processes ('bodily changes') that occur in response to a stressor. The changes occur in much the same way in all individuals. The General Adaptation Syndrome is longer lasting and includes *fight–flight reactions* within the first of its series of three stages. In addition, this model emphasises the 'wear and tear' on the body with prolonged stress.

Fight–flight–freeze response

Any kind of immediate threat to your wellbeing is usually a stress-producing experience that triggers a rapidly occurring sequence of bodily changes. Without our awareness or conscious control, our body instantly responds by automatically activating the fight–flight–freeze response. This was originally described by American doctor Walter Cannon (1932) as a response involving only 'fight' and 'flight' reactions, but it is now recognised that people (and animals) may also 'freeze' in response to a stressor. The changes associated with each reaction are believed to have evolved as part of a survival mechanism, enabling us to react effectively to events that threatened our wellbeing or even our lives.

The **fight–flight–freeze response** is an involuntary, physical response to a sudden and immediate threat (or stressor) in readiness for:

- *fight* — confronting and fighting off the threat
- *flight* — escaping by running away to safety
- *freeze* — keeping absolutely still and silent, avoiding detection.

The physiological changes that occur during the fight–flight–freeze response are activated in order to prepare the body for one or more of these reactions. In terms of observable behaviour, the reactions do not occur simultaneously so the response is often described as *'fight or flight or freeze'*. However, all three are considered to be adaptive responses that enable us to deal with a threat that is present and help minimise harm.

Which of the three reactions occurs as observable behaviour depends on the situation. Biological processes that underlie each reaction can take place before the brain's visual information processing areas have had a chance to fully interpret what is happening. This is believed to explain why we are able to jump out of the path of an oncoming car we catch out of the corner of an eye even before we think about what we are doing.

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Figure 3.18 Fight–flight–freeze is an involuntary, physiological response to a stressor, particularly when feeling threatened. Is this person experiencing fight, flight or freeze?

Fight–flight reactions

When our wellbeing is threatened, two immediate options are to either fight off the threat or escape from it. To prepare our body for either alternative, all energy is directed from non-essential body systems to those systems that will help us either 'outrun' or 'outfight' the threat.

Both the fight and flight reactions are initiated by the sympathetic nervous system and involve changes such as:

- increased heart rate and blood pressure
- redistribution of blood supply from the skin and intestines to the skeletal muscles
- increased breathing rate (to increase oxygen supply)
- increased glucose (sugar) secretion by the liver (for energy)
- dilation of the pupils (so the eyes can take in as much light as possible)
- suppression of functions that are not immediately essential in order to conserve energy (such as digestion and sexual drive) and which can be delayed without damage to the organism.

When a threat is perceived, a signal is sent to the hypothalamus (via the amygdala). This almond-sized gland, located just above the brain stem, links the nervous system to the endocrine (hormonal) system and plays a vital role in monitoring and adjusting bodily processes (homeostasis). It responds to the stressor by activating the sympathetic nervous system in less than 1/20th of a second — less than the amount of time between two beats of the heart.

The sympathetic nervous system then stimulates the adrenal medulla, which is the inner part of the adrenal gland (located just above each kidney). The adrenal glands secrete hormones called catecholamines into the bloodstream. Two of these hormones are *adrenaline* (also called *epinephrine*) and *noradrenaline* (also called *norepinephrine*). These 'stress hormones' circulate in the bloodstream, activating various organs including the heart, lungs, liver and kidneys, and resulting in the bodily changes that characterise the fight and flight reactions. Adrenaline and noradrenaline also occur as neurotransmitters and may be released by neurons to have excitatory effects. Collectively, the fight–flight reactions will enable you to fight harder, run faster, see better and breathe easier than you would if fight or flight did not occur.

A 'racing heart' during fight or flight is explained by the surge of stress hormones in the body. Once the stressor is removed, the parasympathetic nervous system becomes dominant and the high level of bodily arousal gradually subsides. Adrenaline and noradrenaline also fall back to pre-threat levels, thereby contributing to the reversal of all the physiological reactions; for example, heart and breathing rates slow, blood pressure falls and digestion is stimulated again.

These and other changes associated with fight and flight occur within seconds, thereby allowing us to react very quickly to the threat at hand. Once the threat has passed, the parasympathetic system calms and restores normal functioning. The sympathetic nervous system functions like the accelerator pedal in a car. It triggers fight or flight reactions, providing the body with a burst of energy so that it can respond to perceived dangers. The parasympathetic nervous system acts like the car's brake, slowing the body after the danger has passed.

Fight–flight reactions are initiated in the brain and have the overall effect of arousing and energising the body to deal with an immediate threat. The brain–body pathway that activates fight–flight is called the sympathetic adreno-medullary system (SAM). The adrenal medulla is really a part of the sympathetic division of the autonomic nervous system, although it functions in some ways as an endocrine system gland. The adrenal cortex, however, is a typical endocrine gland (Thompson, 2000).

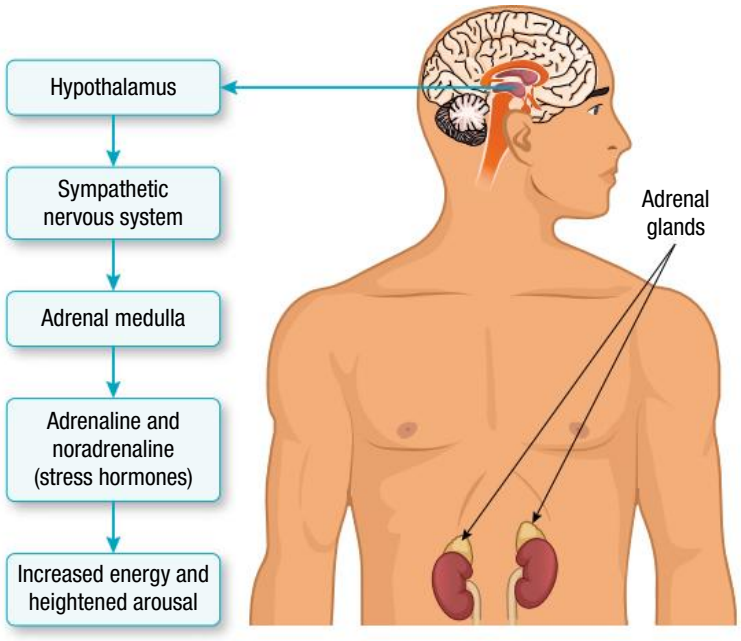

Figure 3.19 Fight–flight reactions are initiated in the brain and have the overall effect of arousing and energising the body to deal with an immediate threat. These changes tend to precede the freeze response. The brain–body pathway that activates fight–flight is called the sympathetic adreno-medullary system (SAM).

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Practical activity
Measurement of a fight-flight reaction

Freeze reactions

Sometimes, we cannot run away or are unable to fight, or the perceived threat is so intense or overwhelming that there is little or no immediate or apparent chance of successfully fighting or escaping. This is when we may go into a freeze state, unable to move or act. Body movements and vocalisations stop, the racing heart slows very significantly, blood pressure drops very quickly and tense muscles collapse and become still. Often, before immobility sets in, there is a reflexive, 'orienting response' of the head or eyes towards the direction of the threat. This is accompanied by hypervigilance — being on guard, watchful, or extremely alert. This initial part of the freeze state has been described as a 'stop, look and listen' behavioural response that is most commonly associated with a stressor that causes fear. Before reacting with flight or fight, many mammals freeze for a few milliseconds. It has been suggested that this is done to assess the situation before making a next move. However, some psychologists believe that this is not a true freeze state because the mind can become numb during the freeze state (Bergland, 2014; Bracha, et al., 2004; Gray, 1988; Roelofs, Hagenaars & Stins, 2010; Scaer, 2001; Schmidt, et al., 2008).

The apparent frozen state of the body is called *tonic immobility* and is seen in the mouse that 'plays dead' when caught by a cat and the startled animal that 'freezes' when caught in a car's headlights at night time. However, the immobility is considered to have adaptive value, especially among animals when fearful and threatened. For example, prey that remain 'frozen' during a threat are more likely to avoid detection. The frozen state also conserves energy until a predator loses interest. When this occurs, the animal can use the excess energy for escape ('flight'). In some cases, however, freezing when fearful is not adaptive. For example, it is not an adaptive response when fear causes a job candidate to freeze during an interview, or overwhelms a student's mind during an important exam, or restricts the everyday life of the individual with a phobia who must continually engage in avoidance behaviour to avoid contact with a stimulus that triggers a panic attack or some other extreme reaction (Gray, 2007).

Nevertheless, when under attack by a person or animal, tonic immobility may also be useful when additional attacks are provoked by movement or when immobility may increase the chance of escaping, such as when a predator believes its captured prey to be dead and loosens its grip or releases it, providing the prey with an opportunity for escape (Gray, 1988).

Biological processes underlying the freeze state are not completely understood. It is believed that sympathetic nervous system activation always precedes the freeze state and becomes a part of this state. When the *freeze reaction* is initiated, the energy-conserving 'rest and relaxation' actions of the parasympathetic nervous system dominate over the existing effects of the sympathetic nervous system activation. This leaves the organism in a physiological state involving high arousal of *both* the sympathetic and parasympathetic systems. The resulting condition is characterised by both energy conservation and a mobilised state ready for action (Levine, 1997; Scaer, 2014).

This has been likened to the organism having one foot on the accelerator (the sympathetic nervous system) and one foot on the brake (the parasympathetic nervous system) at the same time. Consequently, when an animal takes the opportunity for flight after having been in a frozen state, it can very quickly escape by switching to the highly energised state of full sympathetic system arousal (Plaford, 2013).

Figure 3.20 While a rabbit that remains still and 'frozen' when confronted by a predator is displaying an adaptive response, a person whose mind 'freezes' because of a public speaking phobia is not.

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Weblink
Video on fight-flight-freeze 3m 05s

The nervous system responses for fight, flight and freeze are automatic actions. They are similar to reflexes in that they are instantaneous, but the mechanisms underlying these reactions are much more complex. For example, studies have found that, when in a freeze state, some people psychologically dissociate ('detach') themselves from terror-laden, distressing events in which they are caught. A person who is being viciously assaulted or trapped in a horrifying situation is then better able to block out what is much too scary to take in. They actually do not feel what is happening to them (Schmidt, et al., 2008; Selzer, 2015).

Role of cortisol

If we need to deal with a stressor over time, additional physiological resources are required as the body cannot maintain the intensity of the fight and flight reactions for a prolonged period. In these circumstances, a brain-body stress response pathway called the HPA axis is activated. This has a more direct link and therefore line of communication between the brain and the endocrine system. Sympathetic nervous system reactions for the fight–flight–freeze response are instantaneous. These autonomic reactions can be likened to the 'first wave' of response to a stressor. The HPA axis puts into motion a slower but longer-lasting chain of reactions that includes the release of cortisol. This activity can be likened to a 'second wave' of response to the initial stressor, but it may occur shortly after the immediate fight-flight autonomic (SAM) reactions.

As the name suggests, the *hypothalamic-pituitary-adrenal,* or HPA axis, involves the *h*ypothalamus, the *p*ituitary gland and the *a*drenal cortex (the outer layer of the adrenal glands) in a chain of direct influences and feedback interactions. This time, the hypothalamus stimulates the nearby pituitary gland. In turn, the pituitary gland secretes hormones such as adrenocorticotropic hormone (ACTH) into the bloodstream which carries it to the adrenal cortex. Among other things, ACTH stimulates the adrenal cortex to secrete additional stress hormones called *corticosteroids*. Cortisol is the most abundant of these hormones, accounting for about 95% of glucocorticoid activity. The level of cortisol circulating in the bloodstream is commonly used as a measure of stress by researchers.

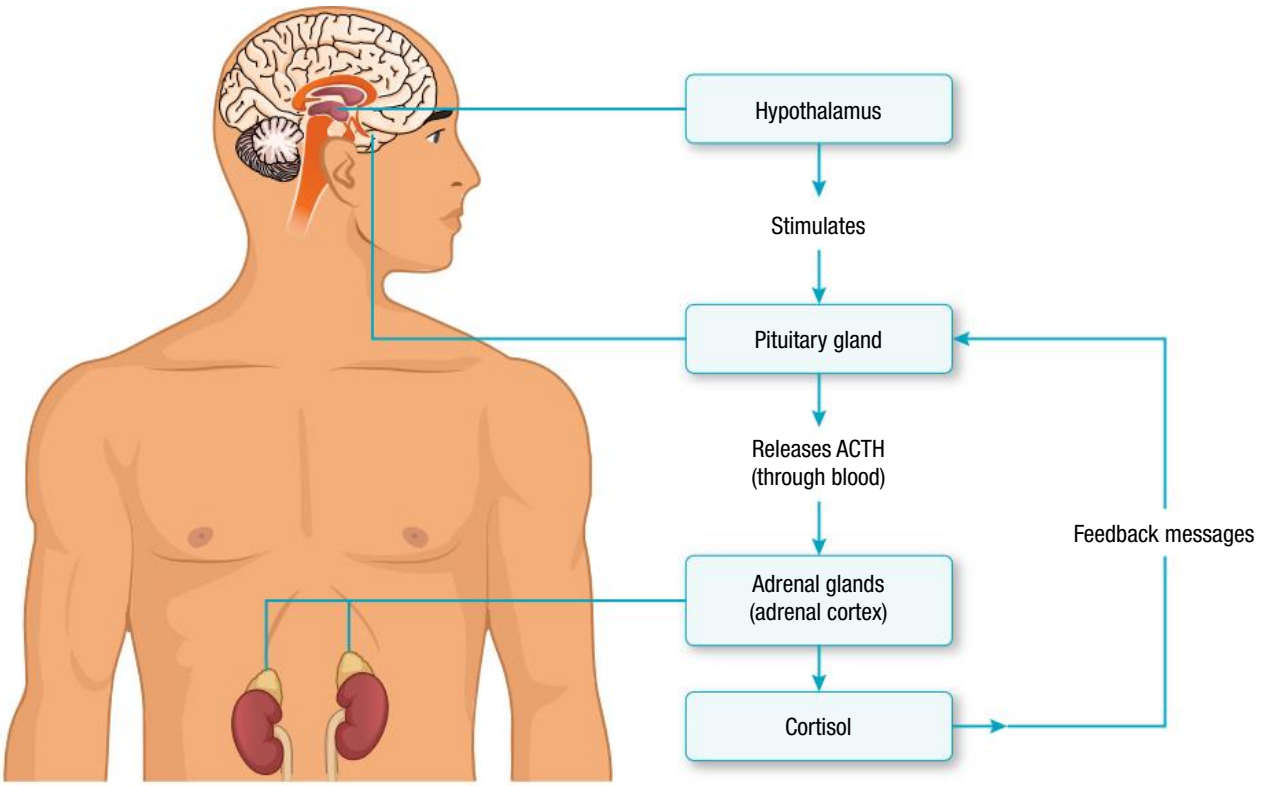

Figure 3.21 The HPA axis is activated if a stressor persists, resulting in the release of cortisol.

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Weblinks
- Animation on HPA axis 2m 0s
- Video on how the body responds to stress 5m 51s

One of the effects of **cortisol** is to energise the body by increasing energy supplies such as blood sugar and enhancing metabolism. For example, cortisol acts upon the liver to make it secrete glucose into the bloodstream for the muscles to use as an energy source. Cortisol also has an anti-inflammatory effect by blocking the activity of white blood cells that contribute to inflammation. However, it can also retard tissue repair, which slows wound healing. Suppressing the activity of the immune system is part of the overall process of targeting essential bodily resources to ensure instantaneous fight, flight and freeze reactions.

Unlike the fight–flight–freeze response, the HPA axis usually takes significantly longer (seconds to minutes) to exert its influences. Its effects also persist for a much longer time (minutes to hours). However, its overall effect is like that of the fight or flight reactions.

Once the level of cortisol (and other corticosteroids) reaches a certain level, the hypothalamus is signalled to turn off the stress response. This is part of the normally occurring feedback loop that 'turns on and off' a healthy, appropriate physiological response to stress. For example, a healthy stress response is characterised by a quick rise in cortisol levels, followed by a rapid decline with the termination of the stressful event.

Although physiological responses to stressors are beneficial and may be adaptive in the short term, prolonged activation of our stress response systems can be harmful to physical and mental health. For example, with long-term stressors, the HPA axis continues to be active and cortisol remains in the bloodstream at a high level.

One effect of the excessive amount of cortisol over a prolonged time is impaired immune system functioning and thereby increased vulnerability to disease. Normally, when foreign substances such as viruses, bacteria, or allergens, enter the body, the immune system launches into action to destroy the invaders. Cortisol interferes with this process, leaving the body less able to deal with infection. Physical health problems associated with higher and more prolonged levels of cortisol in the bloodstream include colds, flu, hypertension (high blood pressure), blood sugar imbalance (hyperglycemia), atherosclerosis (hardening of the arteries), cardiovascular disease and diabetes (see Box 3.12 on page 226).

Sometimes, the feedback system that normally shuts off the stress response may become damaged so its vital function is disrupted. Impaired cognitive performance, learning problems, impaired memory formation and recall (by impacting on hippocampus functioning), and mental disorders such as depression, posttraumatic stress disorder and other anxiety disorders have also been linked to high levels of cortisol in the bloodstream for a prolonged period (Breedlove, Rosenzweig & Watson, 2007; Cohen, et al., 1992; Huffman, 2012; McEwen, 2004; McEwan & Stellar, 1993).

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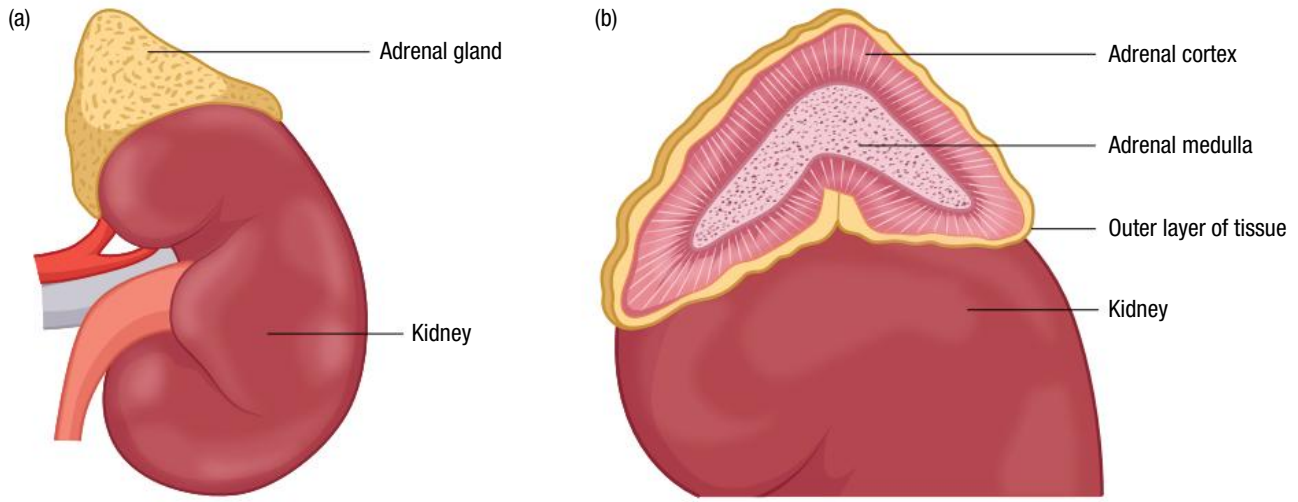

Figure 3.22 (a) The adrenal gland and kidney; (b) a cross-section of an adrenal gland

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Weblink
Tutorial on adrenal gland function 4m 29s

BOX 3.9 Train commuting, passenger stress and cortisol

If you use a suburban train to get to school every morning during peak hour, you probably do not find it the most pleasurable experience of the day — delays and standing up face-to-face with someone else in a crowded carriage can make it a stressful experience, especially when on a long journey. People in such crowded environments often report physical and psychological symptoms of stress such as higher blood pressure, increased heart rate, 'light-headedness', 'feeling like fainting', nausea, difficulties concentrating, frustration, anxiety, fear and anger (Evans, 1979,1980).

One American study investigated the relationship between train commuting and stress in 208 men and women who lived in the suburbs (New Jersey) and took the train to work in Manhattan, New York. The amount of cortisol in saliva produced by participants was used as a measure of stress. One set of results is shown in Figure 3.23 below.

At the end of the journey, the researchers gave participants a proof-reading exercise to complete for which they had to identify errors in a document. Those on short journeys persisted with the task but as the journey got longer, more and more participants set it aside. Participants who did not persist with the task also reported experiencing more stress. There were no significant sex differences in the results (Evans & Wener, 2006).

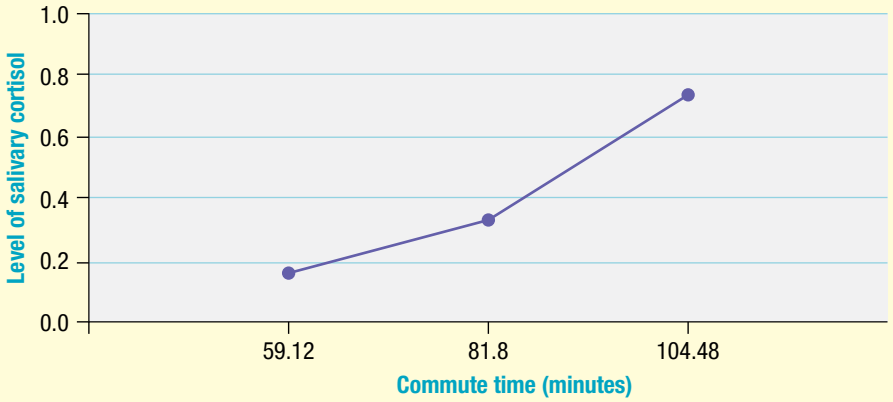

Figure 3.23 Level of cortisol and commute time

Source: Based on Evans, G.W., & Wener, R.E. (2006). Rail commuting duration and passenger stress. *Health Psychology, 25*(3), 408–412.

LEARNING ACTIVITY 3.11

Evaluation of research by Evans and Wener (2006) on commuting and cortisol

Consider the research on train commuting and cortisol summarised in Box 3.9 above and answer the following questions.

1. How was stress operationalised by the researchers?
2. Identify the independent and dependent variables for the cortisol measurement part of the study.
3. (a) Describe the pattern of results shown in Figure 3.23.
   (b) Formulate a research hypothesis that would be supported by the results in Figure 3.23.
4. Explain whether crowded train travel to school or work would be classified as an internal or external stressor.
5. (a) Which stress symptom was measured by the proof-reading exercise?
   (b) Formulate a research hypothesis that would be supported by the results for this measure.
6. What are three questions you would ask the researchers to help you determine potential limitations or criticisms of the research design?
7. What are two conclusions that can be drawn from the results?
8. Are the results generalisible to:
   (a) the study's population?
   (b) other populations?
   Explain your answers.

BOX 3.10 Body systems involved in physiological changes occurring with stress

Many body systems may be involved in a complex interaction when we are exposed to a stressor. Some of the systems and ways they react to stressors include the following.

1. **Nervous system**
   The flight or fight reaction is automatically activated to energise the body to deal with the stressor. Adrenaline and noradrenaline are released by the adrenal glands after receiving a signal from the sympathetic nervous system. These increase the heart rate, blood pressure, breathing and glucose secretion from the liver. Other functions that are not immediately essential are suppressed. Once the threat passes, the parasympathetic system returns the body to normal functioning. In some cases, a freeze reaction occurs in response to a stressor. When this occurs, the parasympathetic system dominates the sympathetic system.
   Continuous activation of the nervous system due to chronic stress impacts on other bodily systems.
2. **Musculoskeletal system**
   Stress causes muscles, particularly in the neck and head, to contract and tighten and, over extended periods, can cause stress-induced headaches and migraines, and aches and pains in other muscles.
3. **Respiratory system**
   Increased breathing and blood pressure makes more oxygen available to the muscles to help meet immediate energy needs for fight or flight. However, 'over-breathing' or excessive breathing (e.g. hyperventilation) in response to stress can bring on dizziness or even panic attacks in some people.
4. **Cardiovascular system**
   A sudden surge of the stress hormones adrenaline and noradrenaline in response to an acute stressor results in the feeling of a 'racing heart', as the heart rate increases and the heart muscle contractions strengthen. Over a prolonged period, this can contribute to hypertension, stroke and coronary heart disease.
5. **Endocrine system**
   As well as secreting adrenaline and noradrenaline for fight or flight, the chain of reactions involving the HPA axis may also be initiated if the stressor persists, resulting in the release of cortisol to further energise the body (but cortisol also has an immune-suppression effect which weakens the body's resistance to disease).
6. **Gastrointestinal system**
   Persistent stress affects the nerves of the digestive system and can upset digestion, causing people to feel a sense of unease or 'butterflies' in their abdomen, or even nausea or pain. Stress can slow the digestive system, resulting in either bloating and constipation or diarrhoea, and can affect which nutrients your intestines absorb. Over time, chronic stress can lead to damage to the digestive system. Stress can also bring about changes to diet, both in terms of what people eat, how much they eat, and how and when they eat, or it can cause people to increase their use of alcohol or caffeine.
7. **Reproductive system**
   Excess production of cortisol can affect the reproductive system of men by suppressing sperm count and production of testosterone, and women by inhibiting the reproductive system and impacting on the menstrual cycle.

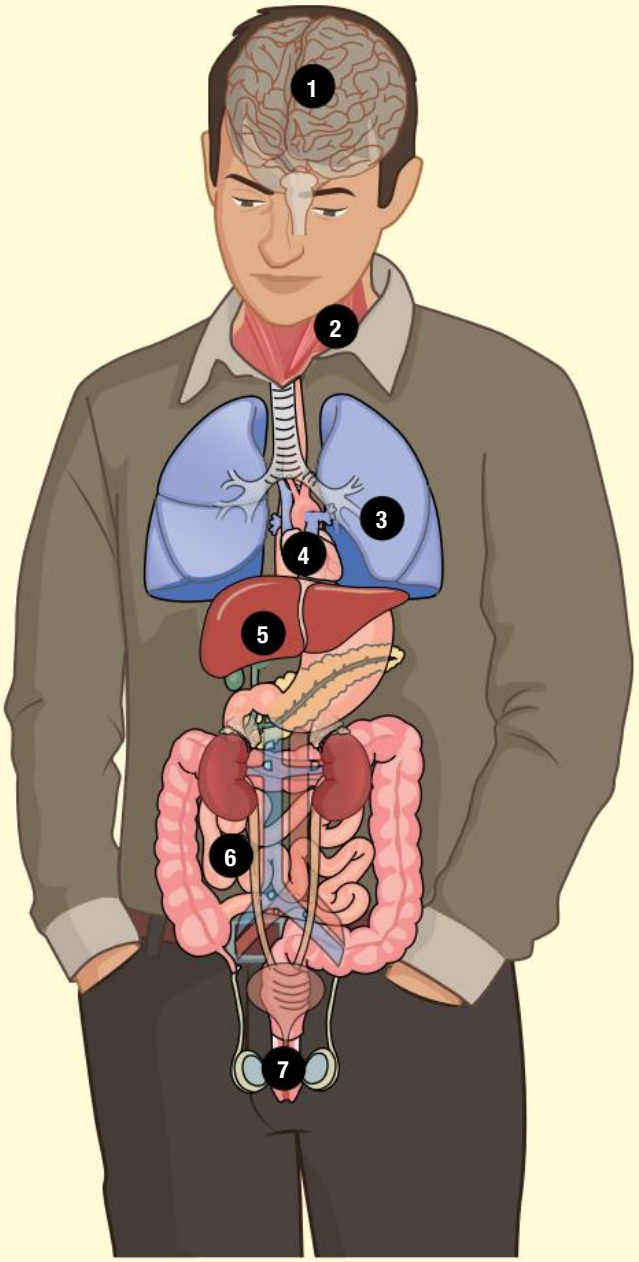

Figure 3.24 Body systems involved in physiological changes occurring with stress

Source: American Psychological Association (2018). *Stress effects on the body* [Psychology Help Center]. Retrieved from http://www.apa.org/helpcenter/stress-body.aspx

LEARNING ACTIVITY 3.12

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Review questions

1. (a) What is the fight–flight–freeze response?
(b) (i) What type of stimulus and/or stressor other than a threat can initiate the response?
(ii) Give three examples of specific stimuli that could initiate the response for you.
(c) Which division of the nervous system is dominant in each of the three reactions?
(d) Explain whether fight–flight–freeze is a conscious or unconscious response.
(e) List the physiological (biological) changes commonly occurring with fight–flight and freeze.
(f) Which stress hormones are released for fight–flight–freeze?
(g) Fight–flight–freeze is sometimes called an 'arousal' response. Suggest an explanation for why this descriptor is used, ensuring you refer to the relevance of arousal if an organism adopts a freeze state.
(h) Does fight–flight occur before or after freeze? Explain your answer.
(i) Why is fight–flight–freeze considered to be 'adaptive'?
(j) Complete the following table on the adaptive nature of fight–flight and freeze reactions.

2. (a) What is cortisol?
(b) When is it secreted in response to a stressor?
(c) What organ or gland initiates its release?
(d) (i) From which gland is cortisol secreted?
(ii) Where is this gland located?
(e) To what extent is the amount or rate of cortisol secretion sensitive to psychological factors?
(f) Under what circumstances is cortisol potentially harmful?
(g) List the beneficial and potentially harmful effects of cortisol.
(h) The following are all involved in a sequence of activity resulting in cortisol secretion: adrenal cortex, ACTH, cortisol, hypothalamus, pituitary gland.
Construct a simple flow chart that shows them in the correct order.

3. As you are walking home alone, late at night, you hear a crackling sound of someone or something stepping on dry leaves nearby. Your heart starts thumping as you imagine who or what is in the darkness.
Outline and explain other physiological changes likely to occur:
(a) during the first 30 seconds
(b) after about 20 minutes if no threat was perceived.

Reaction	Example of when adaptive	Example of when not adaptive
fight–flight		
freeze		

LEARNING ACTIVITY 3.13

Reflection

Describe a fight–flight–freeze response you have experienced and the physiological changes of which you were aware and any you were unlikely to be aware of.

LEARNING ACTIVITY 3.14

Visual presentation

Construct a flow chart or other diagram that combines the SAM and HPA axis responses to a stressor shown in Figure 3.19 (page 215) and Figure 3.21 (page 217). For example, the brain-body pathway for SAM may be shown at the left and for HPA at the right. Common structures, processes and reactions should be shown once only. Include a caption that summarises each response.

Selye's General Adaptation Syndrome

While Cannon was investigating fight–flight reactions in the 1930s, Hans Selye was conducting research on both immediate and long-term effects of stress. Most of Selye's research was done with rats that were exposed to a variety of stressors such as painful tail-pulling, prolonged exposure to heat or cold, mild electric shocks, bacterial infections, strenuous exercise and forced restraint.

Selye observed that the physiological arousal pattern in response to each of these different kinds of stressors was generally the same — adrenal glands were enlarged, gastrointestinal ulcers developed, weight loss occurred and there was a shrinking of vital glands of the immune system (such as the lymph glands that play a vital role in filtering out harmful substances).

On the basis of these observations, Selye concluded that stress is a condition that is non-specific, and which can be brought on by either internal or external stressors. In addition, stress is the body's physiological response to both physical and psychological demands and that it 'represents the body's generalised effort to adapt itself to new conditions' (Selye, 1936).

Selye also drew the same conclusions when he studied responses by people to stressors. He observed a number of hospital patients who had experienced stressors such as the death of someone close to them, retrenchment from a job and arrest for stealing large sums of money. Although the stressors were different, the patients developed similar symptoms as a result of the stressors. For instance, they all had poor appetites, muscular deterioration and a general lack of interest in the world.

According to Selye, any emergency, illness, injury, or an imposing demand at school or work, initiates sympathetic nervous system responses such as increases in heart and breathing rates, slowing of digestive functioning, and so on. These are *non-specific* reactions to stress that occur regardless of the type of stressor. In addition to non-specific reactions, a number of *specific* reactions that are appropriate to particular stressors can occur. These specific reactions may include running away from a vicious dog, fighting off an attacker, activation of the immune system to destroy bacteria and viruses, and becoming tense or frustrated at someone who is annoying. Specific and non-specific responses to stressors are natural reactions to the challenges of varying complexity that we encounter in everyday life.

On the basis of his observations of animals, and to a lesser extent people, Selye developed the General Adaptation Syndrome. The **General Adaptation Syndrome (GAS)** is a three-stage physiological response to stress that occurs regardless of the stressor that is encountered. This means that the GAS is non-specific and will occur whatever the source of the stressor. As shown in Figure 3.26 on the next page, the GAS consists of three stages: a brief alarm reaction stage (with shock and counter shock), a prolonged stage of resistance and a final stage of exhaustion.

Figure 3.25 Based on extensive research with rats, Austrian-born Hungarian-Canadian endocrinologist Hans Selye (1907–1982) developed the three-stage General Adaptation Syndrome (GAS), which describes how organisms react to stress. His popular book, *The Stress of Life* (1956), helped make stress a household word. Selye was also first to demonstrate the crucial role of the HPA axis in the stress response. Selye spent a lifetime researching the GAS and wrote over 30 books and more than 1500 articles on stress and its health-related problems.

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Weblinks
- Selye (1936) first GAS article
- Interview with Selye 2m 45s

Stage 1: Alarm reaction

The first stage of the GAS involves an initial response called the **alarm reaction stage** which occurs when the person (or animal) first becomes aware of the stressor.

At first, the body goes into a temporary state of **shock**, and its ability to deal with the stressor falls below its normal level. Physiologically, the body reacts as if it were injured; for example, blood pressure and body temperature drop, and a temporary loss of muscle tone is experienced. Then the body rebounds from this level with a reaction that Selye called counter shock.

During **counter shock**, the sympathetic nervous system is activated and the body's resistance to the stressor increases. The organism's response is a fight–flight response. It becomes highly aroused and alert as it prepares to deal with the stressor. Adrenaline is released into the bloodstream and the organism's heart and respiratory system respond by accelerating. This supplies the muscles with more energy (glucose and oxygen), allowing the organism to 'fight or flee', as needed.

This initial stage of the GAS is a general defensive reaction to the stressor, and results in a state of tension and alertness, and a readiness to respond to the stressor. Although alarm reaction is typically of a short duration, the HPA axis may be initiated during this stage, so that cortisol can further energise the body (Szabo, Tache & Somogyi, 2012).

Stage 2: Resistance

According to Selye, if the source of the stressor is not dealt with immediately, and the state of stress continues, energy is still required and the body will continue responding in order to cope with and adapt to the stressor. The body will then enter a stage of resistance to the stressor.

During the **resistance stage**, the body's resistance to the particular stressor rises above normal. The intense arousal of the alarm reaction stage diminishes through activity of the parasympathetic system, but physiological arousal remains at a level above normal (even though heart and respiration rates may have slowed down). Since the body is being taxed to generate resistance, all unnecessary physiological processes are shut down. For example, digestion, growth and sex drive stall, menstruation stops, and the production of testosterone and sperm decrease.

However, corticosteroids such as cortisol which support resistance are released (or continue to be released) into the bloodstream to further energise the body and act as an anti-inflammatory agent and provide fast-acting pain relief for inflammation that may have occurred.

Because cortisol also weakens immune system activity, its continuing presence at an abnormally high level interferes with the body's ability to fight disease and to protect itself against further damage. This means that even though the ability to adapt to and deal with the effects of the initial stressor increases during this stage, resistance to other stressors, such as illness or disease, may decline. For example, during an exam week, a VCE student may be able to cope well enough to study for all their exams despite a decrease in sleep, exercise, recreation and healthy food (ie. their body responds to the initial stressor). However, soon after the exams, the student may come down with an illness such as the flu. While the body's focus has been on dealing with the original stressor, it has failed to respond effectively to the flu virus, a new stressor that has entered the body.

Everybody goes through the alarm reaction and resistance stages many, many times in their lives. If the effort to deal with the initial stressor during the resistance stage is successful, the body will have adapted to the stressor and eventually returns to its normal 'balanced' (homeostatic) state of functioning.

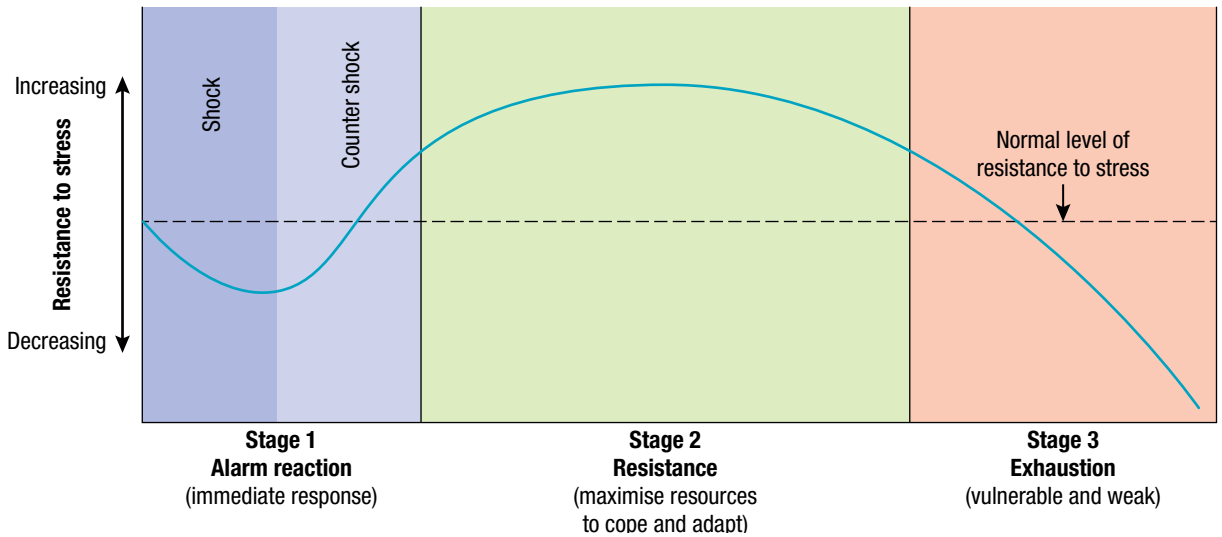

Figure 3.26 A graphical representation of Selye's General Adaptation Syndrome (GAS) which describes how people (and animals) react to any stressor. The GAS consists of three stages that occur in a sequence: alarm reaction (shock/counter shock), resistance and exhaustion.

Stage 3: Exhaustion

According to Selye, if the stressor is not dealt with successfully during the resistance stage, and stress is not relieved, the body may reach a stage of exhaustion.

During the **exhaustion stage**, some of the alarm reaction changes may reappear, but the body cannot sustain its resistance and the effects of the stressor can no longer be dealt with. Because the organism has been trying to deal with the stressor for a prolonged time, its resources have been depleted, its resistance to disease is very weak, and it becomes more vulnerable to physical and mental disorders.

Figure 3.27 In the exhaustion stage, resistance to disease or disorder is very weak or ineffectual.

The exhaustion stage is characterised by extreme fatigue, high levels of anxiety and symptoms of depression, nightmares and impaired sexual performance. Physical disorders such as hypertension, gastrointestinal problems and heart disease may also occur. In extreme cases, if the stress continues further, the organism may even die.

More commonly, the exhaustion stage brings about signs of physical wear and tear, especially in organs that have been consistently trying to deal with the stressor throughout the resistance stage. These are primarily attributable to the immune-suppression and other effects of higher and more prolonged levels of cortisol in the bloodstream. According to Selye (1974), cortisol (and other glucocorticoids) are responsible for most of the physiological effects of stress, especially in the stages of resistance and exhaustion.

Strengths and limitations of Selye's GAS

Selye's three-stage GAS model of physiological responses to stress extended Walter Cannon's findings on the fight–flight response and further developed awareness and understanding of the links between stress and disease. He was among the first researchers to suggest that stress could weaken the body's ability to resist infection and increase the likelihood of developing a physical disorder. This idea is now widely accepted within psychology (and medicine). For instance, there is extensive research evidence that stress is associated with the initiation and progression of a wide variety of diseases, from cardiac, kidney and gastrointestinal diseases to AIDS and cancer. However, in the 1930s, the proposal that stress could actually cause disease, or at least weaken the body's resistance to disease, was a radical idea. Back then, the dominant view was that most diseases could only be caused by exposure to germs, viruses and other sources of infection.

Selye's GAS model also identifies biological processes associated with the body's stress response. For instance, many of his findings on the role in the GAS of the endocrine system and its various hormones have been confirmed by contemporary researchers and continue to be influential. This also applies to Selye's proposals that the GAS will occur in response to any type of stressor and that our bodies have only a limited amount of resources in coping with prolonged stress. These ideas are now included in most contemporary theories on stress and stress responses.

Selye's GAS has also been influential through its description and explanation of the potentially detrimental effects of the three-stage adaptation process following exposure to a persistent stressor. The idea that our bodies can eventually run out of resources and become increasingly vulnerable to disease as the stress persists had not been fully understood by previous researchers.

There are, however, a number of limitations of Selye's GAS. The GAS is a 'one size fits all' model. It assumes that *everyone* has the same general, predictable and automatic physiological responses to any kind of stressor, not unlike a sensor light that turns on outside regardless of the type of motion that is detected. Consequently, the GAS does not fully take account of or explain individual differences in physiological responses to a stressor.

The GAS also tends to understate the roles of bodily systems other than the endocrine system in the stress response (see Box 3.10) and overlooks our psychological response to different types of stressors. It does not take into account cognitive aspects of the stress response, specifically the role of the brain in interpreting a situation or event as stressful. For

example, two people may appraise, or 'weigh up', the same situation and judge it differently as either stressful or not stressful. This means that what might be considered a stressful situation and cause a stress response in one person may not in another. Furthermore, if both individuals appraise the situation as stressful, they may experience qualitatively different stress responses.

Similarly, not all people experience the same physiological reactions to chronic stress. For example, some experience hypertension, gastrointestinal problems, skin rashes or heart disease, whereas others may develop physical aches or pains, gain or lose weight, or become generally 'run down' without a specific disorder. This suggests that, despite the same bodily arousal systems and processes being involved in the GAS in all people, the precise way that prolonged activation can lead to disease could involve other biological and/or psychological processes.

Selye's description of the GAS as a non-specific stress response may also be limited. For instance, there is research evidence that different types of stressors can trigger their own distinctive physiological reactions (Cohen, et al., 1986).

Finally, Selye's GAS has been criticised for being primarily based on the results of research with animals and may therefore be of limited relevance to the human stress response. His reliance on laboratory research with rats may explain why the GAS overemphasises biological factors and does not fully take into account individual differences and psychological factors in the stress response, particularly the role of cognitive processes.

Figure 3.28 Hypertension (abnormally high blood pressure) is one of many physiological reactions associated with chronic stress, but not all people who experience chronic stress will develop hypertension. Selye's GAS tends to overlook such individual differences in the stress response.

BOX 3.11 A study on stress and susceptibility to the common cold

One of Selye's key propositions was that prolonged stress interferes with the functioning of the immune system, leaving the body less able to deal with infection. This has since been demonstrated by numerous research studies, many of which attribute it to the diversion of resources away from the immune system to more urgent physiological needs and the elevated level of cortisol.

One of the best-known studies on the effects of stress on the immune system was conducted by American psychologist Sheldon Cohen and his colleagues (1993). They recruited 420 volunteers (154 males and 266 females), ranging in age from 18–54 years and who were willing to be exposed to a cold virus. All reported no chronic or acute illness or need for regular medication on their applications and were judged in good health following a medical examination (that included blood tests) on arrival at the laboratory. Pregnant women were excluded.

All participants were also required to complete three stress measures, including a major life events scale and the *Perceived Stress Scale* in Box 3.2 on page 200. These measures provided data on how overwhelmed, preoccupied, nervous, unable to cope or out of control and so on participants had felt in the past month.

Figure 3.29 Numerous studies have shown that stress can impair the functioning of the immune system.

(continued)

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Using nasal drops, 394 participants were then exposed to a low infectious dose of one of five cold viruses. The other 26 participants were given saline (a harmless solution of water and salt) instead of a cold virus. For two days before and seven days after this procedure, volunteers were quarantined in large apartments (alone or with two others). Volunteers were reimbursed for their expenses and received free meals and accommodation.

All participants were examined daily for a week to see whether they had developed a cold. Not all participants who were given the nasal drops containing a cold virus were actually infected. Stress seemed to play a factor in the outcome.

Figure 3.30 on the right shows results averaged out across the three stress measures. Participants who reported a higher level of stress before being exposed to the cold virus were more likely to develop a cold than those who reported being less stressed.

Symptoms were not caused by the virus. They were instead a 'side effect' of a weakened immune system. While the results of this study indicate a link between stress and immune system failure, it should be noted that other factors also contribute to a breakdown in the immune system; for example, age, genetic predisposition and nutrition. When these factors occur simultaneously or combine with stress, the effects on the immune system are heightened.

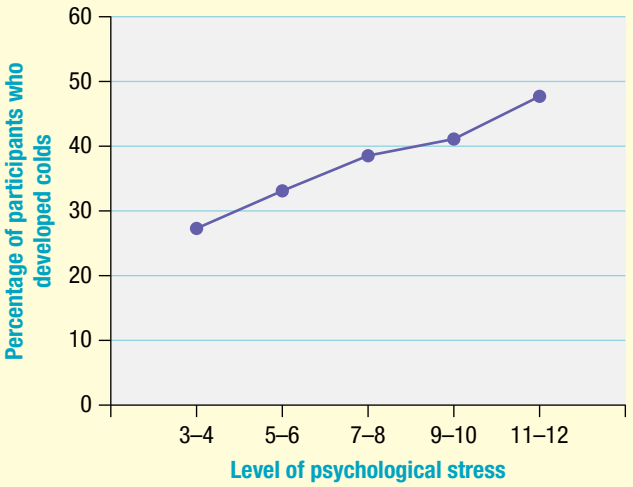

Figure 3.30

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Animation on the Cohen study 1m 51s

BOX 3.12 Some disorders and diseases associated with long-term (chronic) stress

Disorder/disease	Description
Hypertension (abnormally high blood pressure)	Blood pressure measures how strongly blood presses against the walls of the arteries (i.e. large blood vessels) as it is pumped around the body by the heart. If this pressure is too high it puts a strain on the arteries and the heart, which increases the likelihood of heart attack, stroke or kidney disease.
Immunodeficiency disorders	Immunodeficiency disorders occur when the body's immune response is reduced or absent. The immune system helps protect the body from harmful substances such as bacteria, viruses, toxins and cancer cells. If the body is unable to protect itself against harmful substances it will experience persistent, recurrent infections and/or experience a delay or incomplete recovery from illness.
Atherosclerosis ('hardening of the arteries')	Atherosclerosis occurs when fat, cholesterol and other substances build up in the walls of arteries and form hard structures called 'plaques'. These changes make it harder for blood to flow through the arteries. Restricted blood flow can damage organs and stop them functioning properly. If a plaque ruptures, it can lead to a blood clot that blocks the blood supply to the heart, triggering a heart attack, or to the brain, triggering a stroke (i.e. a serious medical condition that occurs when the blood supply to the brain is disturbed or interrupted).
Cardiovascular disease	Cardiovascular disease is a category of diseases that involve the heart or blood vessels (arteries and veins); for example, coronary heart disease, which occurs when the main arteries that supply the heart (the coronary arteries) become clogged with plaques. The causes of cardiovascular disease are diverse but atherosclerosis and/or hypertension are the most common.
Cerebrovascular disease	Cerebrovascular diseases are conditions that develop as a result of problems with the blood vessels inside the brain; for example, a stroke, or transient ischaemic attack (i.e. a temporary fall in the blood supply to the brain, resulting in a lack of oxygen to the brain).
Diabetes	Diabetes is a long-term condition involving too much glucose in the blood. This is caused by the pancreas not producing any or enough insulin to help glucose enter the body's cells (or the insulin that is produced does not work properly).

LEARNING ACTIVITY 3.15

Review questions

1. What is General Adaptation Syndrome (GAS)?
2. Why did Selye use the term adaptation when describing his syndrome?
3. Make a copy of the GAS graph in Figure 3.26 and use it to summarise each stage of the GAS, including shock and counter shock during alarm reaction, and specific physiological changes associated with each stage, including the presence of cortisol and other adrenal gland hormones.
4. Explain the meaning of the phrase 'the GAS is non-specific'.
5. (a) When Daniel hears his teacher tell the class to clear their tables so they can complete 'the SAC test', he suddenly realises he forgot about it and his heart begins pounding rapidly. Which stage of the GAS is Daniel most likely experiencing?
   (b) One week remained before Chloe's exams. She stayed up late every night studying, and although she was feeling tired, she seemed to be managing her workload. Two nights before her first exam, Chloe witnessed her dog being hit by a car, which upset her very much. On the morning of her exam, she woke up with a headache, a sore throat, aches and pains in her joints and she kept sneezing.
      (i) Name and describe the GAS stage Chloe is most likely in, with reference to Chloe's situation and experiences.
      (ii) According to the GAS, under what circumstances would Chloe be vulnerable to a physical disease?
6. Apply the GAS to a sudden and unexpected catastrophic event of your choice. Outline, in point form, when each stage is experienced and associated physiological changes likely to occur.
7. (a) List the strengths and limitations of the GAS.
   (b) Include two significant strengths and limitations in your GAS summary prepared for question 3.

LEARNING ACTIVITY 3.16

Reflection

Comment on Selye's quote that 'every stress leaves an indelible scar, and the organism pays for its survival after a stressful situation', ensuring you refer to his GAS model.

LEARNING ACTIVITY 3.17

Evaluation of research by Cohen and colleagues (1993) on stress and the common cold

Consider the research on stress and susceptibility to the common cold summarised in Box 3.11 on page 225 and answer the following questions.

1. Suggest an aim for the research.
2. Name the type of experimental research design.
3. Identify the operationalised independent and dependent variables.
4. (a) How many participants were in the sample?
   (b) Why were only healthy participants selected?
5. (a) How many participants were in an experimental group?
   (b) How many experimental groups were used?
6. (a) How many participants were given a placebo?
   (b) What was the purpose of the placebo?
   (c) Suggest a suitable title for Figure 3.30.
   (d) Draw a conclusion from the results in Figure 3.30.
7. Formulate a research hypothesis that would be supported by the results in Figure 3.30.
8. Why were participants quarantined after exposure to the treatments?
9. Explain whether the results can be attributed to impaired immune system functioning.
10. To what extent can the results be generalised?
11. (a) What ethical standard led the researchers to exclude pregnant women from the sample?
    (b) (i) What other ethical standard is of relevance to this particular research study?
    (ii) How would this be addressed?
    (c) Comment on the ethical acceptability of the research with reference to the value of beneficance.

LEARNING ACTIVITY 3.18

Visual presentation comparing biological models of stress

Use a Venn diagram such as the one shown below to summarise the key similarities, differences and common features of the fight–flight–freeze response and the GAS.

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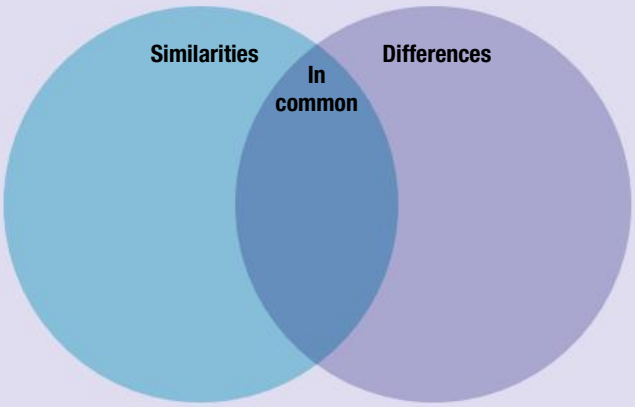

STRESS AS A PSYCHOLOGICAL PROCESS

Researchers have identified many and varied psychological factors that cause or influence how we respond to stressors. These include our

- prior experience with stressors and stress responses
- attitudes
- motivation
- level of self-esteem
- general outlook on life (e.g. optimism versus pessimism)
- personality characteristics
- coping skills
- perception of how much control we have over a stressful event or situation.

Such factors are not independent of each other and combine in different ways within each individual to have more or less impact on their response to a stressor.

American psychologists Richard Lazarus and Susan Folkman (1984) developed a model of stress to describe and explain individual differences in how people respond to a stressor from a psychological perspective. Their model focuses on two key psychological factors that determine the extent to which an event (or situation) is experienced as stressful:

- the meaning of the event to the individual
- the individual's judgment of their ability to cope with it.

Lazarus and Folkman's Transactional Model of Stress and Coping

The Lazarus and Folkman **Transactional Model of Stress and Coping** proposes that stress involves an encounter ('transaction') between an individual and their external environment, and that a stress response depends upon the individual's evaluation ('appraisal') of the relevance of the stressor to his or her wellbeing and their ability to cope with it.

According to Lazarus and Folkman (1984), stress is not a result of the individual alone or the environment alone. The environment can influence the individual, but the individual can also influence the environment. Furthermore, an individual's appraisal of the situation and their resources for dealing with that situation determine whether or not they experience stress and the nature of their stress response. When there is an imbalance between a person's appraisal of the demands of the situation and their estimation of their ability to meet those demands, then they will experience stress.

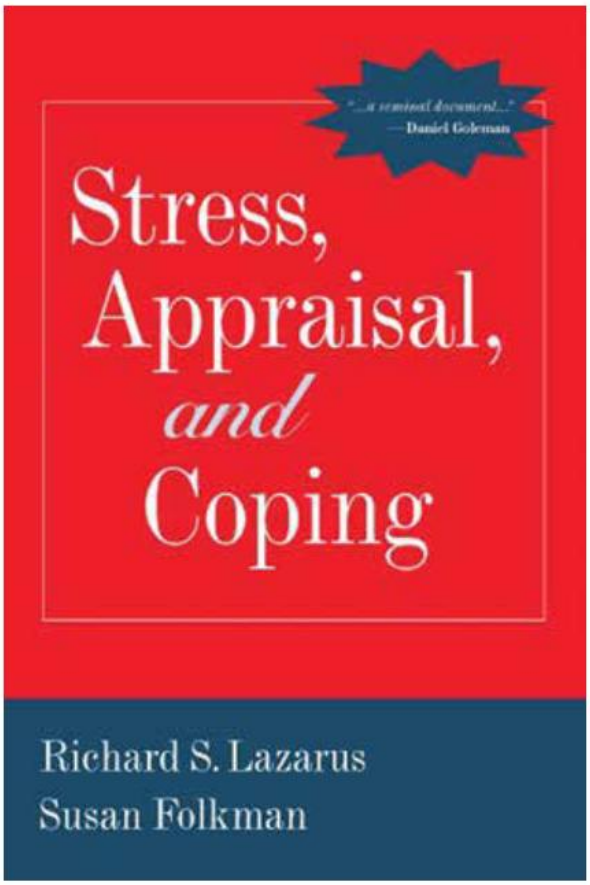

Figure 3.31 *Stress, Appraisal and Coping* by Lazarus and Folkman

For example, imagine two drivers stuck in a traffic jam on a major road caused by a car accident blocking one of the exits. Both are on their way to a business meeting at work. One driver believes that the lack of movement is untimely, but that 'it's no big deal' and there's no point in getting upset because it will not make the cars ahead start moving again. So she decides to phone her assistant and explain that she will be late. She then uses the unexpected 'spare time' to catch up with her sister over the phone. The other driver reacts very differently. She thumps the steering wheel and swears out loud. She then thinks about ringing her assistant but her phone battery is dead. She thumps the steering wheel again, thinking that the traffic jam is awful and will ruin her whole day. As the traffic jam continues, she sits and fumes, tapping on the steering wheel with her finger. She checks her watch regularly and becomes increasingly agitated with the passing of each minute. Her heart is pounding and, despite it being a cold day, she has to wind down the window because she feels very hot. In this example, a specific situation is a stressor for one individual and not the other. The first driver is barely affected by the situation, whereas the second driver experiences significant distress, worsened by the fact that she feels trapped and cannot do anything to improve her circumstances.

According to the transactional model, both drivers are involved in an encounter with the environment that has produced a potential stressor — they are stuck in a traffic jam that will make them late for a business meeting. However, each individual responds differently to the same event because of how they appraise it. The first driver appraised the event as 'no big deal', managed the situation as best she could, then viewed it is an opportunity to speak with her sister. The second driver was overwhelmed and appraised the event as 'awful' and as exceeding her ability and available resources to do anything about.

According to Lazarus and Folkman, stress is largely 'in the eye of the beholder' and therefore a product of each individual's appraisal of a stressor. Furthermore, the event with which the individual has a 'transaction' will lead to stress only if they appraise that event as unpleasant, uncomfortable or perhaps as 'the worst thing that could happen to me', as did the second driver.

Appraisal is not necessarily a conscious process. However, it is always subjective and therefore a highly personal process. It also depends on our estimation of our ability to cope with the stressor. It is for these reasons that two individuals may assess the same potential or actual stressor differently.

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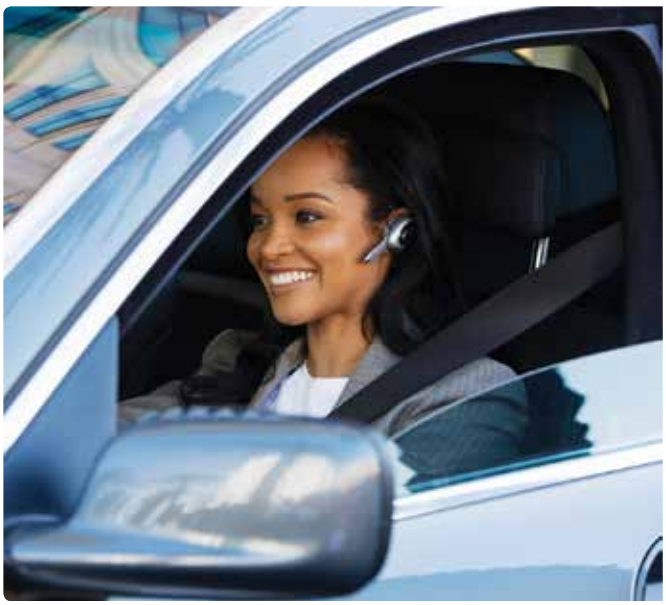

Figure 3.32 According to the Lazarus and Folkman transactional model, stress is 'in the eye of the beholder' and events become stressors only when individuals interpret them as unpleasant, uncomfortable or perhaps 'the worst thing that could happen to me'. This means that stress is a product of our individual appraisals of stressors.

Primary and secondary appraisals

The transactional model of stress and coping distinguishes between two different types of cognitive appraisal of an event. These are called primary appraisal and secondary appraisal, and they occur in a two-step sequence in response to a potential stressor.

In a **primary appraisal**, we evaluate, or 'judge', the significance of the event and whether anything is at stake in this encounter. For example, we may ask questions such as 'Is this something I have to deal with?', 'Am I in trouble?', 'Is there any benefit?' and 'Does this matter to me?' The outcome of a primary appraisal is a decision about whether the event is *irrelevant*, *benign–positive* or *stressful*. If we decide that the situation is stressful, then we engage in additional appraisals that involve deciding if a situation is harmful, threatening and/or challenging. More specifically, these appraisals involve:

- *harm/loss* — an assessment of how much damage has already occurred (e.g. 'I have lost my job')
- *threat* — an assessment of harm/loss that may not have yet occurred but could occur in the future (e.g. 'I mightn't be able to afford the rent'), and
- *challenge* — an assessment of the potential for personal gain or growth from the situation (e.g. 'I'll get any other job I can and will learn to budget and save money').

In a **secondary appraisal**, we evaluate our ability to control or overcome the situation in which we find ourselves. This includes an evaluation of our coping options and resources for dealing with the event. The coping options and resources available may be *internal* (e.g. strength and determination) or *external* (e.g. money and support from family or friends).

If the coping demands of the situation are perceived as being far greater than the resources that are available, then we are likely to experience a stress response. The discrepancy that is perceived may also trigger a search for additional or new resources that can be used to cope with the stress.

Note also that our primary and secondary appraisals can merge to influence our overall judgment of the specific transaction with the potential stressor. For example, we may judge that an event contains the possibility of harm or loss, so it is threatening and challenging, and therefore significant for our wellbeing and will tax our coping resources for some time (Folkman, et al., 1986).

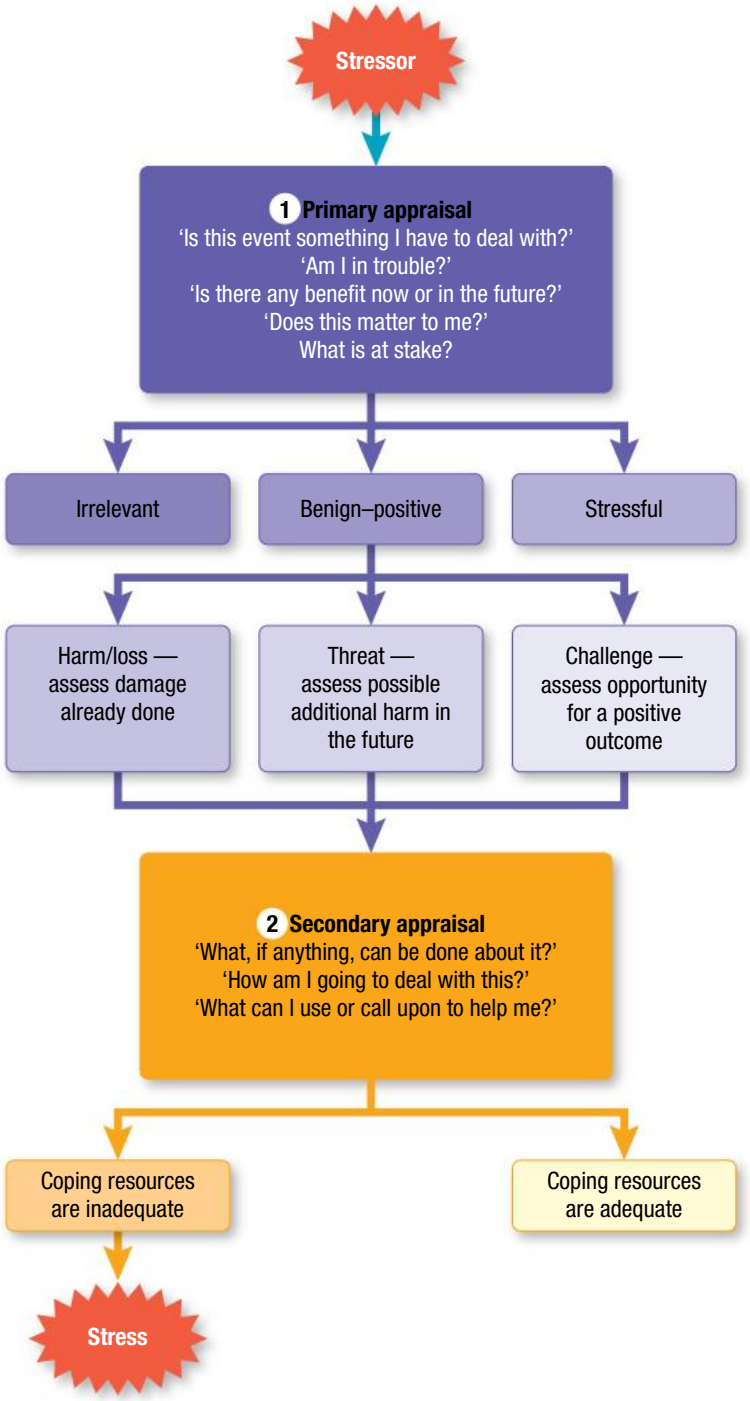

Figure 3.33 A representation of Lazarus and Folkman's (1984) two-step transactional model of stress and coping

Strengths and limitations of the Lazarus and Folkman model

Lazarus and Folkman's transactional model of stress and coping has a number of strengths. Unlike the fight–flight–freeze response and the GAS, which focus on involuntary biological processes occurring in response to stressors and which mostly overlook cognitive processes and individual differences when reacting to a stressor,

the transactional model focuses on psychological influences on how we react to a stressor. It also emphasises the personal nature and individuality of the human stress response.

Development of the model with reference to observations of people may also be considered a strength, as compared with the use of animals in developing the GAS.

The transactional model views stress as involving an interaction with the environment in which the individual has an active rather than passive role. The role involves personal appraisals of a situation or an event that may be a stressor, thereby emphasising each individual's role in interpreting what that situation means to them from their perspective rather than from someone else's. This allows for much more variability in the human stress response and helps explain why different individuals respond in different ways to the same types of stressors.

Figure 3.34 Lazarus and Folkman's transactional model of stress and coping can explain why some learner drivers find driving stressful, whereas most experienced drivers do not. The learner has limited ability to meet the demands of handling a car in traffic, which means that the demands of the environment are greater than their perceived ability to cope. For experienced drivers, the perceived demands of the environment are fewer than their perceived ability to cope.

In sum, strengths of the Lazarus and Folkman model are:

- focuses on psychological determinants of the stress response over which we have control
- emphasises the personal nature and individuality of the stress response
- views stress as an interaction with the environment in which the individual has an active role
- respects personal appraisals of a situation, thereby interpreting the situation from an individual's perspective
- explains why individuals respond in different ways to the same types of stressors
- allows for the fact that stressors and the circumstances under which they occur can change over time
- allows us to change our thinking about a stressor and our response
- proposes different methods for managing psychological responses to stressors.

A major limitation of the transactional model of stress and coping is that it is difficult to test through experimental research. This is mainly because of the subjective nature, variability and complexity of individual responses to stressful experiences. Furthermore, primary and secondary appraisals can interact with one another and are often undertaken simultaneously. This also makes their study problematic as they are difficult to isolate for experimental research purposes as separate variables (Lazarus & Folkman, 1984).

Some psychologists also doubt that we actually need to appraise something as causing stress in order to have a stress response. For example, we can experience a stress response without ever having thought about a specific event or situation, let alone made the assessments and judgments described by the transactional model. Individuals may not always be conscious of or be able to specifically name or identify all the factors that are causing them to experience a stress response. For example, someone might feel a little 'on edge' and experience stomach aches and other reactions associated with stress a few weeks before an important exam, which is well before they have begun to consciously think about preparing for it. This also suggests another limitation of the transactional model, especially when compared with the GAS — that it overlooks physiological responses to stressors.

In sum, limitations of the Lazarus and Folkman model include:

- difficult to test through experimental research because of the subjective nature of individual responses to stressors
- individuals may not always be conscious of all the factors causing them to experience a stress response
- we can experience a stress response without ever having thought about a situation or event (i.e. appraisal is not essential)
- overlooks physiological responses to a stressor
- the linear approach of the model does not allow for individual variation in progression through the stages
- primary and secondary appraisals can interact with one another and are often undertaken simultaneously
- primary and secondary appraisals are difficult to isolate for study as separate variables.

LEARNING ACTIVITY 3.19

Review questions

1. Explain the meaning of 'transaction' in relation to the Lazarus and Folkman model, ensuring you refer to the individual and their environment.
2. Briefly explain why the model is sometimes described as a two-step model.
3. (a) What is the role of appraisal in the model?
   (b) Name and describe the two major types of appraisal.
4. Name and describe the three types of appraisals that follow an appraisal of a stimulus as stressful.
5. Why does how you think about stress matter? Explain in relation to the Lazarus and Folkman model.
6. Xanthe and Olivia must each present a 10-minute oral report in class for one of their SACs. The girls are best friends, enrolled in the same VCE subjects and also work casually three evenings a week, on the same shifts at the same fast food outlet. They have five days in which to prepare their reports. They have different topics of about the same difficulty.

   Xanthe is distressed about having to prepare and present her report. She gets very anxious whenever she thinks about it. She is concerned about the amount of preparation work required within the time available. She also doesn't like making oral presentations because she thinks she looks and sounds 'weird' when doing so. Olivia is not hassled or distressed. Instead, she is looking forward to getting the presentation done and out of the way.

   Explain Xanthe's and Olivia's different reactions to the SAC task with reference to the Lazarus and Folkman transactional model. You may use a diagram to support your explanation.
7. List the major strengths and limitations of the Lazarus and Folkman transactional model.

LEARNING ACTIVITY 3.20

Reflection

Comment on the appropriateness of describing stress as a 'psychobiological response'. Consider fight–flight–freeze, the GAS, and the Lazarus and Folkman transactional model. Is stress in the eye of the beholder?

LEARNING ACTIVITY 3.21

Visual presentation on the transactional model of stress and coping

Construct a flowchart or other diagram that summarises the two-step primary and secondary appraisal process that is a psychological determinant of a stress response.

The chart should demonstrate a response to a stressor of your choice, and include brief definitions and relevant examples of primary and secondary appraisals of a stressor and key strengths and limitations of the model.

The chart may be based on a personal example of primary and secondary appraisal, an example relevant to someone you know, or one reported in the media (including online).

LEARNING ACTIVITY 3.22

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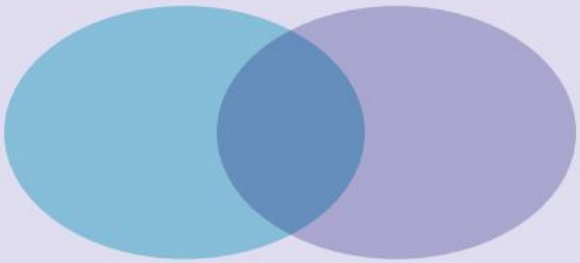
Visual presentation comparing biological and psychological models of stress

Use a Venn diagram like the one on the right to summarise the key similarities, differences and common features of the GAS and the Lazarus and Folkman models.



LEARNING ACTIVITY 3.23

eBookplus
Weblink
Stress myths

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Stress myths

Media analysis/response

Use the Stress myths weblink in your eBookPLUS to consider the six common myths about stress in the *Psychology Today* blog.

1. List the six myths and briefly summarise each one.
2. Reflect on what you have learned about stress in this chapter and write an additional myth (and relevant commentary) that you believe should not have been overlooked.

STRATEGIES FOR COPING WITH STRESS

Everyone experiences stress that arises from daily hassles and other life events. These events often occur when we least expect them and can create stressful consequences that may persist for longer than we prefer. This is particularly the case with stressors arising from events over which we have little or no control and are not easily resolved. How we choose to cope with a stressor can have a significant impact on its immediate and long-term effects on our physical and mental health.

Coping describes all the different things we do to manage and reduce the stress experienced as a result of problems, issues or difficult situations that arise in life. According to Lazarus and Folkman (1984), **coping** is a process involving 'cognitive and behavioural efforts to manage specific internal and/or external stressors that are appraised as taxing or exceeding the resources of the person' in a stressful situation. This means that coping is an attempt to manage the demands of a stressor in some effective way.

In our attempts to cope with a stressor, we use one or more coping strategies. A **coping strategy** is a specific method, behavioural or psychological, that people use to manage or reduce the stress produced by a stressor. There are many different types of coping strategies but there is not a single 'right' way to cope. Nor is there any particular strategy that suits everyone. Some strategies will 'work better' and therefore be more effective than others, depending on a range of factors, such as the nature of the stressor (e.g. acute or chronic, hassle or catastrophe), the individual (e.g. their appraisals, coping flexibility, personality, access to support) and the stressful event itself.

Although there is a wide variety of coping strategies that may be used, some strategies are less beneficial than others. Those with the least benefit reduce stress temporarily but can have an adverse impact on physical or mental health. For example, drugs and alcohol can provide immediate, temporary relief from stress symptoms. However, they also interfere with a good outcome and have potentially harmful consequences. Similarly, ineffective coping strategies for stress due to mounting bills include ignoring them, denying responsibility, gambling, yelling, swearing and becoming physically agitated. A more effective strategy would involve a plan of action that will eventually diminish the financial problems and alleviate the stress. A strategy is not necessarily ineffective if it provides only temporary relief from stress because the short-term relief may be a benefit in itself.

The various coping strategies can be organised into different categories, each with a distinctive approach. Two commonly used categories are called approach and avoidance coping. Generally, *approach* strategies attempt to deal directly with a stressor and *avoidance* strategies deal with it indirectly. In this section, we examine the use of specific approach and avoidance strategies and also evaluate exercise as a coping strategy. We start by considering the nature of the stressful situation requiring coping.

study on

Figure 3.35 Many people report that prayer and meditation are effective coping strategies for dealing with certain stressful events.

Context-specific effectiveness

People with good coping skills tend to be more stress-free and happier and more positive overall than those who haven't yet figured out what coping strategies work best for them. They understand that a coping strategy that works well in one situation does not necessarily work well or may even be counterproductive in another. They are also flexible with their coping and adjust their style or strategy to help ensure it is suitable for dealing with the stressful situation in which they find themselves.

Researchers have found that there are situational determinants of coping effectiveness. This means that a specific coping strategy can be more or less effective in different situations. In order for a strategy to be effective, it must take account of all the characteristics of the stressful situation. These may relate to the physical environment, the stressor and the individual involved. Consequently, it is important that there be an appropriate 'match' between the coping strategy to be adopted, the situationally specific demands of the stressor and relevant personal characteristics of the individual involved (Folkman & Lazarus, 1985; Roth & Cohen, 1986).

A coping strategy is considered to have **context-specific effectiveness** when there is a match or 'good fit' between the coping strategy that is used and the stressful situation. For example, when experiencing stress about upcoming exams, a coping strategy that focuses on taking positive action, such as planning, time management and study would be suitable for many students in that situation, whereas coping strategies such as 'mental distancing' (not thinking about the exams at all) or 'wishful thinking' (hoping for good grades) while engaging in minimal study are likely to be detrimental. However, 'mental distancing' or 'wishful thinking' would be more effective if needing to minimise stress about the exam results while waiting for their release. In this context, when little or nothing can be done but wait until the results are available, these coping strategies would be more effective in reducing stress (Folkman & Lazarus, 1985; Lazarus, 1993).

A stressful context also includes the person confronted by the stressor. Consequently, the coping strategy most likely to be effective will also take account of the personal characteristics of the individual involved; for example, their personality, knowledge, skills, interests, preferences, access to social support from family, friends or community, and any other attributes that are especially relevant to the stressful situation. For example, exercise is commonly recommended as an effective coping strategy when experiencing stress as it has psychological as well as physical benefits. However, it may not be a suitable option for someone who hates all types of exercise. Similarly, if someone has a medical condition that could be compromised by exercise, then this coping strategy is more likely to be detrimental than effective. In either case, a suitable coping strategy could involve a relaxation technique such as slow breathing or meditation, assuming the individual is willing to learn and use the technique.

Figure 3.36 Exercise is commonly recommended as an effective coping strategy when experiencing stress because it has psychological as well as physical benefits. However, it may not be a suitable option for someone who hates all types of exercise.

Coping flexibility

Most people have a number of coping strategies that they may draw upon for use in times of stress. However, mere access to coping strategies does not necessarily produce the desired results. Given the wide variety of stressors encountered in life, we also need to select and use a coping strategy that is appropriate for a specific stressful situation. We must also be willing and able to recognise when a coping strategy is not working and modify a strategy or implement a new one if necessary. This type of flexibility with coping strategies is associated with more effective coping, greater wellbeing and positive outcomes. In contrast, persistent use of the same type of coping strategy for different stressful situations can hinder positive outcomes (Cheng, Lau & Chan, 2014; Lazarus, 1993).

Psychologists use the term **coping flexibility** to refer to the ability to effectively modify or adjust one's coping strategies according to the demands of different stressful situations. It includes the abilities to:

- recognise whether the use of a flexible coping approach is appropriate for a specific situation,
- select a coping strategy that suits the situational circumstances,

- recognise when the coping strategy being used is ineffective,
- discontinue an ineffective coping strategy, and
- produce and implement an alternative coping strategy when required.

Coping flexibility is considered to be an adaptive personality attribute that enables us to adjust our thoughts, feelings or behaviour according to changing situational circumstances. Adaptability in our approach to coping helps ensure we are more able to meet the specific challenges of a variety of stressful situations, most of which occur within the context of an ever-changing environment (Cheng, 2001; Kato, 2015).

There are individual differences in coping flexibility. Some individuals have a higher level of coping flexibility than others.

Individuals with *high coping flexibility* readily adjust their coping strategies if a particular strategy they are using is proving to be ineffective. They also tend to use different types of coping strategies across a variety of stressful situations, and there tends to be a good fit between the coping strategies they deploy and the characteristics of the specific situational demands.

In contrast, individuals with *low coping flexibility* consistently use the same type of coping strategies across different stressful situations, and persist in their use of the coping strategies they deploy, even in the face of ineffectiveness. Essentially, these individuals are not very adaptable and always approach coping in much the same way, almost habitually (Cheng & Cheung, 2005; Kato, 2012).

Consider the example of coping flexibility by Ally who has just separated from her husband and is consequently very distressed. Ally typically finds going to church relaxing, uplifting and inspiring, so she selects this as her coping strategy and increases her church attendance to three times per week. However, after attending church on five occasions, Ally is still very distressed. She evaluates her situation and realises that attending church has not reduced her stress enough so she needs to adapt and consider alternative strategies. Ally therefore arranges to cut back on church attendance and use the time to meet with compassionate friends. She will go to a movie with one friend and to a yoga class with another. Ally has been self-monitoring her coping progress and after going out with her friends realises that these strategies, in conjunction with church attendance, are proving to be effective, so she starts to think more positively about herself and her situation.

As can be reasonably expected, individuals with high coping flexibility tend to cope more effectively with stress and are more likely to achieve positive outcomes from the coping strategies they deploy than are individuals with low coping flexibility. Coping flexibility with a good strategy–situation fit is related to adaptive outcomes, such as mental wellbeing, physical wellbeing, social adjustment and reduced stress symptoms (Cheng & Cheung, 2005).

The concept of coping flexibility originates in the Lazarus and Folkman's transactional model of stress and coping. The model describes coping as a process that is responsive to situational changes rather than one that remains relatively stable across situations. More specifically, individuals take into account the contextual characteristics of the stressful situation and appraise whether the outcome is controllable. This type of appraisal guides their choice and use of coping strategies to meet specific situational demands (Cheng, Lau & Chan, 2014).

Figure 3.37 People who have high coping flexibility readily change or adjust their coping strategy if a particular strategy they are using is ineffective.

BOX 3.13 Coping Flexibility Scale

The *Coping Flexibility Scale (CFS)* was developed by Japanese psychologist Tsukasa Kato. The scale is based on the operationalisation of coping flexibility as 'the ability to discontinue an ineffective coping strategy and produce and implement an alternative coping strategy'. Following is a reproduction of the scale.

INSTRUCTIONS

When we feel stress, we try to cope using various actions and thoughts. The following items describe stress-coping situations. Please indicate how these situations apply to you by choosing one of the following for each situation:

0 = Not applicable; 1 = Somewhat applicable; 2 = Applicable; 3 = Very applicable

_____ 1 When a stressful situation has not improved, I try to think of other ways to cope with it.
_____ 2 I only use certain ways to cope with stress.
_____ 3 When stressed, I use several ways to cope and make the situation better.
_____ 4 When I haven't coped with a stressful situation well, I use other ways to cope with that situation.
_____ 5 If a stressful situation has not improved, I use other ways to cope with that situation.
_____ 6 I am aware of how successful or unsuccessful my attempts to cope with stress have been.
_____ 7 I fail to notice when I have been unable to cope with stress.
_____ 8 If I feel that I have failed to cope with stress, I change the way in which I deal with stress.
_____ 9 After coping with stress, I think about how well my ways of coping with stress worked or did not work.
_____ 10 If I have failed to cope with stress, I think of other ways to cope.

To obtain your scores, first reverse the answer values for items 2 and 7. That is, for these two items, 0 = 3, 1 = 2, 2 = 1 and 3 = 0.

Next, sum the answer values for items 2, 6, 7, 8 and 9 to obtain your Evaluation Coping score. Then sum the answer values for items 1, 3, 4, 5, and 10 to obtain your Adaptive Coping score. Evaluation coping refers to your tendency to abandon ineffective strategies. Adaptive coping refers to your tendency to consider and create alternative coping strategies.

Kato (2012) found a mean of 10.10 (sd = 3.12) for Evaluation Coping and a mean of 7.29 (sd = 3.20) for Adaptive Coping in a sample of Japanese college students.

Source: Kato, T. (2012). Development of the Coping Flexibility Scale: Evidence for the coping flexibility hypothesis. *Journal of Counseling Psychology, 59*, 262–273.

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Word copy of Coping Flexibility Scale

LEARNING ACTIVITY 3.24

Reflection

Consider a time when you had to cope with a relatively significant stressor. What aspects of your coping style suggest you have high or low coping flexibility? Given the potential benefits of coping flexibility, how could you achieve greater flexibility?

Approach and avoidance coping strategies

Strategies people use to cope with difficult or stressful circumstances in their lives have been organised into different categories. One classification system distinguishes between approach and avoidance strategies. In this system, the terms 'approach' and 'avoidance' are used to refer to the orientation or focus of an individual's activity either toward or away from the stressor. The aim of both approach and avoidant strategies is to reduce stress levels and increase the ability to cope, but the method in which this is achieved differs (Billings & Moos, 1981; Roth & Cohen, 1986).

Approach coping strategies involve efforts to confront a stressor and deal directly with it and its effects. Activity is focused *towards* the stressor, its causes and a solution that will address the underlying problem, issue or concern and minimise or eliminate its impact. For example, an approach strategy for a stressor involving loss of a job through retrenchment is to search for a new job. Similarly, stress due to an upcoming exam might involve an approach effort that targets working harder and spending more

time studying while maintaining a healthy lifestyle. Stress due to a chronic pain condition might involve trying to seek more information about the condition, working out the triggers for flare-ups and identifying alternative treatment options.

Avoidant coping strategies involve efforts that evade a stressor and deal indirectly with it and its effects. Activity is focused *away* from the stressor and there is no attempt to actively confront the stressor and its causes. For example, an avoidant strategy for a job loss stressor may be to not tell anyone and not think about it. For stress due to an upcoming exam a strategy might involve 'preparing for the worst' or indirectly reducing the tension by such behaviour as eating more or playing video games. An avoidant strategy for stress due to pain might involve trying to ignore the pain through distraction or attempting to avoid increasing the pain.

Table 3.5 below includes additional examples of approach and avoidant strategies. Note that avoidance-oriented coping includes strategies that involve behavioural or emotional *disengagement* (e.g., 'I stop trying', 'I pretend it isn't real'), whereas approach-oriented coping includes strategies that involve *engagement* with the stressor (e.g. 'I try to find out more information', 'I consider several alternatives for handling it').

Approach coping strategies are generally considered to be more adaptive and effective than avoidance strategies. For example, research studies have found that people who rely more on approach strategies to cope with a stressor tend to experience fewer psychological symptoms and are more able to function effectively compared to people who rely more on avoidance strategies. In addition, excessive reliance on avoidance strategies tends to be associated with a number of negative consequences, such as an increase in vulnerability to mental health problems and stress-related physical problems, such as hypertension and cardiovascular disease. Long-term use of avoidance strategies can also contribute to other problems. For example, one study of adolescents found that those who relied on avoidance coping strategies were more likely to engage in various socially inappropriate or illegal behaviours, including substance use (Cooper et al., 2003; Mund & Mitte, 2011).

Figure 3.38 If experiencing stress over job loss, (a) an approach strategy would involve effort to confront the stressor and deal directly with it and its effects, whereas (b) an avoidant coping strategy would involve effort that evades the stressor and deals indirectly with it and its effects.

Although avoidance coping strategies tend to be maladaptive, this does not mean that avoidance coping strategies are all maladaptive or ineffective, or always maladaptive or ineffective. For example, when coping with a number of stressors at the one time, selectively avoiding to deal with unchangeable aspects of a stressor by 'switching off' may be considered an adaptive strategy. This allows for the conservation of energy to focus on other stressors that

TABLE 3.5 Examples of approach and avoidance strategies

Approach strategies	Avoidance strategies
• 'I try to find out more information.' • 'I consider several alternatives for handling it.' • 'I try to think about it in a more positive way.' • 'I try to step back from the situation and be more objective about it and what I might be able to do.' • 'I ask a professional person for advice and follow it.' • 'I take steps to eliminate the cause.' • 'I make a plan of action and I follow it.' • 'I draw on my past experiences in similar situations.' • 'I will try to find a way of controlling the situation.' • 'I accept the reality of the situation and deal with it.'	• 'I stop trying.' • 'I pretend it isn't real or doesn't exist.' • 'I accept the death and know that I must make the funeral arrangements, but I try to not think about it.' • 'I change the subject.' • 'I use alcohol or drugs to feel better.' • 'I yell a lot at other people even though I don't mean to.' • 'I try to distract myself with other activities.' • 'I avoid people and situations that remind me of it.' • 'I sleep more than usual.' • 'I go on an eating binge.'

can be changed. Disengagement, for example, might be appropriate in a situation where nothing can be done (such as awaiting the outcome of an important medical test), but might be detrimental when action is needed (such as seeking medical attention for a serious health problem).

In addition, avoidant strategies can be more effective in coping with stress in the *short term*. For example, many students find preparing for exams very stressful. In this situation, using avoidant strategies such as listening to music, playing a video game or going to a movie can all decrease stress. Similarly, ignoring a relationship problem for a couple of days while focusing on an important priority at work can also provide 'time out' from one stressor while minimising potential stress from another source, such as the workplace. However, these avoidance strategies are only helpful in the short term and their *long term* use can prevent people from responding to stressors in constructive ways.

A delay in dealing with a stressor can also have negative consequences. For example, not thinking about an exam until the night before can provide stress-free time, but waiting until the last moment to study can make that study period more stressful than it might have been and may also have negative consequences for future achievement if spending less time studying does not allow for proper exam preparation.

Many stressors and stressful situations are actually quite complex, so both approach and avoidance strategies may be used for coping. For example, in some situations, we may first use an avoidance strategy, which allows us to deal with the intense emotions that have been triggered by an especially overwhelming stressor. Then, later on, when we are feeling somewhat better, we can evaluate our situation and use an approach strategy to look for ways of managing the stressor or solutions. Of course, in other situations, the strategies may be used in the opposite order.

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Recognising avoidance coping

Figure 3.39 Use of avoidance strategies can be effective in the short term by reducing distress, anxiety and preventing stressors from becoming overwhelming. However, long-term use of avoidance strategies may increase the risk of experiencing negative physical and/or mental effects of the stressor and ultimately delay, prevent or interfere with its resolution.

BOX 3.14 Problem-focused and emotion-focused coping

One of the most widely used classification systems for coping strategies in contemporary psychology is derived from the Lazarus and Folkman transactional model. This system distinguishes between problem-focused and emotion-focused coping.

Problem-focused coping involves efforts to manage or change the stressor which is the cause or source of the stress. This may include:

- reappraising the stressor by examining it from new perspectives
- obtaining more information about the stressor by talking to someone who could help
- redefining the stressor in a way that is more manageable
- generating alternative ways of dealing with the stressor
- focusing on changing only what is changeable
- learning new skills to more effectively manage the stressor.

For example, you may become stressed when you realise that you will not be able to afford to go to a rock concert with your best friends. Some possible problem-focused solutions include taking action to get more money by offering to do jobs for family members or neighbours, seeking an advance on a weekly allowance received at home, reducing your expenses or requesting repayment from someone who owes you money.

Problem-focused coping strategies tend to be used when we believe that we have some control over a stressful situation and think that we can change the circumstances, or at least change ourselves to more capably deal with the circumstances. Like approach strategies, they deal directly with the stressor to reduce or eliminate it.

Emotion-focused coping involves efforts to deal with the emotional response to a stressor. The strategies are therefore usually directed towards decreasing the negative feelings in a stress response. Emotion-focused coping strategies include such efforts as:

- denial, e.g. 'I'm not stressed'
- distancing, e.g. 'I don't let it get to me'
- avoiding, e.g. 'I'm not entering the public-speaking competition'
- minimising, e.g. 'It's not that bad'
- wishful thinking, e.g. 'I wish that the situation would go away or somehow be over with'
- acceptance, e.g. 'I accept that this has happened and can't be changed'
- venting emotions, e.g. 'I feel angry'
- distraction, e.g. reading a book, going to a movie
- seeking emotional support from family members or friends.

Emotion-focused coping strategies tend to be used when we believe that we have little or no control over a situation and therefore cannot do anything to change the circumstances. For example, emotion-focused coping would tend to be used if we become stressed on learning that a loved one has been diagnosed with a serious illness. Emotion-focused coping efforts may reduce or postpone stress and 'help us get by', but they do not address the cause of a stressor or prevent it from happening again in the future.

Like approach and avoidance strategies, problem-focused and emotion-focused coping are not mutually exclusive and can therefore co-occur, especially in more complex stressful situations.

Figure 3.40 Problem-focused coping targets the cause of the stressor and aims to diminish its impact. For example, to cope with stress arising from an upcoming SAC test, you can prepare a timetable for studying, study hard, get a tutor, plan to cheat or pretend you are sick and re-sit the test after asking a friend what is on it. If none of these options is available, possible or desirable, and you fear that you may not pass the test, then you may use emotion-focused coping to decrease your emotional response to the stressor. For example, you can tell yourself it is not important to get a good result, remind yourself that you are quite good at sitting tests, moan to your friends, 'cry on someone's understanding shoulder' or become very busy doing something else.

Exercise

Physical activity encompasses all movements in everyday life, including work, recreation, exercise and sporting activities. Everyone engages in some physical activity as part of their daily routines. For example, walking up a flight of stairs, walking to school, going shopping, cleaning your room, riding a bike and playing basketball or netball at school are all forms of physical activity.

Exercise is physical activity that is usually planned and performed to improve or maintain one's physical condition. For example, going for a walk or a run to improve your fitness and doing bicep curls to develop upper-arm strength all involve physical activity considered to be physical exercise because they have the goal of improving physical condition. Similarly, dancing, swimming, rowing and pilates are all forms of exercise, whether low or high intensity and regardless of whether they are undertaken recreationally or more formally.

There is now worldwide acceptance among mental health professionals and medical practitioners in all types of cultures that virtually any type of exercise is an important element of healthy living, not just for our physical wellbeing but also our mental wellbeing. It is also widely believed that traditional definitions of physical exercise should be broadened to refer to the improvement of an individual's mental condition as well as their physical condition (Alters & Schiff, 2010; World Health Organization [WHO], 2010a).

Being physically active, especially exercise that requires a sustained increase in oxygen consumption, can significantly reduce the risk of a serious disease, including those associated with chronic stress, such as cardiovascular heart disease, kidney disease, hypertension, digestive disorders,

Figure 3.41 Regular physical exercise can substantially reduce the risk of a stress-related disorders. Virtually any form can act as a stress reliever and is generally better than no exercise.

stroke and possibly certain forms of cancer. In addition to improving physical health, regular exercise can enhance mental health and overall sense of wellbeing.

Exercise takes time and effort, and sometimes carries a risk of injury or harm when not executed properly or in a manner that takes account of the individual's pre-existing physical condition. However, its potential benefits tend to outweigh potential costs. For example, exercise can help counter stress reactions in several ways. These include:

- When an individual experiences stress, stress hormones are secreted into the bloodstream. Physical exercise increases demands on the body for energy and in the process uses up the stress hormones. This reduces levels of stress hormones, thereby helping the body return to normal functioning sooner.
- Exercise can also help 'work out' tension that has built up in the muscles, thereby reducing muscle tension associated with elevated sympathetic nervous system activity.
- Exercise increases the efficiency of the cardiovascular system and increases strength, flexibility and stamina for encountering future stressors.
- Many people experience short-term psychological benefits during or immediately after exercising. For example, exercise can promote relaxation, thereby providing relief from stress symptoms.
- Strenuous physical activity can produce chemical changes in the body that can improve psychological health. For example, the brain releases mood-enhancing beta-endorphins during exercise. Beta-endorphins relieve pain and increase a sense of wellbeing and relaxation.
- Exercise can also provide an opportunity for distraction or 'time out' from a stressor. For example, through a focus on breathing and repetitive motion, or simply through being in a different environment, it can divert a person's attention away from a stressor and the negative emotional states associated with stress. It can also benefit by removing the individual from the stress-producing situation.
- People who exercise with others can experience long-term psychosocial benefits from the social interaction and potential social support the interactions can provide.

LEARNING ACTIVITY 3.25

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Word copy of table

Review questions

1. Explain the meaning of coping in relation to a stress response.

2. (a) Explain the meaning of context-specific effectiveness in relation to coping strategies.
(b) Which elements of a stressful situation are relevant to context-specific effectiveness?
(c) Give an example of a stressful situation in which context-specific effectiveness is
(i) demonstrated
(ii) not demonstrated.

3. (a) Explain the meaning of coping flexibility with reference to an example involving:
(i) high coping flexibility
(ii) low coping flexibility.
(b) What is a potential benefit of coping flexibility?

4. Describe the relationship between context-specific effectiveness and coping flexibility.

5. (a) Complete the table below to summarise approach and avoidance coping strategies. Include two of your own examples for each strategy.
(b) Explain why approach strategies are considered to be more adaptive than avoidance strategies, especially when considered from a long-term perspective.
(c) Give an example of when an avoidance strategy may be considered adaptive.
(d) Are approach and avoidance strategies mutually exclusive and therefore unable to be used together? Explain with reference to an example.
(e) Explain whether each of the following stress coping strategies involves approach, avoidance or both.
(i) meditating
(ii) praying for guidance or strength
(iii) procrastination
(iv) waiting until an appropriate opportunity presents itself before taking action
(v) seeking social support for emotional reasons
(vi) seeking advice from a friend
(vii) exercise

Coping strategy	Description	Key features	Examples
Approach			
Avoidance			

(continued)

(continued from previous page)

(f) Consider the cartoon at the right depicting a coping strategy.
  (i) Explain whether the cartoon depicts use of approach or avoidance.
  (ii) What is an advantage and a disadvantage of using this type of strategy in both the short and long term?

6. Describe three potential costs and benefits of exercise for coping with effects of stress.

LEARNING ACTIVITY 3.26

Reflection

Comment on whether the use of *any* coping strategy is better than not using a coping strategy when experiencing stress. Of what relevance is the nature of the stressor to your answer?

LEARNING ACTIVITY 3.27

Visual presentation

Produce a pamphlet or fact sheet that summarises stress management strategies, ensuring you describe and give examples of the strategies and how or why each one is potentially beneficial.

LEARNING ACTIVITY 3.28

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Washington Post article on therapy animals

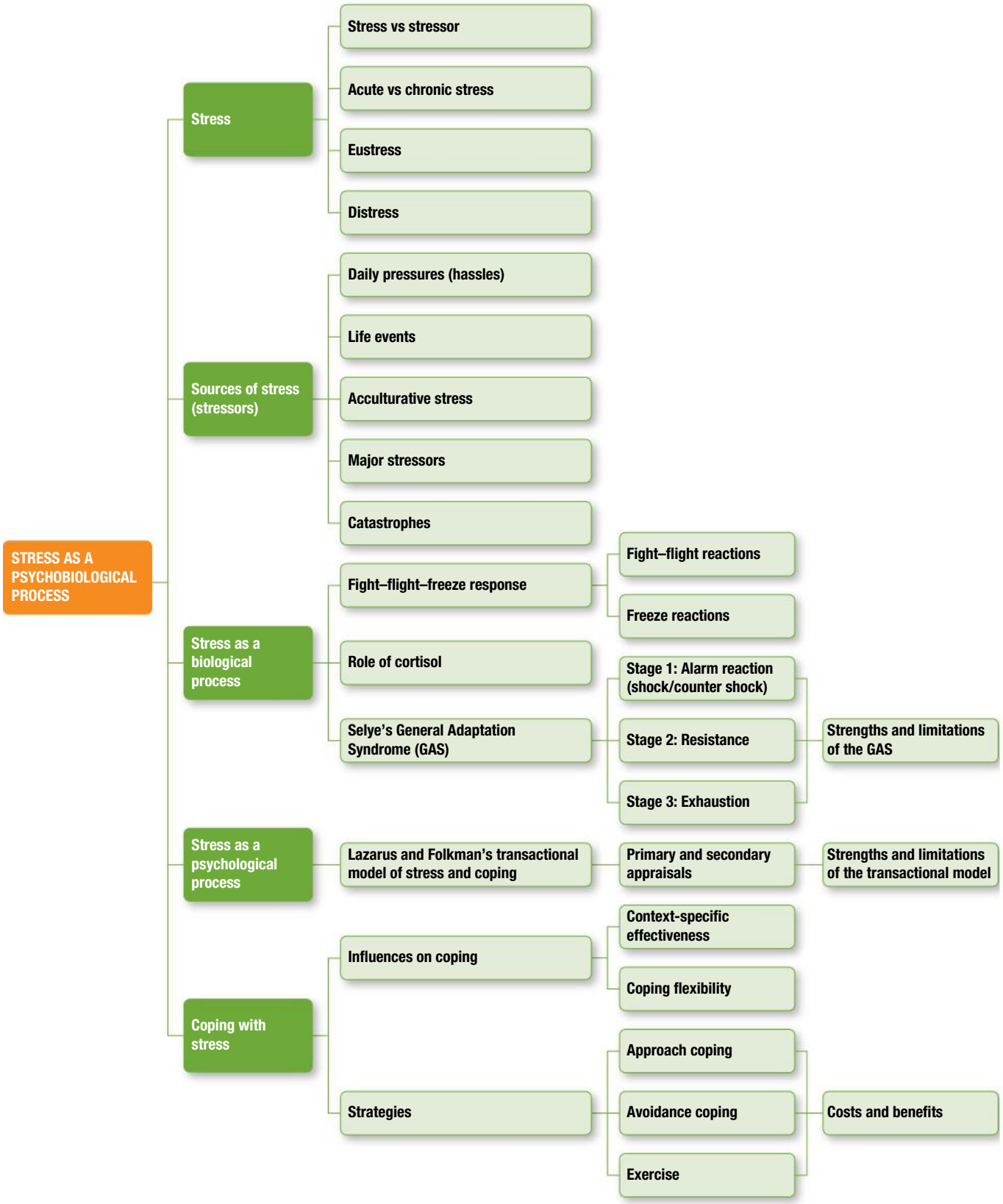
Media analysis/response

Read Karin Brulliard's *Washington Post* article on the use of therapy animals for stress management and then answer the following questions.

Access via the weblink in your eBookPLUS.

1. Explain the meaning of 'therapy animal' with reference to an example.
2. What animals are used?
3. What costs and benefits of animal assisted stress management (or therapy) are raised in the article?
4. How does the 'biophilia hypothesis' account for the potential benefits of animal assisted stress management?
5. What position does the author adopt on the use of animal assisted stress management?
6. To what extent is the article evidence-based?
7. Follow the link to Crossman's (2017) 'recent literature review' on the 'Effects of interactions with animals on human psychological distress'. Read the abstract and list three key findings by Crossman.
8. Comment on the benefits of Animal Assisted Therapy described by the Australian Network for the Development of Animal Assisted Therapies at their website: http://andaat.org.au/site/home/whatisaat Ensure you refer Crossman's findings.
9. What is your personal perspective on animal assisted stress management?

CHAPTER SUMMARY



KEY TERMS

acculturative stress p. 202
acute stress p. 191
adrenal cortex p. 218
adrenal gland p. 218
adrenaline p. 215
alarm reaction stage (GAS) p. 223
anti-inflammatory p. 218
approach coping strategy p. 236
avoidance coping strategy p. 236
catastrophic event stressor p. 209
chronic stress p. 191
context-specific effectiveness p. 234
coping p. 233
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coping strategy p. 233
cortisol p. 218
counter shock (in GAS alarm reaction) p. 223
daily pressure (hassle) stressor p. 193
distress p. 191
eustress p. 191
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exhaustion stage (GAS) p. 224
fight–flight–freeze response p. 214
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General Adaptation Syndrome (GAS) p. 222
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resistance stage (GAS) p. 223
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shock (in GAS alarm reaction) p. 223
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stress hormone pp. 215, 217
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Transactional Model of Stress and Coping p. 228

LEARNING CHECKLIST

Complete the self-assessment checklist below, using ticks and crosses to indicate your understanding of this chapter's key knowledge (a) before and (b) after you attempt the chapter test. Use the 'Comments' column to add notes about your understanding.

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Key knowledge I need to know about stress as a psychobiological response	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
Stress			
eustress vs distress			
acute stress vs chronic stress			
stress vs stressor			
psychobiological process			
Sources of stress			
daily pressures (hassles)			
life events			
acculturative stress			
major stressors			
catastrophes			
Stress as a biological process			
fight–flight–freeze response			
• fight–flight reactions			
• freeze reactions			
SAM			
HPA axis			

Key knowledge I need to know about stress as a psychobiological response	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
Role of cortisol			
• benefits			
• harm			
Selye's General Adaptation Syndrome (GAS)			
• Stage 1: Alarm reaction			
shock/counter shock			
• Stage 2: Resistance			
• Stage 3: Exhaustion			
• Strengths and limitations of GAS			
Stress as a psychological process			
Lazarus and Folkman's transactional model of stress and coping			
• transaction			
• two-step model			
• primary and secondary appraisals			
• strengths and limitations of transactional model			
Strategies for coping with stress			
coping			
context-specific effectiveness			
coping flexibility			
approach vs avoidance strategies			
exercise			

studyon

Unit 3 > Area of study 1 > Topic 3

Concept screens and practice questions

CHAPTER 3 TEST

SECTION A — Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Question 1

One of the hormones secreted during the fight–flight–freeze response is

A. cortical.
B. adrenaline.
C. cortisol.
D. ACTH.

Question 2

Fight–flight–freeze is best described as a

A. specific reaction occurring in a specific sequence.
B. series of three specific reactions occurring independently.
C. naturally occurring learned response.
D. naturally occurring unconscious response.

Question 3

A benefit of fight–flight–freeze is that

A. the body is quickly energised to react to a threat.
B. it enables an organism to successfully adapt to all types of situations.
C. it prevents organisms from being harmed by stressors that are threatening.
D. the individual organism can choose how to respond to a threat depending on the situation.

Question 4

The sympathetic nervous system

A. activates bodily functions to deal with an immediate stressor.
B. activates muscular relaxation and decreases heart rate.
C. counterbalances the energising effects of the parasympathetic system.
D. maintains the internal systems of the body in a balanced state.

Question 5

As you walk down the street on your way to visit a friend, a ferocious dog jumps a fence and chases you, barking and growling. Which of the following systems is least likely to be dominant as you try to flee from the dog?

A. sympathetic
B. cardiovascular
C. endocrine
D. parasympathetic

Question 6

Which of the following potential stressors would be classified as having an internal source?

A. travelling in an overcrowded peak hour train
B. being refused entry to an important exam for being late
C. achieving a lower grade than expected for a SAC
D. being bullied by another student

Question 7

Hormones of the body's endocrine system are important contributors to a stress response. Which gland in the brain initiates hormonal secretion?

A. pituitary
B. hypothalamus
C. adrenal
D. amygdala

Question 8

A life event such as moving out from home to live alone could be a stressor because it

A. involves adjustment to change.
B. is a choice people make.
C. can be positive or negative.
D. depends on the individual involved and their interpretation of the specific event.

Question 9

Why does the temperature in our hands drop when exposed to a stressor?

A. We breathe in less oxygen.
B. We feel threatened or fearful.
C. To support cortisol's immunity requirements.
D. Blood flow diverts to major muscle groups for possible fight or flight.

Question 10

Which of the following is an example of an approach coping strategy?

A. 'I exercise more.'
B. 'I eat.'
C. 'I sleep more.'
D. 'I get busy with other things to keep my mind off it.'

Question 11

Coping refers to the

A. product of stress.
B. typical biological reaction to stress.
C. typical psychological reaction to stress.
D. process of dealing with stress.

Question 12

The opposite of a fight–flight response to a stressor is

A. eustress.
B. the HPA axis.
C. a freeze state.
D. an arousal state.

Question 13

The most immediate effect of adrenaline and noradrenaline secretion is

A. arousal.
B. immobility.
C. relaxation.
D. energy conservation.

Question 14

An elevated level of cortisol in the bloodstream for a prolonged period due to a chronic stressor may

A. maintain the parasympathetic nervous system in an active state.
B. deplete the body of all its hormones.
C. deplete the body's resources and lead to long-term illness or disease.
D. contribute to a breakdown in the functioning of the immune system.

Question 15

The body's inbuilt safeguard system against excessive cortisol primarily involves

A. an exhaustion stage.
B. feedback to the hypothalamus.
C. the HPA axis.
D. the parasympathetic nervous system.

Question 16

The stage of Selye's General Adaptation Syndrome in which an organism initially responds to a stressor is called

A. resistance.
B. exhaustion.
C. alarm reaction.
D. counter shock.

Question 17

After overcoming the initial blow of finding that her mobile phone was stolen, Sam sees the year level coordinator and becomes actively involved in seeking witnesses to the incident. At this point, Sam is most likely in the ____ stage of the General Adaptation Syndrome.

A. shock
B. counter shock
C. resistance
D. exhaustion

Question 18

Which of the following is an example of primary appraisal according to the Lazarus and Folkman transactional model of stress and coping?

A. determining the extent to which additional resources are needed to cope
B. evaluating the potential impact of the stressor
C. judging the usefulness of coping resources that are available
D. any exchange between the individual and the environment

Question 19

Which of the following is an example of secondary appraisal according to the Lazarus and Folkman transactional model of stress and coping?

A. making a judgment about whether a situation is actually stressful
B. minimising harm or loss that may occur
C. estimating the value of coping options and resources that may be accessed
D. minimising harm or loss that has occurred

Question 20

According to the Lazarus and Folkman transactional model of stress and coping, stress is

A. a product of appraisal.
B. a product of arousal.
C. a biological response to a stressor.
D. an environmental response to a stressor.

Question 21

Acute stress is a _____ state of arousal, whereas chronic stress is a _____ state of arousal.

A. long-term; short-term
B. non-harmful; harmful
C. minor; major
D. transient; continuous

Question 22

In the Lazarus and Folkman model, appraisal is best described as a/an ____ process.

A. biological
B. cognitive
C. emotional
D. environmental

Question 23

Jack scored over 300 points (life change units) on the Social Readjustment Scale. What does this mean?

A. Jack has probably experienced very few daily pressures (hassles) during the past 12 months.
B. Jack has probably not spent much time engaged in primary and secondary appraisals of his stressors during the past 12 months.
C. Jack will definitely develop physical or psychological stress-related problems within the next 12 months.
D. Jack is vulnerable to developing physical or psychological stress-related problems within the next 12 months.

Question 24

Zaphie got up late and rushed to get ready to get to work on time. Whilst doing so, she burnt a finger on her hair straightener, found that there was no milk in the fridge after pouring her coffee and damaged her stockings when putting on her shoes. These incidents are best described as

A. daily pressures or hassles.
B. major life events.
C. major stressors.
D. life change units.

Question 25

When Charlie was chased and attacked by a swooping magpie during her regular morning run, she experienced the classic fight-flight physiological reactions described by Walter Canon. It is likely that her sympathetic nervous system stimulated her adrenal medulla to secrete hormones called

A. glucose.
B. lymphocytes.
C. catecholamines.
D. corticosteroids.

SECTION B

Answer **all** questions in the spaces provided. Write using blue or black pen.

Question 1 (2 marks)

Define stress as a psychobiological process.

Question 2 (2 marks)

(a) How do daily pressures (hassles) contribute to stress? 1 mark

(b) Under what circumstances are daily pressures more likely to influence onset or maintenance of a major health problem? 1 mark

Question 3 (3 marks)

(a) Describe the role of appraisal in the Lazarus and Folkman transactional model of stress and coping. 1 mark

(b) What is a strength and a limitation of the transactional model? 2 marks

Question 4 (5 marks)

(a) Harry and Carla have both started attending a new school. Harry is an outgoing sporty person, whereas Carla is very shy and reserved. State whether Harry and Carla are likely to experience eustress or distress and explain why. 2 marks

(b) List three differences between eustress and distress. 3 marks

Question 5 (3 marks)

(a) Define the meaning of acculturative stress. 1 mark

(b) What two factors can influence the degree of acculturative stress experienced by an individual? 2 marks

Question 6 (4 marks)

Your friend tells you about a scary movie about killer cockroaches she watched last night. In one scene, a cockroach came around the corner and confronted a young woman who was waiting for a late night bus. She saw the ferocious-looking 'monster', but did nothing. She did not run. Nor did she scream. She just stood there 'scared stiff' with a look of horror on her face until the cockroach approached and ate her. Your friend screamed as she thought the woman was stupid because she should have run or at least done something. Your friend has seen this failure to respond in some other horror movies and is confused. She knows you are studying psychology and wonders if you can offer an explanation.

(a) What term would psychologists use to describe the woman's response? 1 mark

(b) Would they describe it as a voluntary or involuntary response? 1 mark

(c) What is a psychobiological explanation of the response? 2 marks

Question 7 (6 marks)

A research study measuring the effectiveness of a stress management course used cortisol level as their dependent variable.

(a) Explain whether cortisol level is a valid dependent variable for this study. 1 mark

(b) If the stress management course was effective, what would happen to the participants' cortisol levels? 1 mark

(c) What are two potential benefits and two potential harmful effects of cortisol when stressed? 4 marks

Question 8 (4 marks)

(a) Jack usually takes the stairs at work because he gets anxious in a crowded elevator. One morning, when late for work, he notices the elevator is empty and decides to take it. The elevator jams and he is told over the emergency phone that it will take 'quite a while' to repair. He focuses on remaining as calm as possible and decides to use the spare time to review the report in the document he is carrying.
Explain whether Jack is using approach and/or avoidance to cope with the stress of being stuck in an elevator. 2 marks

(b) Ramij suffers migraines and always takes her medication as soon as she notices a migraine coming on.
Explain whether Ramij is using an approach or avoidance coping strategy. 2 marks

Question 9 (7 marks)

(a) Explain the meaning of coping flexibility. 1 mark

(b) List three characteristics of coping flexibility. 3 marks

(c) Explain how coping flexibility can influence context-specific effectiveness of coping. 3 marks

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The answers to the Section A multiple-choice questions are in the answer section at the end of this book and in eBookPLUS.
The answers to the Section B questions are in eBookPLUS.

4 NEURAL BASIS OF LEARNING AND MEMORY

KEY KNOWLEDGE

- neural plasticity and changes to connections between neurons (including long-term potentiation and long-term depression) as the fundamental mechanisms of memory formation that leads to learning
- the role of neurotransmitters and neurohormones in the neural basis of memory and learning (including the role of glutamate in synaptic plasticity and the role of adrenaline in the consolidation of emotionally arousing experiences).

Source: ©VCAA, VCE Psychology Study Design (June 2017 update), p. 25.

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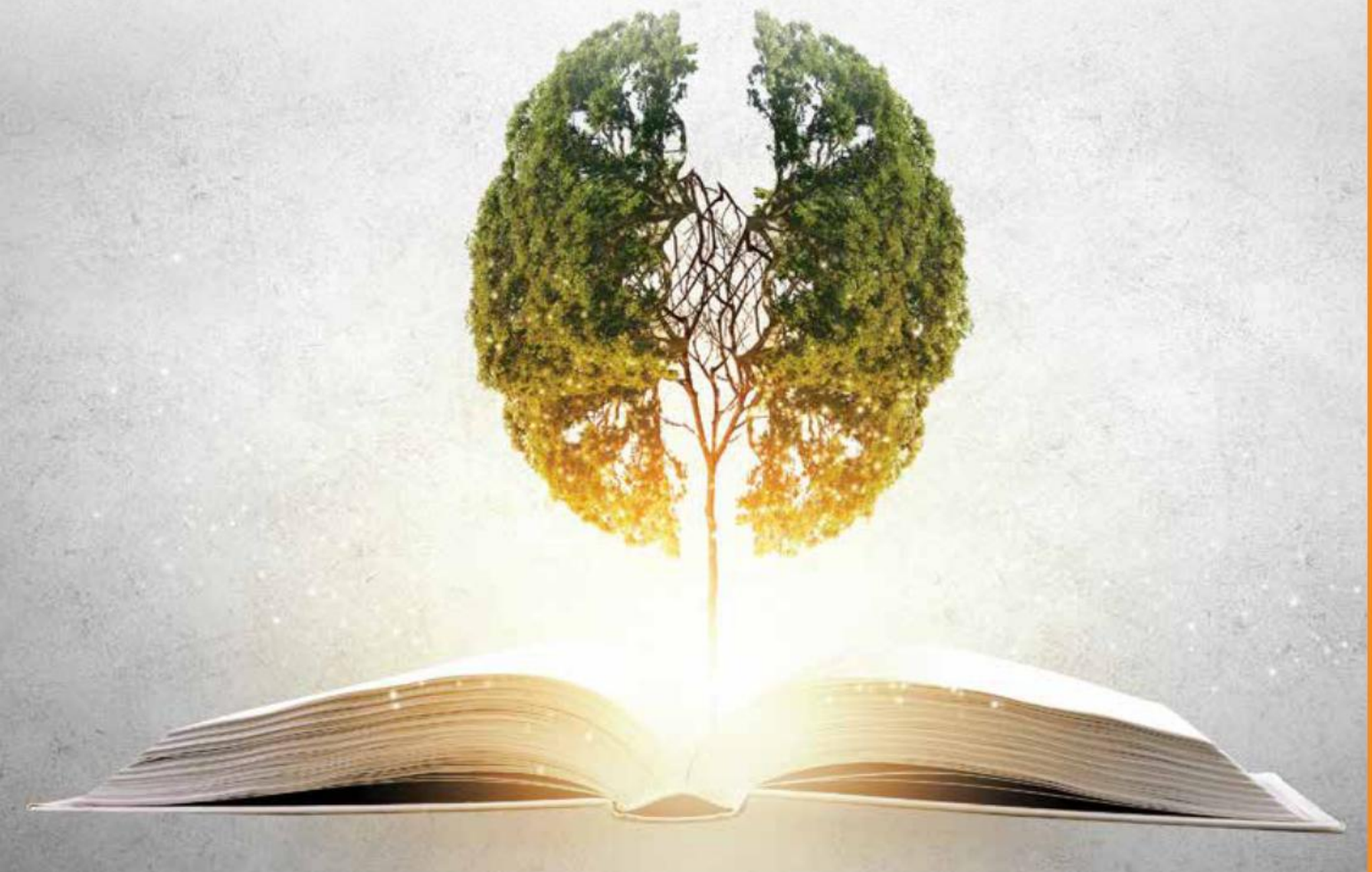

Can you think of something you do that you did not learn? It's a difficult task because learning is involved in nearly all our behaviours. Except for a range of physiological responses that are involuntary and normally occur automatically, such as breathing, digesting food, secreting hormones and blinking, most of what you do each day depends to a large degree on learning. For example, behaviours such as brushing your teeth, tuning in to your favourite television program, texting a friend and undertaking the VCE all depend on learning in a significant way. Your attitudes, values, beliefs, opinions, interests and decisions all involve learning. Many of our emotions are also learned or influenced significantly by learning. Learning is such an integral part of daily living that without the ability to learn from an early age, people would be unable to live independently and would need constant care in order to survive.

Next, imagine for a moment what life would be like without your memory. You would have no recollection of what happened to you 2 seconds ago, 10 minutes ago or even 10 years ago. Without memory, every moment would be a new experience. Each person you met would be a stranger and each task you tackled would be a new challenge. Even the most basic tasks that most of us take for granted, such as tying a shoelace or walking the dog, would be difficult because we would have no memory of how to do them.

Imagine the effect on your social life. You would not be able to hold a conversation and you would have no friends because you would have no memory of ever having met them or knowing anything about them from one encounter to the next. Without memory you would have no self-concept or true sense of yourself as an individual. Our self-concept develops from the many experiences we have during our lives. With no recollection of these experiences we would have no basis for developing an understanding of 'who I am'. Each time you looked in the mirror you would be confronted by a complete stranger.

In this sense, it is memory that provides meaning to our lives by integrating the past and the present, and enabling us to think about the future.

Learning is change that occurs through experience. Memory is very closely related to learning. The relationship is so close that learning and memory are often described as inseparable. Learning is the acquisition of skill or knowledge, while memory is the expression of what you have acquired. The existence of memory indicates that learning has occurred. If no learning occurs there is nothing to remember. Without memory, learning would not be possible because we need the capability to retain what we have learned. Nor would learning have any value if we could not remember — we usually learn with the understanding that at some future time we will be able to recall what we learned.

Memory is essentially the outcome of learning and enables knowledge and skills acquired through experience to be stored in the brain and retrieved when needed. The close relationship between learning and memory is evident not only from a psychological perspective, but also biologically as they both involve and are influenced by many of the same neural mechanisms and processes. All memory involves neurological changes that occur as a result of learning. Memory is not a recorded 'snapshot' of an event but a neurological representation of the event. From a biological perspective, learning may be viewed as the capability of modifying information already stored in memory based on new sensory input or learning experiences. Since memory is dependent on some kind of prior experience, the first step in memory formation is learning, which occurs when our sensory systems send information to the brain.

In this chapter we examine the neural basis of learning and memory, focusing on the brain's plasticity and changes to connections between neurons that enable learning and memory to take place and demonstrate that learning and memory are actually inseparable.

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Figure 4.1 Learning and memory are inseparable. If no learning occurs there is nothing to remember, and to learn requires a capability to remember what will be learned.

NEURAL PLASTICITY AND CHANGES TO CONNECTIONS BETWEEN NEURONS

The human brain typically follows a predictable pattern of growth and development, with different structures and abilities progressing at different rates and maturating at different points in the lifespan. Although our genes ensure that the basic structure and organisation of our brain are established well before birth, our brain continues to mature and change long after birth. It is not a rigidly fixed organ. Nor are the neural circuits and pathways extending within and between different areas of our brain 'hardwired' like a computer or other human-made electronic device.

Neurons are soft, flexible living cells. They can change in size, shape and function. They can also change their connections with other neurons and their patterns of connections. These types of changes are influenced by the interaction of biological processes that are genetically determined and by experiences in everyday life.

From birth through to the end of life, neurons and the connections between them change in response to our experiences. They change to represent and store this information so that we can learn and remember. This fundamental and very important ability to change is referred to as neural plasticity, neuroplasticity, or simply plasticity.

Neural plasticity

Neural plasticity is the ability of the brain's neural structure or function to be changed by experience throughout the lifespan. This may involve a single neuron, a pair of neighbouring neurons or entire networks of neurons. The term plasticity is used because 'plastic' originally meant flexible, pliable or malleable. This property of the brain provides the physiological basis of learning and memory. It makes learning and memory possible, provides the brain with a way of being continually responsive to environmental input, and thereby assists us in adapting to life's ever-changing circumstances.

The brain's plasticity is a feature that persists from embryonic development through to and including old age. Lifelong plasticity accounts for many of the learning experiences we have throughout life, such as learning language as a child, learning to play a musical instrument as an adolescent, learning new job skills as an adult, learning how to use digital media at an older age, and so on. Our genes govern the overall architecture of our brain, but experience guides, sustains and maintains the details.

If a monkey is trained to push a lever with a finger several thousand times a day, the brain tissue which controls that finger changes to reflect the experience. Human brains function in a similar way. Whether learning to use a computer keyboard or to ride a skateboard, we will perform with increasing skill as our brain incorporates the learning within its neural structure. The neural activity underlying this process occurs in a systematic way and not haphazardly (Breedlove, Watson & Rosenzweig 2010; Myers, 2007).

Although some parts of the brain, such as the sensory and motor areas in the cerebral cortex, have a higher level of plasticity than others, it is unclear as to whether all brain parts have plasticity. However, the brain of a developing individual is even more plastic than that of an adult, particularly at specific times in development when it seems that the brain is more responsive to certain types of experiences. This is one reason why young children tend to learn a new language more quickly than do adults. Similarly, infants tend to recover more quickly from brain damage than adults due to the greater plasticity of their brain.

Figure 4.2 Lifelong plasticity accounts for many of the learning experiences we have throughout life, such as learning how to use digital media in young or old age.

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Weblinks

- TEDx Talk on learning, memory and neural plasticity 14m 24s
- TEDx Talk: Norman Doidge on neuroplasticity 44m 49s

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There also seems to be a relationship between the type of experience we have and the extent of the structural change that takes place in the brain. Generally, the more complex the experience in terms of the variety of sensory input, the more distinctive the structural change that will occur in neural tissue involved in that experience. This seems to be the case for both children and adults (Centre for Educational Research and Development [CERI], 2007; Kolb & Whishaw, 2014).

Changes to connections between neurons

Neural plasticity is evident in physical changes that take place at synapses where neurotransmission occurs and multiple neurons interconnect to form neural pathways. At the level of the synapse, neural plasticity is commonly called synaptic plasticity.

Synaptic plasticity refers to the ability of the synapse to change over time. For example, change may occur through growth or formation of new synaptic connections that strengthen the synapse or change may occur through disuse of synaptic connections that weaken or eliminate the synapse. Synaptic plasticity enables a flexible, efficient and effectively functioning nervous system. It is also the biological basis of learning and memory.

As we learn through the constant stream of new experiences in everyday life, our brain modifies its neural connections and pathways, thereby actually changing its structure and function by 'rewiring' itself. Existing connections between neurons can reorganise, and new networks or pathways can form and strengthen through use during the learning (and memory formation) process, thus making communication across a connection and along a pathway easier the next time. Furthermore, the brain can reorganise and reassign its neural connections, and pathways based on which parts of it are overused or underused. The result is a structure constantly remodelled by experience.

Canadian psychologist Donald Hebb is credited with the idea that learning involves the establishment and strengthening of neural connections at the synapse. For example, learning a list of new spelling words, to use a pogo stick, to play a harmonica or any other task will establish new neural connections, and regular practice of the task will strengthen these connections with the result that you get better at the task, become more efficient and make fewer mistakes.

Some 70 years ago, Hebb proposed that learning results in the creation of *cell assemblies* — interconnected groups of neurons that form networks or pathways. Neurons in a network send messages to other neurons within the network, but messages from one network may also be sent to other networks and small networks may also organise into bigger networks. Consequently, the same neurons may be involved in learning different things or in producing different patterns of behaviour, depending on which combination of neurons is active.

According to Hebb (1949), when neurotransmitter is repeatedly sent across the synaptic gap, presynaptic and postsynaptic neurons are repeatedly activated at the same time. When a presynaptic and a postsynaptic neuron are active at the same time, this changes the structure or chemistry of the synapse, strengthening the connections between these two neurons at the synapse. When the synaptic connection is strengthened, this makes them more likely to fire together again and to transmit their signals more forcibly and efficiently in the future. Conversely, not firing together — for example, through disuse — weakens the connections between neurons and also makes them less likely to fire together at the same time in the future.

Hebb's explanation of changes to synaptic connections between neurons during learning is known as *Hebb's rule* or *Hebbian learning* and is often summarised as 'neurons that fire together, wire together'. Subsequent research in the 1970s on neurological processes during learning found that the synaptic changes underlying the formation of cell assemblies described by Hebb were also involved in the formation and storage of new memories. In particular, the discovery of long-term potentiation provided evidence in support of Hebb's rule (Kandel, 2001).

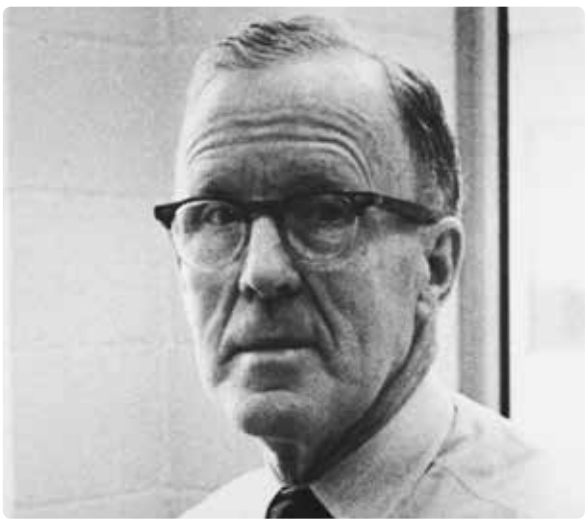

Figure 4.3 Canadian psychologist Donald Hebb (1904–1985) first proposed that the strength of a connection between neurons is determined by the neural activity of adjacent pre- and postsynaptic neurons. According to Hebb (1949 p. 62), 'when an axon of cell A is near enough to excite cell B or repeatedly or persistently takes part in firing it, some growth process or metabolic change takes place in one or both cells such that A's efficiency, as one of the cells firing B, is increased'. This theory has become known as Hebb's rule and is often summarised more simply as *neurons that fire together, wire together*.

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Animation explaining Hebb's rule 1m 02s

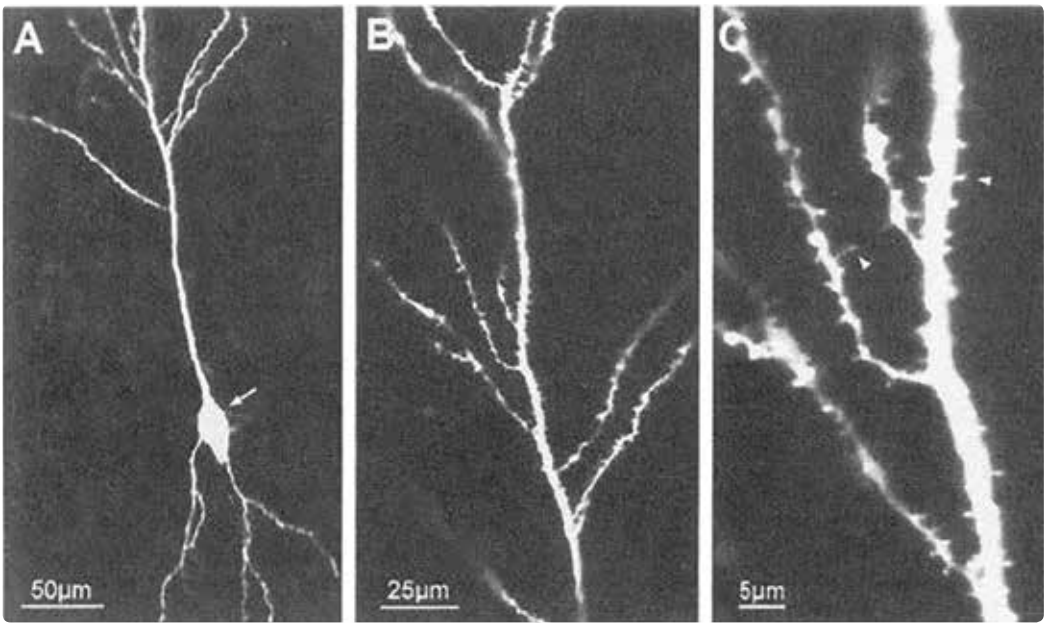

Figure 4.4 Change to connections on a postsynaptic neuron in the hippocampus of a laboratory rat when learning and forming a memory of that learning. A: the arrow is pointing to the soma. B: branches that have grown on a dendrite. C.: the dendritic branches are studded with numerous dendritic spines that have formed.

Long-term potentiation and long-term depression

Long-term potentiation and long-term depression are enduring (long-lasting) changes in synaptic strength that are brought about by specific patterns of activity at the synapse. These *activity-dependent* changes are thought to play a critical role in learning and subsequent memory formation. Both have been observed primarily in brain areas involved in learning and memory.

Long-term potentiation (LTP) refers to the long-lasting strengthening of synaptic connections, resulting in enhanced or more effective synaptic transmission. Basically, the effect of LTP is to improve the ability of two neurons — a presynaptic and a postsynaptic neuron — to communicate with one another at the synapse (Bliss & Lomo, 1973).

LTP strengthens synaptic connections in a way that enables postsynaptic neurons to be more easily activated. The postsynaptic neurons become more and more responsive to the presynaptic neurons as a consequence of repeated stimulation by neurotransmitters. The more that the connection is activated, the more the connection is strengthened. The more the connection is strengthened, the more the relevant neural pathway is strengthened, increasing the efficiency in transferring information along the pathway and decreasing the likelihood that what has been learned will be forgotten (and thereby enhancing memory storage of the information). In addition, the more we use the information being remembered, the more the LTP process strengthens the pathway, making it easier to retrieve that information. This suggests that simple repetitive 'rote learning' when studying for an exam is worthwhile (but not necessarily more effective than other study methods). With LTP, there also appear to be changes in the presynaptic neuron. For example, the terminal buttons on the neurons involved in LTP release more glutamate after the potentiation has been created (Thompson, 2000).

LTP was first reported in 1973 after it was observed in the brains (hippocampus) of anesthetised rabbits in a laboratory in Norway. It is the same kind of mechanism that Hebb had imagined 25 years earlier when he proposed that learning results from a strengthening of synaptic connections between neurons that fire together. The discovery of LTP confirmed Hebb's rule and helps explain in biological terms why 'neurons that fire together, wire together'.

Long-term depression (LTD) is the long-lasting decrease in the strength of synaptic transmission (which is the opposite of LTP). This results from lack of stimulation of pre- and postsynaptic neurons or prolonged low level stimulation. Basically, a postsynaptic neuron becomes less responsive to the neurotransmitter released by a presynaptic neuron and the effect is to weaken the synaptic connection and therefore weaken or even silence communication at the synapse (Bliss & Cooke, 2011).

LTD was discovered in the cortex of the cerebellum by Japanese researchers in 1981, then later found to

also occur in the hippocampus and elsewhere in the CNS (Ito & Kano, 1982; Ito, 1989).

It is believed that LTD may be just as important for learning and memory as LTP. The weakening or elimination of unused synapses through LTD may prune unimportant or unwanted connections, leaving only the important connections that have been strengthened through repeated use by LTP. The process occurs as if the rule 'use it or lose it' is being followed. LTD may, for example, enable old memories or unused connections and pathways for previously learned information or skills to be cleared out. LTD may be what allows us to correct our thinking when solving a problem, or to adjust our movements when learning how to serve in tennis or ride a surfboard. It may also provide the basis of blocking or erasing unwanted, inappropriate or incorrect thoughts, feelings and behaviours.

Although LTP and LTD have opposite outcomes in that they result in persistent increased vs decreased synaptic excitability and one increases neurotransmitter release in presynaptic neurons and the other does not, there are a number of similarities. For instance:

- both are activity dependent i.e. more or less activity
- both involve glutamate
- both occur at glutamate synapses
- both involve changes in excitability
- both are long-lasting effects
- both are forms of long-lasting neural plasticity.

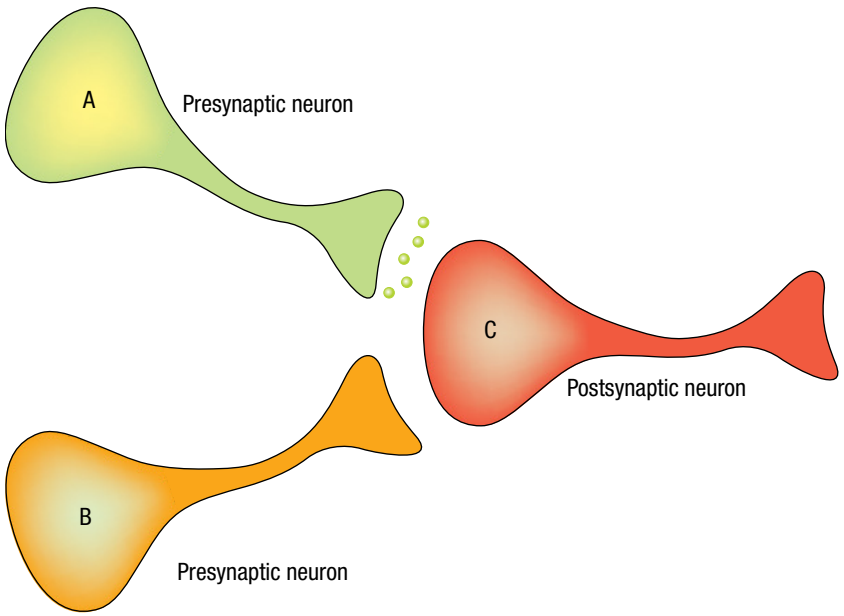

Figure 4.5 Long-term potentiation. The synapses between neuron A and neuron C and between neuron B and neuron C are initially weak. If neuron A fires and neuron C is activated immediately, and this occurs repeatedly for a sufficient number of times, neuron C will become more responsive to A than it was initially. This means that C will be more prepared to receive A's message (neurotransmitter) than B's message. In addition, the simultaneous activity between neurons A and C will grow and strengthen this synapse.

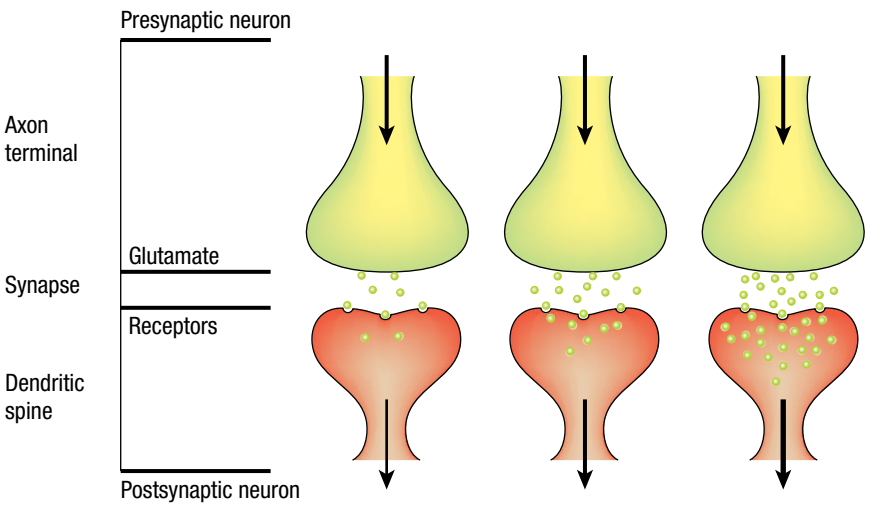

Figure 4.6 With LTP, there is an increase in the amount of neurotransmitter released by the presynaptic neurons, thereby enhancing communcation.

Although Hebb's rule, LTP and LTD are often described with reference to a pair of neurons, this is an oversimplification and it should be kept in mind that a single neuron in the human brain may have thousands of connections with other neurons, often in extremely complex ways. For example, a memory of a single bit of information may be stored within many connections, and each connection may be involved in several different memories. Thus, multiple memories may be stored within a single neural pathway, and have multiple synaptic connections. Similarly, a single memory may involve simultaneously activating several different groups of neurons in completely different areas of the brain so that the information can be brought into conscious awareness.

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Khan Academy presentation on LTP, LTD and neural plasticity 9m 39s

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BOX 4.1 Animal studies on neural plasticity

A series of experiments conducted with rats in the 1960s by American psychologist Mark Rosenzweig and his colleagues provided some of the earliest evidence that the brain can be altered when learning. Simply living in a complex environment where new learning was possible produced distinctive anatomical and chemical changes in the brains of rats.

In a typical experiment, laboratory-born rat pups of the same sex and from the same litter were randomly allocated to different environments shortly after weaning (at 25 days after birth). Within each environment, the rats had different experiences and opportunities for informal learning. The three most common environments were:

- Condition 1 — a 'standard' environmental condition in which a small group of three rats were kept in a standard laboratory cage and provided with food and water. This is the typical environment for laboratory rats.
- Condition 2 — an 'impoverished' environmental condition in which a single rat was housed in a standard laboratory cage
- Condition 3 — an 'enriched' environmental condition in which a group of ten to 12 rats were kept in a large cage containing a wide variety of stimulus objects, which were changed daily and provided opportunities for complex stimulation and informal learning.

All rats were kept in these conditions for 80 days. When their brains were dissected, those rats reared in the enriched environment were found to have developed a thicker and heavier cerebral cortex than had their littermates raised in the other two conditions, particularly the impoverished environment rats. Significant changes were also found to occur at the neuronal level, particularly at the synapse. The brains of rats reared in the enriched environment had larger neurons with longer and bushier dendrites, existing synapses were bigger and new synapses had formed. In addition, there was evidence of heightened neurotransmitter activity.

In later experiments, the researchers found that spending shorter periods in the enriched condition could produce similar changes in the cerebral cortex, and that the brains of both young and adult rats changed, although changes in the young were more pronounced than those of the adults. Furthermore, these changes occurred even when rats were not placed in the differing environments until well into adulthood (Rosenzweig, Breedlove & Leiman, 2002).

Other researchers who replicated or substantially varied Rosenzweig's experiments have obtained similar results. American psychologists Bryan Kolb and Ian Whishaw (1998) analysed the results of these types of studies and reported that the weight of rats' brains following exposure to an enriched environment, and therefore opportunities for new experiences, can increase by up to 10% and the number of synapses can increase by as much as 20%. These neural changes may provide a greater number and variety of connections in the brain, thereby increasing the brain's ability to effectively deal with a more cognitively demanding and complicated environment. For instance, there is research evidence that rats raised in complex environments are much better than control group animals in solving various maze-learning tasks (Banich, 2004).

Enrichment and impoverishment studies have been carried out with many other species, including monkeys, cats, birds, honey bees and even fruit flies. In all cases, enriched environments are associated with measurable changes in the brain (Kolb & Whishaw, 2014).

Can the conclusions drawn from studies on rats, monkeys and other animals be applied to human brains? Obviously, for ethical reasons, researchers cannot conduct experiments on the effects of enriched or impoverished environments on human brain tissue as they can with animals. However, there is a growing body of evidence from studies that have used other research methods indicating that the human brain also seems to benefit from enriched, stimulating environments. For example, autopsies have been conducted to study differences in the brains of university graduates with those who had dropped out of high school. The brains of university graduates had up to 40% more synaptic connections than those of early school-leavers (Hockenbury & Hockenbury, 2006).

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(continued from previous page)

Researchers have also conducted studies that have compared the life experiences of elderly people. The results suggest that a stimulating environment may delay the onset of some of the adverse effects associated with ageing. For example, in a long-term study of more than 5000 adults it was found that being involved in activities that are intellectually stimulating and challenging, both at work and at home, can reduce the risk of cognitive decline in old age, particularly earlier onset than might ordinarily occur. These activities include having a job involving a high level of complexity and a low level of routine, participating in continuing education such as a short course at a TAFE, having a habit of extensive reading, being active in social groups, and engaging in travel. Such an effect is also found when biological factors are controlled, or kept constant. For example, in a research study using sets of identical twins, one with a neurodegenerative disease (dementia) and one without, it was found that the twin with a low level of education (i.e. did not complete high school) and who tended not to be mentally active was more likely to get Alzheimer's disease (Banich, 2004).

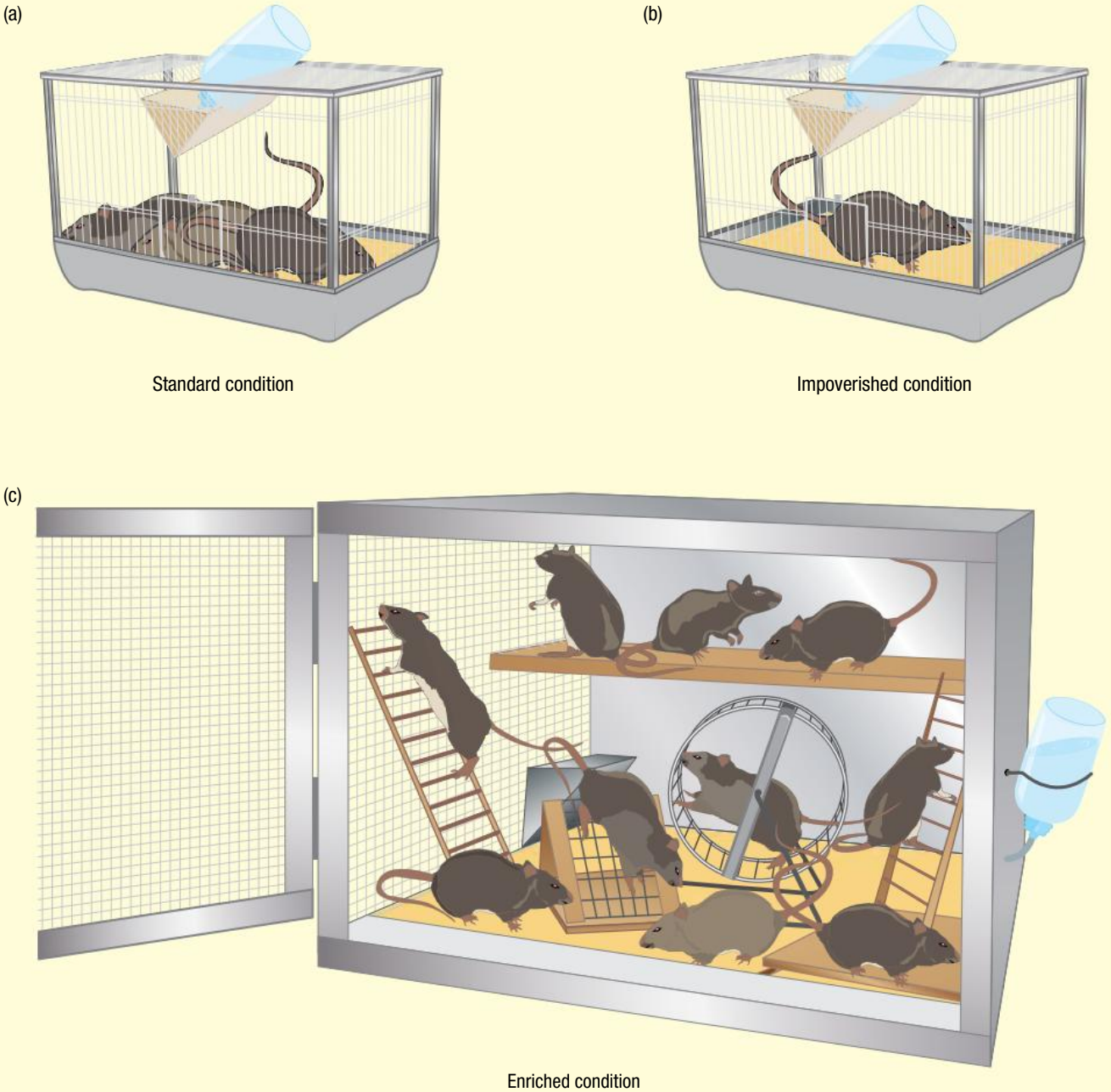

Figure 4.7 The three conditions in Rosenzweig's 1960s experiments.

LEARNING ACTIVITY 4.1

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Review questions

1. What is neural plasticity?
2. Explain the meaning of synaptic plasticity with reference to two examples of synaptic change.
3. (a) How does neural plasticity enable learning and memory?
   (b) Explain whether any learning or memory would be possible without neural plasticity.
4. Explain how learning and memory occur with reference to 'connections between neurons' and Hebb's rule.
5. To how many neural pathways might the memory of a single bit of information belong? Explain your answer.
6. Complete the following table to summarise similarities and differences between LTP and LTD.

Characteristic	LTP	LTD
Definition		
Neurotransmitter involved		
Where it occurs		
How it occurs		
Change in excitability (activation)		
How enduring		
Effect on neuronal communication		
Role in learning and memory		

7. Explain why LTP and LTD demonstrate neural or synaptic plasticity.
8. Why is LTP considered to be 'evidence' supporting Hebb's physiological explanation of learning?
9. Make a copy of Figure 4.5 (page 256) on LTP. Modify the drawing and caption to illustrate and explain LTD.
10. Briefly explain why learning and memory may be considered inseparable from:
    (a) a biological perspective
    (b) a psychological or behavioural perspective.

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LEARNING ACTIVITY 4.2

Reflection

Some psychologists who have adopted a biological perspective to the discipline describe learning and memory as processes of modifying existing neural pathways or building new neural pathways.

Considering the roles of learning and memory in shaping our identity, influencing our psychological development and supporting our adaptation to everyday life, is this a suitable description?

LEARNING ACTIVITY 4.3

Evaluation of research by Rosenzweig et al. on learning and neural plasticity

Consider the description of an experiment conducted by Rosenzweig and his colleagues in the 1960s summarised in Box 4.1 on the previous pages and answer the following questions.

1. Name the type of experimental research design.
2. Identify the operationalised independent and dependent variables.
3. Identify the experimental and control conditions (groups).
4. Why were the rats randomly allocated to different conditions?
5. Briefly state the results obtained.
6. Formulate a research hypothesis that could have been tested by the procedures used in the experiment and supported by the results obtained.
7. (a) List three synaptic changes attributed to the experimental procedure.
   (b) What three conclusions can be drawn about the relationship between experience and neural plasticity on the basis of the results obtained?
8. What are three other variables that the researchers tested in follow-up experiments?
9. To what extent can the results be applied to other animals? To people?
10. (a) What are two ethical issues of this type of research that prevent use of human participants?
    (b) Other than animal studies, how have researchers overcome ethical constraints for this type of research with people?

ROLE OF NEUROTRANSMITTERS AND NEUROHORMONES

Different neurotransmitters tend to have different roles in learning and memory. Researchers have yet to entirely isolate or explain every effect of each one. Generally, they all enable communication of the information being learned and initiate or contribute to important structural changes at the synapse that help ensure the memory is durable and long-lasting when formed. The neurotransmitter glutamate has been the target of considerable research. In this section we examine its role in synaptic plasticity that provides the neural basis of learning and memory.

Some neurohormones also have roles in learning and memory. Like neurotransmitters, **neurohormones** are chemical messengers that are manufactured by neurons and released from axon terminals. Unlike neurotransmitters, they are not released into the synaptic gap. Instead, they are released into capillaries (tiny blood vessels) where they are absorbed into the bloodstream and carried to target neurons or other cells. The effects of neurohormones can therefore be on distant cells or organs some time after their secretion, whereas neurotransmitters are released locally at a synapse and exert their effects on adjacent postsynaptic neurons within milliseconds if fast-acting (or up to minutes if slow-acting) (Thompson, 2000).

For example, the hypothalamus in the brain has neurons that produce different kinds of neurohormones. These are secreted into the blood and travel to the pituitary gland where they exert their effect. When we experience stress for a prolonged time, it is the neurohormone TRH that signals the pituitary gland to produce ACTH which then enters the bloodstream and travels down to the adrenal cortex where it stimulates secretion of cortisol and other corticosteroids.

Keep in mind that some neurotransmitters can also occur as neurohormones. In such cases, the neurotransmitter and neurohormone are essentially the same chemical substance. For example, epinephrine may be secreted by a neuron as neurotransmitter and adrenaline may be secreted by a neuron as neurohormone (as described on page 215). Consequently, neurotransmitters and neurohormones are best distinguished in terms of their *function* rather than their chemical structure. In the next section, we examine the role of adrenaline as a neurohormone in the consolidation of emotionally arousing experiences in memory.

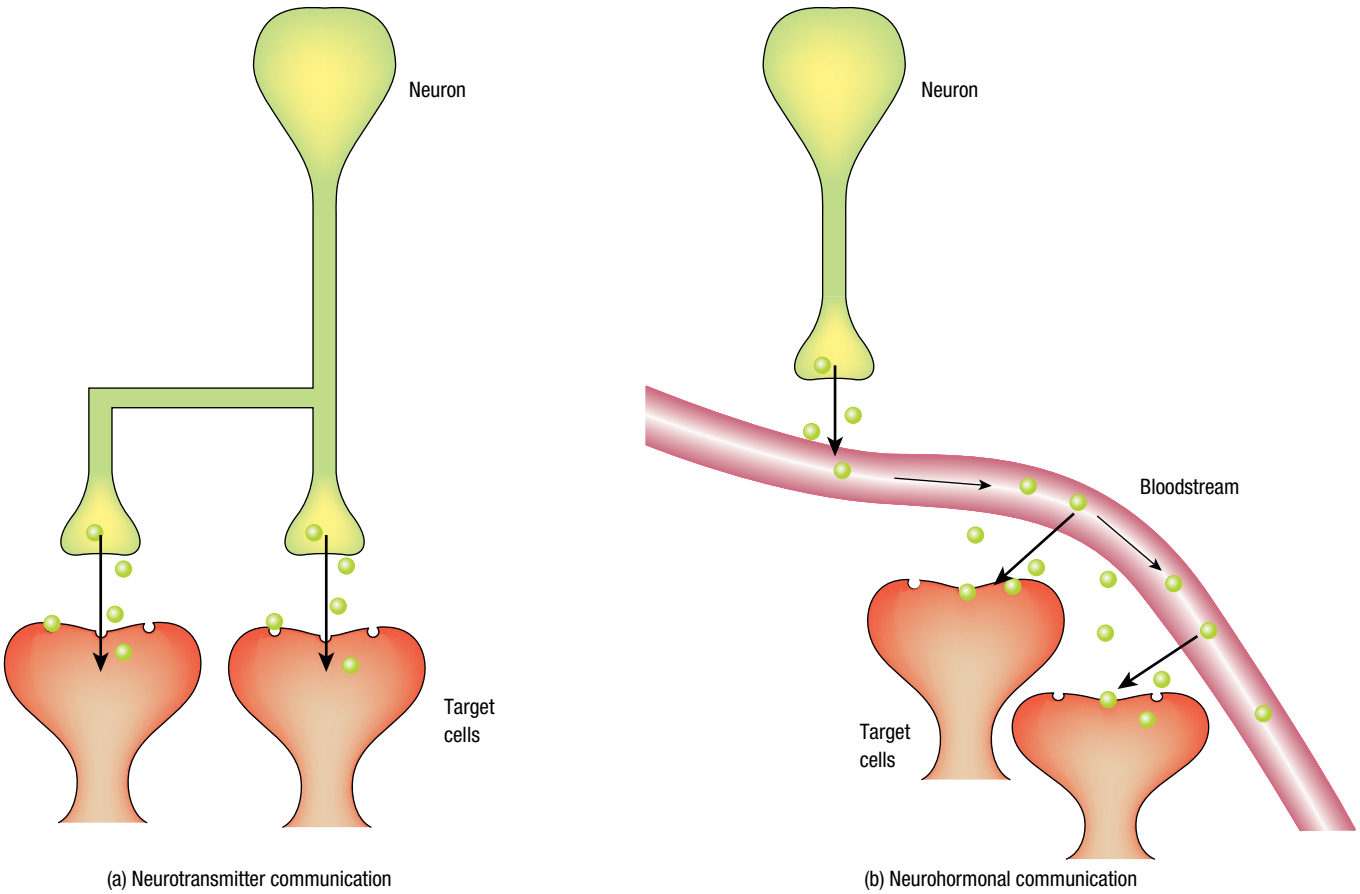

Figure 4.8 A comparison of neurotransmitter and neurohormonal communication. (a) Neurotransmitters are secreted into the synaptic gap and deliver their message to adjacent target cells, whereas (b) neurohormones are secreted into the blood for transport to target cells. Neurotransmission messages therefore travel rapidly, whereas neurohormone messages travel more slowly.

Role of glutamate in synaptic plasticity

When we learn, remember or engage in any other mental process or physical activity, neurons excite each other through the release of neurotransmitters. **Glutamate (Glu)** is the main excitatory neurotransmitter throughout the brain and enhances information transmission by making postsynaptic neurons more likely to fire.

In learning and memory, glutamate plays crucial roles in the synaptic changes that occur. In particular, it promotes the growth and strengthening of synaptic connections between neurons within a neural pathway that subsequently represents the memory of what has been learned.

LTP and LTD are important forms of synaptic plasticity that occur at synapses within several brain regions, particularly areas with significant roles in learning and memory (such as the cerebral cortex, hippocampus and cerebellum). Given glutamate's excitatory effect, it has a vital role in LTP and LTD. Generally, the more often that glutamate can excite an adjacent neuron, the more it contributes to LTP (and vice versa for LTD).

Specific types of glutamate receptors also have to be present on the dendrites of postsynaptic neurons for glutamate to have these effects. Two of these receptors are commonly called AMPA and NMDA and glutamate has to have an effect on both of them. Without these receptors at the specific sites where glutamate is received, any message carried in glutamate cannot be 'accepted' by a postsynaptic neuron (Gazzaniga, Ivry & Mungun, 2014; Zakharenko, Zablow & Siegelbaum, 2001).

Role of adrenaline in the consolidation of emotionally arousing experiences

Lasting memories are not created immediately at the time of a new experience. A period of time is required to ensure the experience becomes long-lasting when transferred to long-term memory for storage. Consolidation is the process by which this is achieved.

Consolidation

Consolidation is the biological process of making a newly formed memory stable and enduring after learning. Time is required after learning takes place to enable the new information to consolidate ('set') as a durable long-term memory. Consolidation is usually described as a process in its own right although some psychologists consider it to be part of the actual memory storage process.

New incoming information is temporarily stored in short-term memory before its transfer to long-term memory. Research evidence indicates that if consolidation is disrupted, new information may not transfer from short-term to long-term memory or will not be stored well in long-term memory if it arrives there. The outcome depends on the timing of the disruption. Consolidation appears to be a gradual process, and the information being remembered tends to be particularly vulnerable to disruption for at least 30 minutes following learning (Dudai, 2004).

The consolidation of information during transfer from short-term to long-term memory can be compared to writing your name in wet concrete. Once the concrete has set (the information has consolidated in long-term memory), your name (the information) is relatively permanently ingrained. But while it is setting (the process of consolidation), it can be interfered with (altered) or erased (completely lost).

Evidence in support of consolidation comes from studies of people who have experienced brain trauma resulting in memory failure or loss; for example, after suffering concussion or being knocked unconscious as a result of an accident, after acquiring certain diseases affecting the brain (such as encephalitis) or after receiving electroconvulsive therapy (ECT) as part of the treatment used in the more serious cases of depression. These people are frequently unable to report any memory of the events immediately before the accident or treatment, and in many instances they cannot remember anything that occurred during a period of about 30 minutes before the brain trauma (Breedlove, Rosenzweig & Watson, 2007; Squire & Kandel, 1999).

Other evidence for consolidation has come from research using animals. In one of the earliest and best known studies, researchers were interested in learning whether rats that were given ECT at various intervals after learning to run a maze would be able to remember the task they had learned.

In the 1960s, American psychologist William Hudspeth and his colleagues conducted an experiment using four groups of rats. ECT was administered to the rats in Group A immediately after they had learned the task, to Group B 20 seconds after learning, to Group C 30 minutes later and to Group D 60 minutes after learning. The results showed that consolidation of the experience occurred within about 60 minutes of the rats learning the task. None of the rats in Group A remembered the task they had learned. Those in Groups B and C showed partial retention (but Group C's retention was on average greater than that of Group B). All the rats in Group D remembered the task completely (Hudspeth, McGaugh & Thomson, 1964).

The hippocampus located deep within the brain has a crucial role in the consolidation of most of our memories. Once consolidated, memories are not

Figure 4.9 A severe blow to the head may disrupt consolidation and result in memory failure or loss. Eventually, any permanent memory loss is usually confined only to the contents of short-term memory during the time of the trauma since the information was never stored in long-term memory.

necessarily fixed. Whenever a memory is retrieved, it is open to further consolidation and has to be 're-stabilised' through the process called *reconsolidation*. If information in the original memory is changed, which is common when we rehash a memory, then the revised version is 'reconsolidated' (see Box 4.2 on page 265).

Consolidation is often described as comprising two phases — an initial rapid process for temporary storage, followed by a slower, more permanent process for long-term storage that may take days, weeks, months or years depending on such variables as the information, its storage requirements and how often the information is used (Gazzaniga, Ivry & Mungun, 2014).

Because consolidation is time-dependent, the process is exposed to various factors that can influence the strength or durability of the memory being formed during the consolidation period. One such factor involves stress hormones, particularly the adrenaline and cortisol secreted by the adrenal glands.

Figure 4.10 Administration of an electric shock after maze learning by rats enhanced understanding of consolidation and indicated it was a time-dependent process.

Role of adrenaline

There is considerable research evidence that adrenaline has an important role in the consolidation of specific types of memories. In particular, adrenaline can *enhance* the consolidation of long-term memories of *emotionally arousing experiences*. This means that these types of events are more likely to be well remembered (but not necessarily more accurately). In contrast, consolidation can be disrupted by brain trauma.

You probably know from personal experience that emotionally significant experiences tend to be well remembered. This is very common for both pleasant and unpleasant events.

Significant stress-inducing events are often unpleasant experiences that are emotionally arousing. They typically leave memories that are lasting, vivid and highly detailed from a personal perspective. For example, being a victim of a crime or a natural disaster will be remembered much better than the experiences of a routine day. Many years later, people can remember details about where they were, what they were doing, who they were with and what their emotional reaction was to the event. Memories of pleasant occasions that were emotionally arousing, such as a first kiss, first date, a wedding, or specific birthdays and holidays also tend to be well-retained.

When released during heightened emotional arousal, adrenaline induces the release of noradrenaline (also called norepinephrine) in the amygdala, which is located deep within the brain and has a crucial role in processing emotions. It is believed that the presence of noradrenaline during consolidation may then activate the amygdala to signal to the nearby hippocampus that details of the relevant experience are significant and its long-term storage should be strengthened. There is also interaction between the amygdala and other brain regions, so it is likely these are also involved in the consolidation process (Hamann, 2009; LeDoux, 2008; Phelps, 2004).

The exact way in which adrenaline as a neurohormone affects consolidation, either in isolation or together with other stress hormones, is not yet fully understood and is subject to further research. Nor is it fully understood how the amygdala actually interacts with the many other brain regions to which it is connected in order to strengthen the memory of an emotionally arousing experience. In addition, there is evidence that there may be an optimal level of adrenaline to enhance memory consolidation. Moderate doses seem to enhance consolidation, whereas lower or higher levels are less effective. Higher levels may even impair memory consolidation (Gazzaniga, Ivry & Mungun, 2014; Roozendaal, McEwen & Chattarji, 2009).

Research studies have also found that the strength of memories of events varies with the emotional significance of the events. The more emotionally significant the event to an individual, the longer-lasting its memory is likely to be and the more detail that will be recalled (and vice versa). For example, participants given a drug that promotes release of adrenaline when viewing emotionally arousing images will tend to have an enhanced memory of those images compared to control or placebo groups. Conversely, participants given a drug that inhibits the release of adrenaline later tend to have more trouble remembering details of the images (Cahill, et al., 1994).

Figure 4.11 Significant stress-inducing events may be pleasant or unpleasant experiences as either type can be emotionally arousing. They typically leave memories that are lasting, vivid and highly detailed.

Some psychologists have proposed that longer-lasting memories of emotionally arousing experiences, particularly for important or threatening events, has adaptive value as these memories can guide our behaviour in appropriate ways in the future. The ability to remember consequences can keep us from making the same mistakes again. For example, there is a greater chance of survival when we (and animals) remember situations that are dangerous and therefore need to be avoided. It may also be advantageous when we find ourselves in a dangerous situation and can remember exactly how we got into that situation and how we got out of it (McGaugh, 2013; McIntyre & Roozendaal, 2007).

The number of life-threatening, traumatic situations that are ordinarily encountered by most people has been greatly diminished in our modern world. Because of this, a mechanism that once may have kept us alive can become a hindrance more than a help. For example, people suffering from posttraumatic stress disorder are often haunted by memories and images of highly arousing, emotionally traumatic events to a point where it becomes unbearable. The ordeal they underwent keeps resurfacing over and over again. Each time the event resurfaces, adrenaline may be released, thereby maintaining the strength of the memory each time it is reconsolidated (Shenfield, 2013).

Adrenaline and amygdala-hippocampus interaction during emotionally arousing situations do not necessarily account for all the effects on consolidation and the enduring nature of arousal events. By their very nature, emotionally arousing events are more distinctive and unusual than everyday life events. Their novelty puts them in a special category of events quite unlike routine everyday events. They tend to be recalled more often than routine events so their neural pathways are also activated more often. These and other variables may influence their consolidation in ways that do not depend on adrenaline, noradrenaline or the amygdala (Gazzaniga, Ivry & Mungun, 2014; Roozendaal, Barsegyan & Lee, 2008).

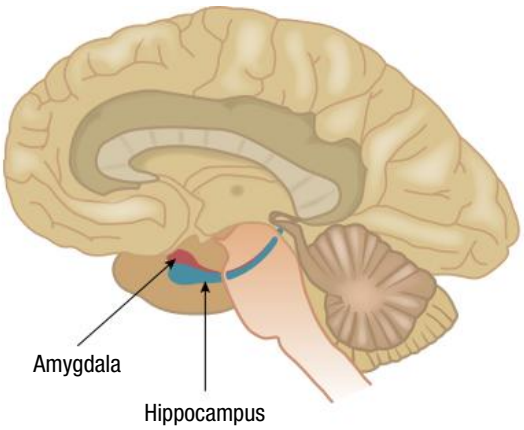

Figure 4.12 The amygdala and hippocampus are located near one another, deep within the brain, beneath the cerebral cortex.

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Joseph LeDoux presentation on the role of the amygdala in emotional memories 3m 24s

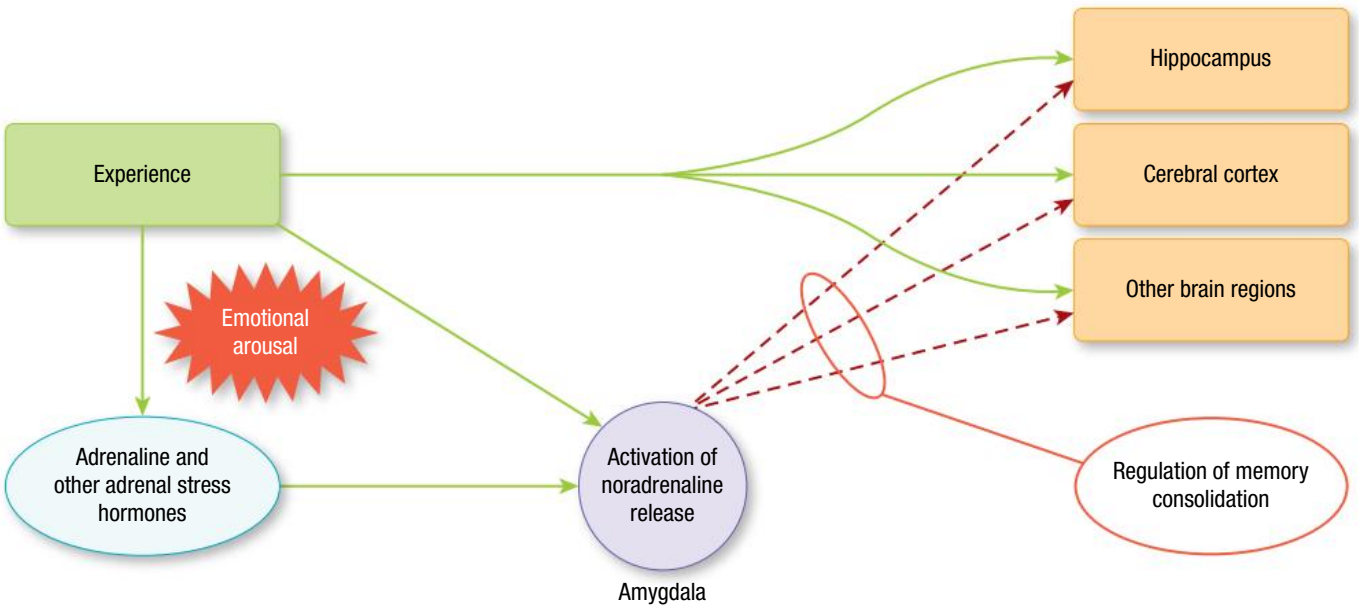

Figure 4.13 How memory consolidation of emotionally arousing experiences may occur. During periods of emotional arousal, stress hormone systems interact with the amygdala to regulate memory consolidation and storage processes occurring in other brain regions. Experiences can also be consolidated and stored in various brain regions with little or no involvement of stress hormone activation.

Source: Adapted from: McGaugh, J.L. (2006). Make mild moments memorable: add a little arousal. *Trends in Cognitive Science, 10*(8), 345–347.

BOX 4.2 Reconsolidation

It is believed that after a memory is retrieved from long-term memory it needs to be consolidated again in order to be stored back there. This process is known as *reconsolidation*.

According to American psychologists Michael Gazzaniga and Todd Heatherton (2006), evidence for reconsolidation has been obtained in studies with rats that were injected with drugs that interfered with memory storage following its retrieval. The rats were unable to reliably or accurately recall the information that was once stored in long-term memory. This suggests that memories for past events can be affected by new circumstances once they are retrieved, so that the newly reconsolidated memories may differ from their original versions.

This is similar to what would happen if you took a book out of the library and some pages were torn out before it was returned. The book that is placed back on the shelf is slightly different to the one that was taken out — the information contained in those torn-out pages is no longer available for retrieval.

The reconsolidation process is believed to repeat itself each time a memory is retrieved and placed back in storage, which may explain why our memories for events can change over time. For example, we frequently recall memories, rehash them, and integrate them with new information. In addition, we will integrate our revised, reconsolidated memories within our lifetime of stored memories.

The concept of reconsolidation has received considerable attention by researchers because it not only has implications for what it means to remember something, but it also opens up the possibility that bad memories could be altered or even erased by activating them and then interfering with reconsolidation. It seems that reconsolidation does occur, at least for some types of memories. However, much research on this memory process remains to be done.

Figure 4.14 Reconsolidation raises the possibility of intentionally altering or even erasing unwanted memories.

LEARNING ACTIVITY 4.4

Review questions

1. (a) What is a neurohormone?
(b) What are two characteristics that neurohormones have in common with neurotransmitters?
(c) What are two characteristics that distinguish neurohormones and neurotransmitters?
(d) Give an example of a substance that occurs as both a neurohormone and a neurotransmitter.

2. (a) Explain the role of glutamate in synaptic plasticity, ensuring you refer to LTP and synaptic connections.
(b) How does glutamate contribute to learning and memory?

3. (a) What is memory consolidation?
(b) Explain, with reference to consolidation, why a footballer who is knocked unconscious during a game may be unable to remember how that occurred.
(c) Jen and Sam were in a car accident. Jen was not wearing a seat belt, hit her head on the dashboard and was knocked unconscious for about a minute. Sam was wearing a seat belt and was not injured. Police arrived about half an hour after the accident and interviewed all involved.
i. Will Jen or Sam be more likely to recall how the accident occurred?
ii. Explain your answer with reference to consolidation theory.

4. (a) Formulate a research hypothesis for the experiment conducted by Hudspeth, McGaugh and Thomson (1964) which is described on page 261.
(b) Identify the operationalised independent and dependent variables.

5. (a) Why is memory consolidation vulnerable to the effects of adrenaline?
(b) What is the overall effect of adrenaline on consolidation of emotionally arousing experiences and how does this affect recall of those events?
(c) Briefly outline the role of adrenaline in the effects described in part b.
(d) What are three potential confounding variables requiring control in experiments on the role of adrenaline in the consolidation of emotionally arousing events?

6. (a) What is reconsolidation?
(b) Suggest how reconsolidation may be manipulated to change someone's memory of an event.

7. A friend who is not studying Psychology asks you to explain the neural basis of learning and memory. What five key points would you provide in your explanation?

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LEARNING ACTIVITY 4.5

Reflection

The tendency of traumatic experiences to persist in memory can be debilitating rather than useful. Comment on whether this justifies the development of medications to erase unwanted or inappropriate memories, giving examples of how such medications could be used and abused.

LEARNING ACTIVITY 4.6

Role play on the neural basis of learning and memory

Working in a group of five or six, prepare a role play demonstrating synapse formation in learning and memory, the strengthening of neural connections through use, then weakening through disuse. During your presentation, name or refer to as many of each of the following concepts as possible: presynaptic neurons, postsynaptic neurons, axon terminals, dendrites, glutamate, receptors, LTP, LTD and consolidation. Ensure each anatomical feature and biological process can be clearly distinguished and understood by other members of the class.

LEARNING ACTIVITY 4.7

Flow chart on the neural basis of learning and memory

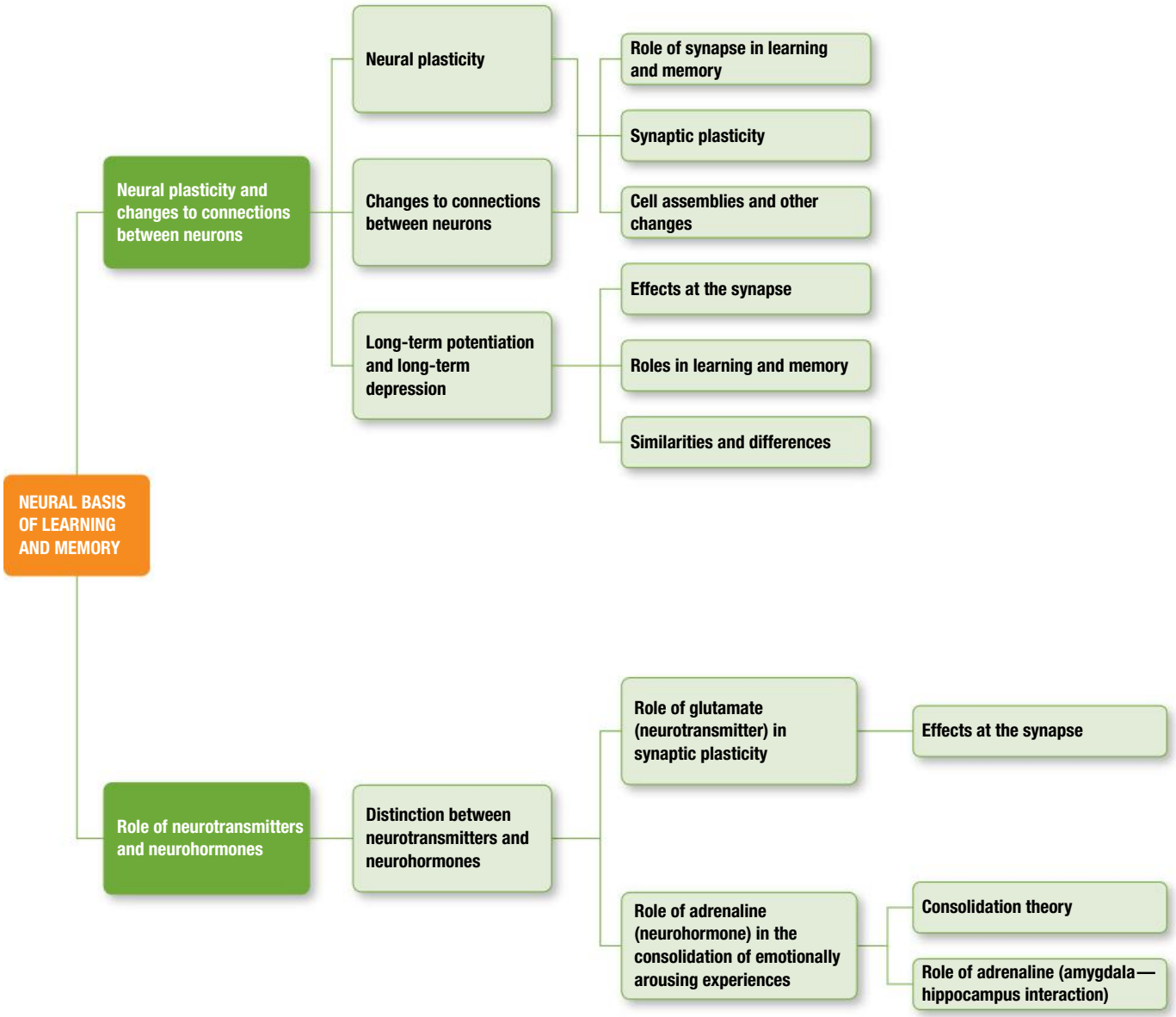
Create a flow chart that clearly outlines the neural basis of learning and memory.

In your chart, ensure that you:

- show changes at the synapse when learning and memory occurs (e.g. synapse formation)
- show the modification of a neural pathway for learning (and its associated memory)
- show the creation of a new neural pathway for learning (and its associated memory)
- demonstrate and briefly explain (e.g. in point form) the roles of neural plasticity, connections between neurons (including synapse formation and neural pathways), glutamate, long-term potentiation, long-term depression and consolidation
- demonstrate a possible role of adrenaline
- label all relevant anatomical structures and features and describe the roles of key structures and features.

In preparing your chart, base the presentation on learning of new knowledge or a specific new skill.

CHAPTER SUMMARY



KEY TERMS

adrenaline p. 263
amygdala p. 263
cell assembly (neural pathway) p. 254
consolidation p. 261
emotionally arousing p. 263
glutamate p. 261
hippocampus p. 261
learning p. 252
long-term depression (LTD) p. 255
long-term potentiation (LTP) p. 255
memory p. 252
neural plasticity p. 253
neurohormone p. 260
neuronal activation (excitability) p. 261
neurotransmitter p. 260
noradrenaline (norepinepherine) p. 263
postsynaptic neuron p. 255
presynaptic neuron p. 255
receptor p. 261
synapse p. 254
synaptic connection p. 254
synaptic plasticity p. 254

LEARNING CHECKLIST

Complete the self-assessment checklist below, using ticks and crosses to indicate your understanding of this chapter's key knowledge (a) before and (b) after you attempt the chapter test on pages 269–71. Use the 'Comments' column to add notes about your understanding.

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Word copy of checklist

Key knowledge I need to know about the neural basis of learning and memory	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
Neural plasticity and changes to connections between neurons			
Neural plasticity			
Synaptic plasticity			
Types of changes at the synapse i.e. to connections between neurons			
Long-term potentiation (including role in learning and memory)			
Long-term depression (including role in learning and memory)			
LTP and LTD similarities and differences			
Role of neurotransmitters and neurohormones			
Distinction between neurotransmitters and neurohormones			
Role of glutamate neurotransmitter in synaptic plasticity (including effects at the synapse)			
Role of adrenaline neurohormone in the consolidation of emotionally arousing experiences			
• Consolidation theory			
• Role of adrenaline			
• Amygdala-hippocampus interaction			

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Unit 4 › Area of study 1 › Topic 1

Concept screens and practice questions

CHAPTER 4 TEST

SECTION A — Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Question 1

Where are memories most likely stored?

A. in a synapse
B. in glutamate
C. in a presynaptic neuron
D. in a postsynaptic neuron

Question 2

Neurohormones

A. are manufactured during synaptic plasticity.
B. are manufactured by the endocrine system.
C. communicate messages to dendrites.
D. communicate messages slower than neurotransmitters.

Question 3

When learning and memory occur

A. neurons change in structure and function.
B. there is an increase in the amount of synapses produced by neurons, thereby enabling them to flow more freely within a neural pathway.
C. new neurotransmitters grow and interconnect the neurons to form a pathway for the information.
D. neurons assemble in a formation that creates a neural pathway for the learning and its subsequent memory.

Question 4

Long-term potentiation is

A. the potential to learn and remember.
B. the potential to form a long-term memory.
C. the long-lasting release of glutamate at the synapse.
D. the long-lasting strengthening and efficient functioning of synaptic connections.

Question 5

If long-term potentiation is to occur between two neurons, then

A. the two neurons must be activated simultaneously.
B. the two neurons must be connected within a neural pathway.
C. the existing connection between the two neurons must be weak.
D. the existing connection between the two neurons must be strong.

Question 6

Long-term potentiation and long-term depression are _____ dependent processes.

A. time
B. activity
C. learning
D. learning and memory

Question 7

During chemical communication within the brain, neurohormones and neurotransmitters are both secreted from

A. the hypothalamus.
B. the pituitary gland.
C. synapses.
D. axon terminals.

Question 8

Which of the following statements about learning is not true?

A. Learning causes changes at the synapse.
B. Learning can create new neural pathways.
C. Learning causes weakening of synaptic connections.
D. Learning can reorganise neural pathways.

Question 9

Long-term potentiation and long-term depression cannot occur during learning unless

A. the organism also wants to remember the new information or skill.
B. the neurons involved in establishing a pathway already have synaptic connections.
C. prolonged simultaneous activity occurs in either adjacent presynaptic or postsynaptic neurons.
D. prolonged simultaneous activity occurs in both adjacent presynaptic and postsynaptic neurons.

Question 10

Simultaneous firing of two adjacent neurons makes those neurons

A. more inclined to fire together in the future.
B. less inclined to fire together in the future.
C. rearrange their connections.
D. prune connections that cannot adapt to the activity.

SECTION B

Answer **all** questions in the spaces provided. Write using blue or black pen.

Question 1 (2 marks)

Neurohormones secrete into the _____, whereas neurotransmitters secrete into the _____.

Question 2 (2 marks)

Describe the roles of the neuron and neurotransmitter as mechanisms of learning and memory.

Question 3 (4 marks)

(a) When considered from a neuronal perspective, no two human brains are identical. Explain why, with reference to neural changes associated without learning. 2 marks

(b) Explain how neural plasticity makes learning and memory possible. 2 marks

Question 4 (8 marks)

(a) What is synapse formation (or growth) and what role does it play in learning and memory? 2 marks

(b) Describe the role of glutamate and glutamate receptors in synapse formation. 2 marks

(c) Explain how long-term potentiation and long-term depression influence synapse formation. 4 marks

Question 5 (3 marks)

Explain the meaning of the phrase 'learning and memory involve the building of neural pathways in the brain', ensuring you refer to Hebb's rule.

Question 6 (6 marks)

An experiment found that rats remembered the place in an apparatus where they received electric shocks to a foot for much longer and better than rats that did not receive foot shocks.

Explain this finding with reference to the role of adrenaline in the consolidation of emotionally arousing experiences.

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The answers to the Section A multiple-choice questions are in the answer section at the end of this book and in eBookPLUS.
The answers to the Section B questions are in eBookPLUS.

5 MODELS TO EXPLAIN LEARNING

KEY KNOWLEDGE

- classical conditioning as a three-phase process (before conditioning, during conditioning and after conditioning) that results in the involuntary association between a neutral stimulus and unconditioned stimulus to produce a conditioned response, including stimulus generalisation, stimulus discrimination, extinction and spontaneous recovery
- operant conditioning as a three-phase model (antecedent, behaviour, consequence) involving reinforcers (positive and negative) and punishment (including response cost) that can be used to change voluntary behaviours, including stimulus generalisation, stimulus discrimination and spontaneous recovery (excluding schedules of reinforcement)
- observational learning as a method of social learning, particularly in children, involving attention, retention, reproduction, motivation and reinforcement
- the 'Little Albert' experiment as illustrating how classical conditioning can be used to condition an emotional response, including ethical implications of the experiment.

Source: ©VCAA, VCE Psychology Study Design (June 2017 update), p. 25.

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Learning is commonly defined as a relatively permanent change in behaviour that occurs as a result of experience. It is an ongoing process that continues throughout the lifespan, enabling us to adapt and cope in an ever-changing world. Learning can occur *intentionally*, such as when someone takes piano lessons, or *unintentionally*, such as when watching or hearing someone else playing the piano. Similarly, learning can be *active*, such as when reciting multiplication tables, or *passive*, such as when hearing about Australia's performance in the Olympic Games.

The concept of *change* is an important part of the definition of learning, because something must be different about an organism after learning has taken place. The change in behaviour may be immediate (e.g. changing a tennis serve immediately after a coach suggests a way to improve it), or it may be delayed and actually occur some time after learning has taken place (e.g. changing a tennis serve the next time you play tennis after watching an instructional video). Furthermore, the change may be possible but not evident because of a lack of opportunity (e.g. by watching a tennis pro serving on TV you know how to improve your serve but you never again play tennis). Consequently, learning refers to the potential to behave in a particular way, as well as behaviour that is observed to take place.

Learned behaviour is also defined as *relatively permanent* because it cannot be something that is present one moment and gone the next, or 'here today and gone tomorrow'. It must have a continuing or lasting effect for a period of time, but it does not necessarily have to produce a permanent (lifelong) change. Thus, information you recalled when correctly answering a question in a SAC test a week ago is said to have been learned even if you cannot recall that information now. Learning is regarded as *relatively* permanent because most, if not all, learned behaviours can be modified. For example, someone who has learned to fear spiders can subsequently learn not to fear them.

Temporary changes in behaviour that are caused by illness, prescription and illegal drugs, injury, fatigue and alcohol and other substances are not classified as learning. Such changes in behaviour tend to be brief compared with those that result from learning. For example, the effects on behaviour of a sleepless night will typically wear off after a night or two of rest. Similarly, the effects of medication will usually disappear after a certain period.

Psychologists have developed many different models and theories to describe and explain human learning in terms of psychological processes. Most of these are based on studies involving observations of the learning experiences of animals in laboratory experiments. Through such studies, psychologists have identified many principles of learning that apply across a wide range of species, including humans. Collectively, the models indicate that there are many ways that we learn and that different types of learning share common elements. The models also suggest that how we learn can vary from situation to situation and from individual to individual. We may also shift between different types of learning depending on personal factors, what we are learning and the context in which the learning is occurring.

Figure 5.1 Distinguishing between behaviour that is learned and not learned. (a) This child is learning through experience and the associated change is likely to be relatively permanent following appropriate practice. (b) The automatic, involuntary reduction of the size of the pupil (within the coloured iris) in response to light is an inborn reflex response that is not learned. (c) Some behaviour is the result of maturation rather than learning as it depends on the development of the body and nervous system structures. Most infants throughout the world sit erect without support at around six months of age. This behaviour will occur automatically when the opportunity arises and the time at which it emerges and the way it emerges appears to be programmed in the individual's genes. No amount of practice will hasten the onset or significantly influence its course of development.

One of the most basic learning processes involves linking two events that occur close together. **Conditioning** is the process of learning associations between a stimulus in the environment (one event) and a behavioural response (another event). For example, associating a smile with friendly behaviour and associating working at a supermarket with getting paid involve learning through conditioning by linking events that occur together. A conditioned response is any type of learned response. Similarly, anything can be a stimulus, as long as our senses can detect it. For example, it can be a phone, light, insect or house, a sound, an odour, a puff of air, a touch, a change in temperature, an event we see happening or an event we read or hear about.

The term 'conditioning' is often used interchangeably with 'learning', but conditioning is more to do with the learning process; that is, *how* the learning occurs. However, as well as being considered as an element of other types of learning, conditioning is viewed by many psychologists as a type of learning in its own right.

The two main types of conditioning on which psychologists have tended to focus are classical conditioning and operant conditioning. In *classical conditioning* we learn that two events go together after we experience them occurring together on a number of occasions; for example, walking in the rain and getting wet. In *operant conditioning* we learn by forming a three-way association between a specific stimulus, a response and the consequence of the response. Therefore, in response to an upcoming VCE exam (the stimulus), we are likely to repeat behaviour (studying) associated with a satisfying consequence (a good grade). Conversely, the upcoming exam (the stimulus) will also make us more likely to avoid behaviour (partying) associated with an unsatisfying consequence (a bad grade).

Other types of learning that are similar to and different from classical and operant conditioning in varying degrees have also been described and explained. For instance, we can learn by watching and/or listening to others. This is called *observational learning* and reflects the widely held belief that learning involves cognitive processes that often occur in a social context, as well as associations between behaviour and consequences. Unlike classical and operant conditioning, the observational learning model is primarily based on studies with people, particularly children.

In this chapter, we examine each of these three models that have been used to describe and explain learning. We start with classical conditioning, which was first reported at the end of the 19th century.

BOX 5.1 Measuring learning by observing performance

Like intelligence, personality, memory, consciousness and many other psychological characteristics and processes, learning is a *psychological construct* — a concept used to describe or explain something that is believed to exist or occur but cannot be directly observed or measured. Because it is not possible to observe or measure learning actually taking place during the learning process, psychologists observe externally expressed, overt behaviour, or *performance*, to gain an understanding of what is occurring. Inferences are then made about the learning that has (or has not) taken place. For example, it is not possible to see learning take place as you read this book. In this case, the change referred to as part of the definition of learning may not be immediately evident. But a test of your recall of the material (such as your performance on a test) will provide information about whether learning has occurred and how much learning has taken place.

The measurement of performance on a learning task can be plotted on a graph to produce what is referred to as a *learning curve*. A learning curve shows the increase in performance that occurs over the period of time the task is practised. Typically, learning progresses slowly at first, then it speeds up, and finally slows down (or levels off) again. When learning something for the first time, we may experience a *plateau*; that is, a period of limited progress in the learning process. This is represented on a learning curve by a 'flat spot' or a horizontal section of the graph. Of course, a plateau may also indicate that learning is complete.

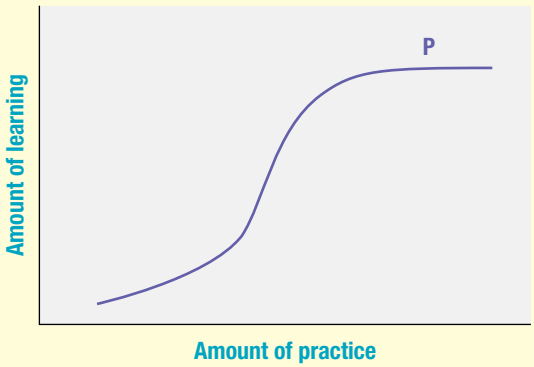

Figure 5.2 This graph represents an ideal S-shaped learning curve. It shows the *amount of learning* plotted against the *amount of practice*. The point marked P indicates a plateau, or period of little progress, in learning.

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Practical activity
Measuring the effect of practice on performance (generating a learning curve)

CLASSICAL CONDITIONING

What do the following three people have in common: Annie, a former cigarette smoker who always has the urge to light up a cigarette whenever she has coffee; Samir, who will no longer travel anywhere by plane after his previous two interstate flights were caught in a violent thunderstorm; and Jack, who broke up with his girlfriend a year ago but still feels sad whenever he catches sight of her? The answer is classical conditioning. Annie, Samir and Jack have all changed their behaviour by learning through classical conditioning, sometimes called *respondent conditioning*.

Classical conditioning was first described by Russian physiologist Ivan Pavlov in 1899 while he was conducting research into the digestive system of dogs. Pavlov was particularly interested in the role of salivary secretions in the digestion of food and was awarded the Nobel Prize in Physiology or Medicine in 1904 for his work in this field. He used apparatus like that shown at right to measure the amount of saliva produced when a dog ate. The flow of saliva occurred naturally whenever food (meat powder) was placed in the dog's mouth, as salivation is an involuntary reflex response.

To minimise the influence of potential confounding variables, the dog was restrained in a harness that held it in the desired position (as shown in Figure 5.5). Food (meat powder) was placed directly on the dog's tongue or in its bowl. A tube was surgically attached to the dog's cheek near one of the salivary glands. As shown below, this drained saliva straight out into a type of test tube that enabled precise measurements of the amount of saliva secreted.

Figure 5.4 This sketch shows the simple apparatus used by Pavlov to collect the dog's saliva in his initial experiments.

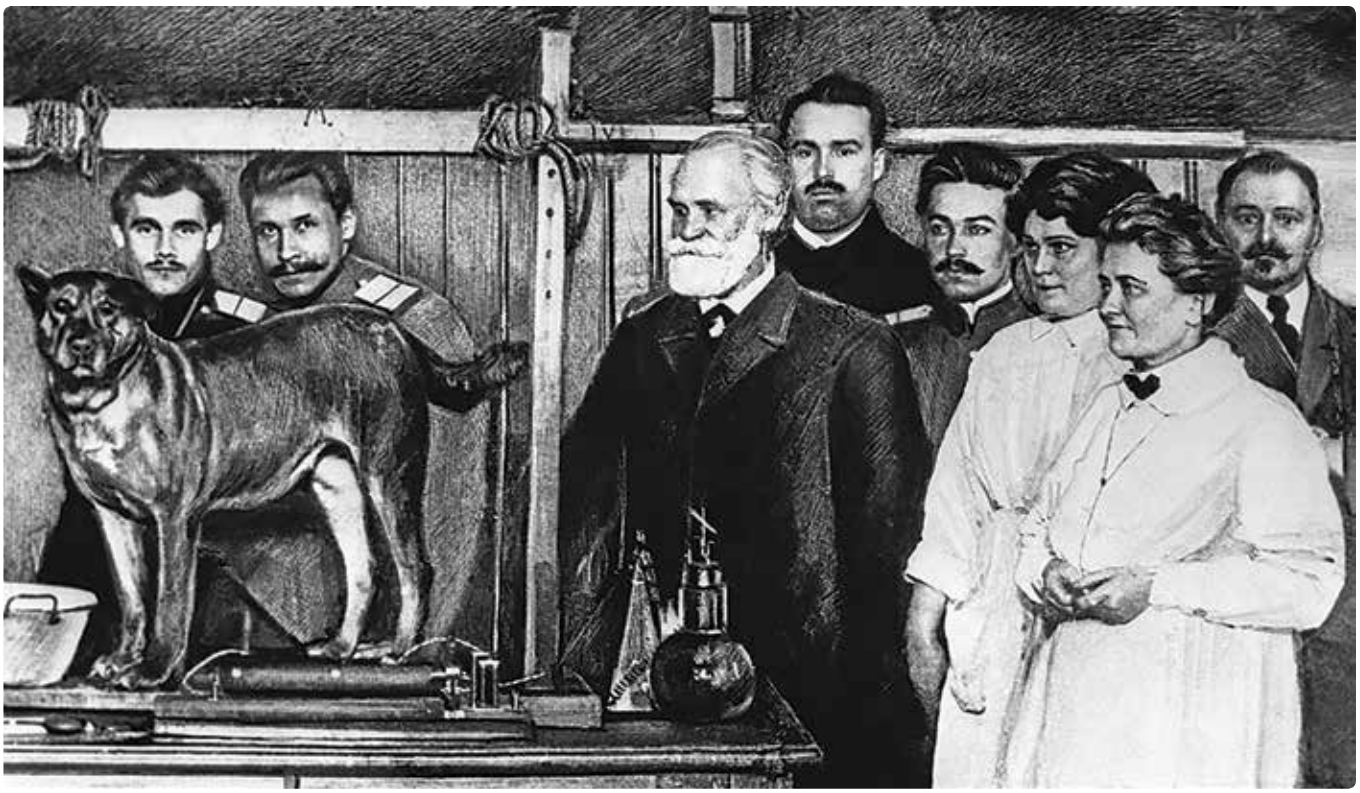

Figure 5.3 Ivan Pavlov (1849–1936) and some of his research colleagues

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Video on Pavlov's experiments 3m 54s

In later experiments, more sophisticated measuring devices were used, some of which measured the rate (speed) of the saliva flow as well as the quantity produced. The dog was observed using a series of mirrors, as shown below, so that it could not see or be distracted by the observer.

In the course of his research, Pavlov observed that the dogs salivated not only at the sight of the food and when food entered their mouths, but also at the sight or sound of the laboratory assistant who had been preparing their food. For example, the dogs salivated when they heard the rattling sound of the spoon against the container as the food was being prepared. These unintentional observations intrigued Pavlov and he decided to conduct further experiments under controlled conditions in order to systematically investigate the dogs' behaviour.

Pavlov's subsequent experiments provided clear evidence of a type of learning that occurred through association of two different stimuli. In relation to learning, a **stimulus** is any object or event that elicits (produces) a response from an organism. A **response** is a reaction by an organism to a stimulus.

In Pavlov's experiment, the stimulus of *food* initially produced the response of *salivation*. Eventually, however, the sight or sound of the laboratory assistant became the stimulus that produced the salivation response. The salivation response is controlled by the autonomic nervous system so it occurs involuntarily. It is a reflex response over which the dog has no control. Salivation had become associated with, and conditioned to, a new stimulus — the sight or sound of the laboratory assistant. This new stimulus was originally a 'neutral' stimulus because it did not produce any specific response other than attention when the laboratory assistant was seen or heard before he was associated with food. The process through which the dog learned to associate the sight or sound of the laboratory assistant with food is basically the process of classical conditioning.

Classical conditioning refers to a type of learning that occurs through the repeated association of two (or more) different stimuli. Learning is only said to have occurred when a particular stimulus consistently produces a response that it did not previously produce. Learning results from the involuntary linking of this stimulus, over a number of trials, with a stimulus that normally produces the response automatically. In classical conditioning, a response that is automatically produced by one stimulus becomes associated, or linked, with another stimulus that would not normally produce this response.

In later experiments, Pavlov varied the stimulus that had been conditioned to test whether it would still produce the same response (salivation). He found that the salivation response could be brought on after repeated associations of the meat powder with a range of different stimuli such as a bell, the musical tone of a tuning fork, a light, a tug on the hind leg or even the sight of a circle.

studyon

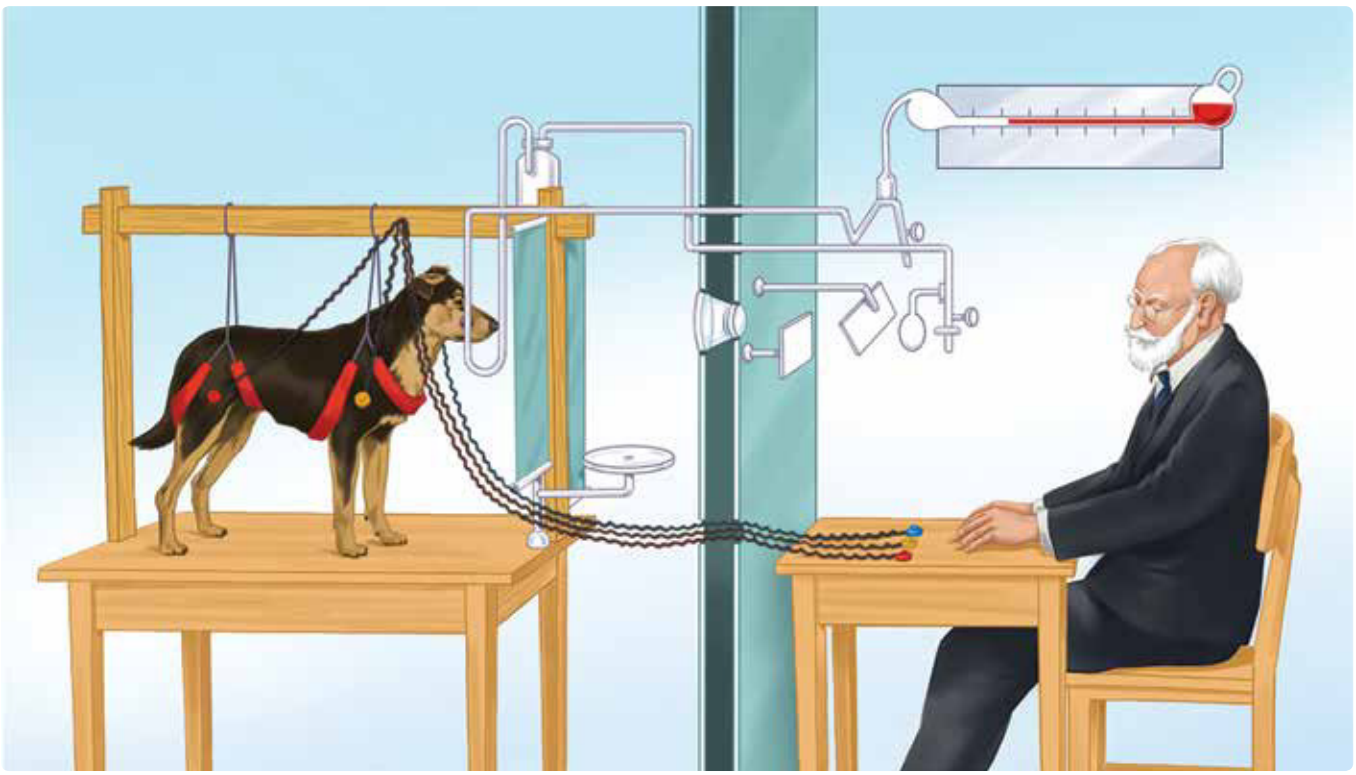

Figure 5.5 This sketch of Pavlov's apparatus is reproduced from one that appeared in his published lectures and shows a more elaborate saliva-measuring device than that used in his earlier experiments (as shown in Figure 5.4).

BOX 5.2 Habituation — the simplest type of learning

A sudden, unexpected noise usually startles us and causes an orienting response. When the orienting response occurs, we become alert and turn our head towards the source of the sound. However, if the same noise occurs over and over again, we gradually cease to respond to it until we ignore it altogether. This is an example of *habituation* — learning not to respond to a stimulus that occurs repeatedly. With habituation, the response to an unchanging stimulus weakens or decreases over time. Consequently, it is often described as a type of 'non-associative' learning because it does not involve the association of two stimuli to produce behaviour change.

Habituation is often described as the simplest of all forms of learning and reflects the fact that an organism has become familiar with or accustomed to a particular stimulus over time, usually without awareness or any intention to learn.

Habituation may occur with all our senses and is evident for many everyday events. For example, people living near main roads in the Melbourne suburbs become habituated to the noise of passing traffic but can be woken early in the morning by the sounds of birds when they take a holiday in the country. Similarly, when you first put on a shoe, you 'feel' it on your foot, but very shortly it is as if the shoe is no longer there and you ignore the sensation of pressure on your foot. However, you do not develop an 'insensitivity' to the sensation. You stop noticing the 'feel' of the shoe and habituate to it. If later in the day someone steps on your foot, you will still feel the pressure.

Habituation is observed among almost all animal species. Even animals with very primitive nervous systems are capable of habituation. For example, if you tap the shell of a snail with a pencil, it will withdraw its body into its shell. After a while, it will extend its body out of its shell and continue with whatever it was doing. If you tap again it will again withdraw, but this time it will tend to stay within its shell a shorter time. After several repetitions, it will eventually stop responding to the tap. The organism will have habituated.

Consider how distracting it would be to have your attention diverted every time a common noise occurred. Habituation is believed to be adaptive — it allows us to ignore a stimulus that has no significance and to focus our attention on more important things, relatively free from distraction.

Habituated learning typically occurs without conscious awareness and therefore also involves memories which we can recall without conscious awareness. Consequently, memories based on this simple form of learning are considered to be 'implicit' memories (as compared to 'explicit' memories which involve conscious awareness). Implicit and explicit memories are examined in Chapter 6.

Figure 5.6 These tourists have habituated to the roaring sound of low-flying aeroplanes that take off and land each hour at a nearby airport. Initially, an orienting response was unavoidable but they soon learn to ignore and not to respond to the planes as they fly overhead.

Classical conditioning as a three-phase process

Classical conditioning if often described as a learning process that occurs in a series of three phases or stages — before conditioning, during conditioning and after conditioning. Five key terms are used to explain the entire process and are applied whenever describing or analysing any simple response or more complex behaviour acquired through classical conditioning. These are known as the unconditioned stimulus, the unconditioned response, the neutral stimulus that becomes a conditioned stimulus, and the conditioned response.

The **unconditioned stimulus (UCS)** is any stimulus that consistently produces a particular, naturally occurring, automatic response. In Pavlov's experiments, the UCS was the food. Another example of a UCS is the placement of a nipple in a newborn infant's mouth. With no learning whatsoever, and assuming it is 'maturationally ready', the infant will automatically commence sucking. This is a naturally occurring, automatic sucking reflex response.

The **unconditioned response (UCR)** is the response that occurs automatically when the UCS is presented. A UCR is a reflexive involuntary response that is predictably caused by a UCS. In Pavlov's experiments, the UCR was the salivation by the dogs to the presence of food. In the example of the newborn infant, the infant's sucking is the UCR to the mother's nipple being placed in its mouth.

The **neutral stimulus (NS)** is any stimulus that does not normally produce a predictable response. In particular, this stimulus is 'neutral' to the UCR. For example, dogs do not normally salivate in response to the ringing of a bell. Pavlov's dogs had to be conditioned to do so through repeated pairing of the bell ring with meat powder, a food stimulus that does produce the particular response. Through repeated association with the meat powder (UCS), the originally neutral stimulus (the bell ring) becomes a conditioned stimulus that triggers a very similar or identical response to that caused by the UCS. Therefore, the **conditioned stimulus (CS)** is the stimulus that is 'neutral' at the start of the conditioning process but eventually elicits a very similar response to that caused by the UCS — a response that has become a conditioned response.

The **conditioned response (CR)** is the learned response that is produced by the CS. The CR occurs after the NS has been associated with the UCS and has become

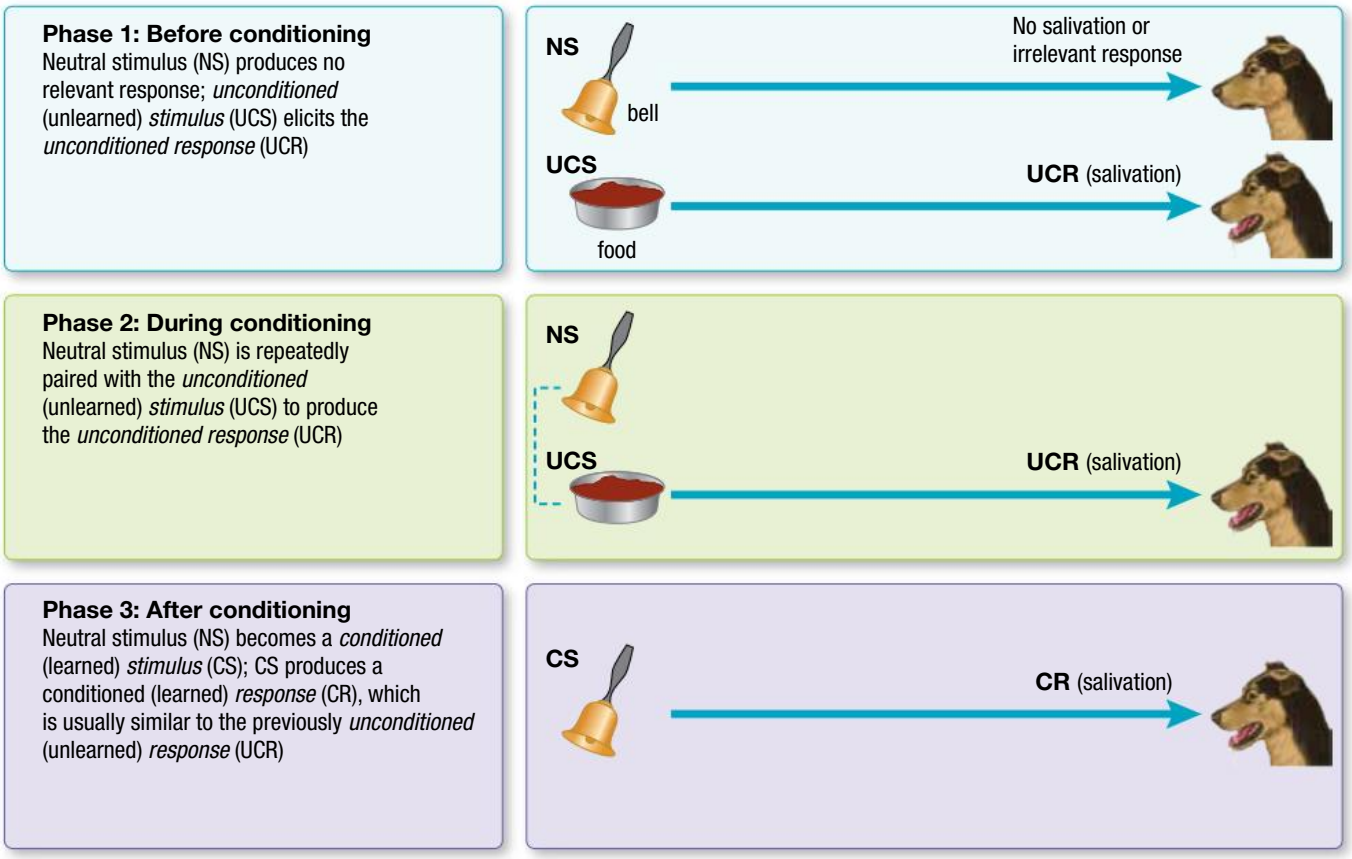

Figure 5.7 The three-phase process of classical conditioning in Pavlov's experiments. Classical conditioning is learning through involuntary paired associations between a neutral stimulus and an unconditioned stimulus to produce a conditioned response. Dogs do not normally salivate in response to the ringing of a bell. Pavlov's dogs had to be conditioned to do so through repeated pairing of the NS (the bell ring) with the UCS (the meat powder), a stimulus that does produce the particular response.

a CS. The behaviour involved in a CR is very similar to that of the UCR, but it is triggered by the CS alone. Pavlov's dogs displayed a CR (salivation) only when they began to salivate to a CS. When a dog responded to a CS such as the sound of a bell, classical conditioning had taken place because salivation would not be a usual response to the sound of a bell. Similarly, we would not expect the newborn infant to begin sucking merely at the sight or smell of the mother's breast unless an association between these stimuli and the feeding process had been made.

The acquisition of the conditioned response is evident in the anticipatory behaviour of the learner. For example, Pavlov's dogs could anticipate the arrival of the meat powder (UCS) by the sound of the bell (CS). Similarly, the newborn infant soon learns to anticipate the arrival of the milk well before the nipple enters their mouth. In bottle-fed babies, this may be even more evident, as they anticipate food at the sight of the bottle, even before it has been filled with milk.

During classical conditioning, each paired presentation of the NS with the UCS is referred to as a *trial*. The term *acquisition* is used to describe the overall process during which an organism learns to associate two events — the NS and the UCS — until the NS alone has become a CS that produces the CR. During acquisition, the presentations of the NS and the UCS occur close together in time and always in the same sequence. The duration of the acquisition stage is usually measured by the number of trials it takes for the CR to be acquired (learned). This may vary considerably. The rate of learning is often very fast early in the acquisition period (see Figure 5.12 on page 285).

One of the important considerations in classical conditioning is the *timing* of the NS and UCS pairing. Pavlov examined how much time should elapse between the presentation of the NS (e.g. the bell) and the UCS (the meat powder) in order to maximise the speed with which they would be associated so that the CS alone would elicit the conditioned response.

Pavlov found that the NS should be presented *before* the UCS and that there should be a very short time between their presentations. Ideally, the NS should occur not more than half a second before the UCS in order for the association to be most effectively made. According to Pavlov's research, longer time intervals were less effective for the dogs in establishing the links.

Behaviours that have been classically conditioned may occur so automatically that they appear to be reflexive. In fact, Pavlov used the term 'conditioned reflex' to describe what has since come to be known as a conditioned response. Essentially, classically conditioned responses *are* conditioned reflexes that are acquired through associative learning; that is, they are 'conditional' upon an organism's experience.

Conditioned responses are reflexive in the sense that they are automatic, involuntary and involve little conscious thought or awareness on the part of the organism. For example, when driving a car behind another vehicle, we learn to rely on its brake lights as a signal that the vehicle is slowing down. It does not take long as a driver for us to put our foot on the brake as soon as we see the brake lights illuminated on the vehicle in front. It becomes such an automatic response that we rarely give it much thought. However, forming and responding to the connection between the brake lights of a car illuminating and that car slowing down (or stopping) is not necessarily without any thought. We may learn to *expect* that a car with illuminated brake lights is slowing down and may stop (or even stop suddenly) in certain situations.

In this sense, classically conditioned responses are often described as involving *anticipatory behaviour*. The behaviour of touching the brake whenever we see the brake lights of the vehicle in front involves anticipatory behaviour in the same way that Pavlov's dog salivated at the sound of the bell or the laboratory technician in anticipation of food (but not at the sound or sight of Pavlov). Consequently, learning through classical conditioning may be involuntary and relatively simple, but conditioned reflexes or responses acquired through classical conditioning may not necessarily be 'thoughtless' and are therefore not as 'mechanistic' as Pavlov believed them to be.

TABLE 5.1 **In models that explain learning through conditioning, the term 'conditioned' simply means 'learned', as described in this summary.**

Key term	Learned or not learned
unconditioned stimulus	stimulus that is *not learned*
neutral stimulus	stimulus that is *not learned*
conditioned stimulus	stimulus that is *learned*
unconditioned response	response that is *not learned*
conditioned response	response that is *learned*

Figure 5.8 The parrot immediately flew to the fence on sighting the white paper food bags. It has formed an association between the sight of the white bag (CS) and the presentation of food (UCS). This suggests the development of anticipatory behaviour through repeated pairing of the two stimuli.

Figure 5.9 In many scary movies, the soundtrack music becomes intense just before something horrible happens. When we hear the music we became tense, anxious or even fearful. This technique has led us to form the association after having watched several scary movies. The intense music is the conditioned stimulus (CS) that triggers the conditioned response (CR) of tension, anxiety or fear.

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Weblink
Scientific American blog outlining classical conditioning and everyday applications

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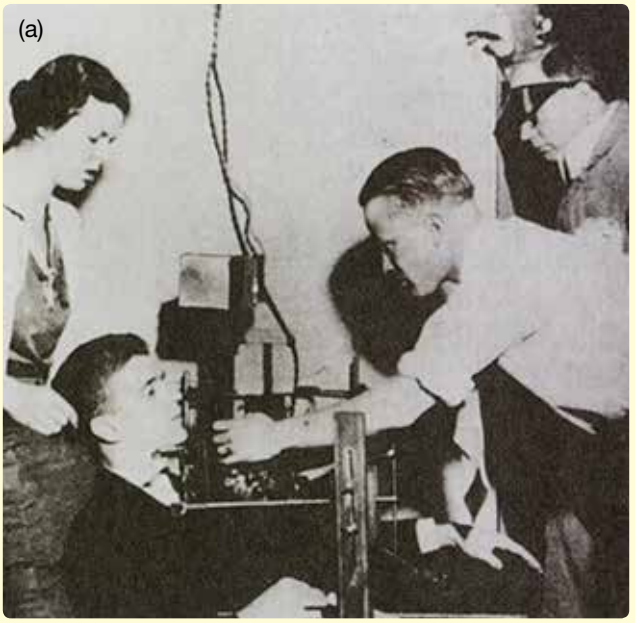
Practical activity
Conditioning a pupilary response to an auditory stimulus

BOX 5.3 Eye-blink conditioning

Classical conditioning of the eye-blink reflexive response is perhaps the most thoroughly studied form of classical conditioning of mammals over the past 100 years or so. For example, you could condition an eye-blink response in a volunteer participant using simple apparatus such as drinking straw and a pencil. The procedure would generally involve pairing a puff of air blown through the straw (directed at the bridge of your participant's nose) with the tapping sound made by the pencil on a table. When the correct procedure is used, this can usually be achieved within 20 or so trials (pairings).

Despite the relative simplicity of eye-blink conditioning, some of the early research procedures used with humans were unusual. For example, shown at right is eminent American psychologist Clark Hull (1884–1952) during an experiment in which he is conditioning one of his students to blink in anticipation of a slap to the face.

For practical as well as ethical reasons, researchers no longer use the face slap as a UCS in human eye-blink conditioning. Instead, they use an air-puff and electronic devices that can precisely deliver stimuli and record responses. For example, in an experiment using the rabbit shown below, a tube delivers a puff of air (UCS) and a photo beam measures the eye-blink CR and UCR. An electromyograph which detects electrical activity of muscles is also used to accurately record the reflexive response.



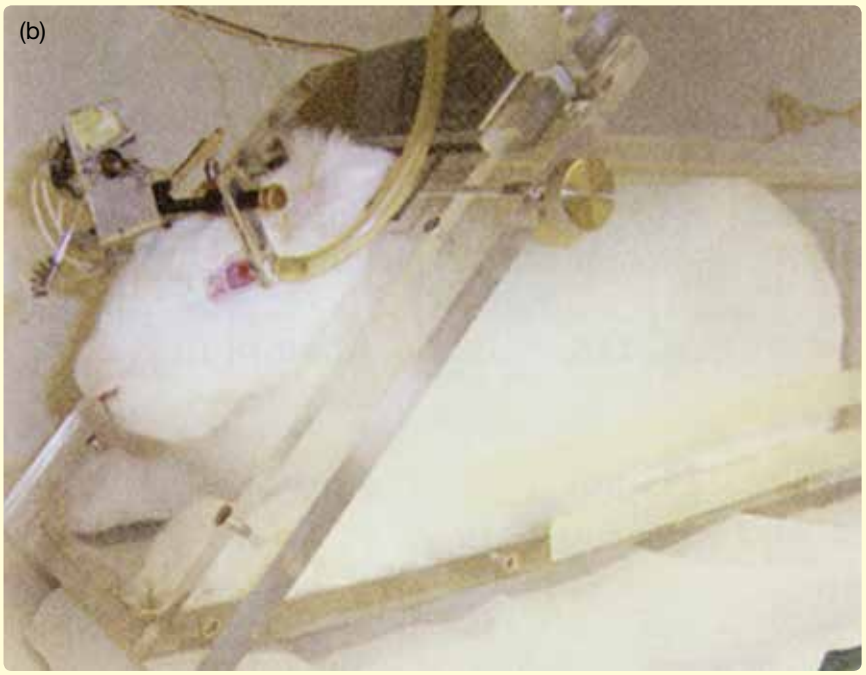


Figure 5.10 (a) In an experiment on classical conditioning in the 1920s, Hull (far right) conditioned a student (seated) to blink in anticipation of a face slap. (b) In this experiment using a rabbit, a tube (upper right) delivers a puff of air (UCS) and a photo beam measures the eyeblink CR and UCR.

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Practical activity
Eye-blink conditioning

LEARNING ACTIVITY 5.1

Review questions

1. (a) Define the meaning of the term learning.
(b) Briefly describe three key characteristics of behaviour that is learned.
(c) Compare and contrast the concepts of learning and conditioning.
(d) Distinguish between a learned response and a reflexive response.

2. Smiling, laughing and crying have all been observed in deaf–blind children who cannot have learned these responses by seeing or hearing them in others. What is a possible explanation of these responses?

3. What observation led Pavlov to study classical conditioning?

4. In what way(s) did restraining the dogs in his experiments help to control potential confounding variables?

5. (a) Define classical conditioning with reference to the neutral stimulus, unconditioned stimulus, conditioned stimulus and conditioned response.
(b) What is a possible explanation for why Pavlov actually used the term 'conditioned reflex' rather than conditioned response?
(c) Briefly describe how classical conditioning occurs, with reference to the three phases, but not to any other 'technical' terms.

6. (a) Define and explain the role of each of the different kinds of stimuli and responses in classical conditioning: UCS, NS, CS, CR, UCR.
(b) Describe the relationship between the neutral stimulus and conditioned stimulus in classical conditioning.
(c) Explain the importance of each of the following in classical conditioning:
(i) nature of the response that is conditioned
(ii) frequency of stimulus presentation during conditioning
(iii) timing of stimulus presentation during conditioning.

7. When can it be said that a response has been learned and the final phase is evident?

8. Make a copy of Table 5.1, but with a third column headed 'Meaning'. For each key term, add a brief, 'non-technical' definition or description.

9. Draw and label a diagram like Figure 5.7, showing the elements in classical conditioning as they occur for the conditioned response to the sight or sound of the food container demonstrated by the parrot in Figure 5.8, or the people in Figure 5.9.

LEARNING ACTIVITY 5.2

Identifying elements of classical conditioning

Identify the NS, CS, UCS, CR and UCR in each of these three scenarios.

Scenario A
During Christmas Eve in 1974, Cyclone Tracey — one of the most destructive cyclones in Australia's history — struck Darwin. Sixty-six people died and many more were injured. Many people sought shelter in the smallest room of their house because it was structurally the strongest. Many families therefore huddled together in bathrooms as the cyclone destroyed the area. After the cyclone, some children feared going to the bathroom — a fear that persisted for a several years. These children had learned to associate going to the bathroom with the noise and destruction of a cyclone.

Scenario B
On 11 September 2001, terrorists crashed two passenger planes into the twin towers of the World Trade Center in New York. The attacks killed some 3000 people and injured over 6000 others. The noise, destruction and loss of life witnessed on that day has led many New Yorkers to become anxious whenever they see or hear low-flying aircraft.

Scenario C
A participant is seated in an experimental chamber. A buzzer is sounded and the participant is given a mild electric shock to the left hand through a metal plate on the armrest of the chair. After several trials, the buzzer is sounded without the electric shock being given, but the participant still moves their hand.

LEARNING ACTIVITY 5.3

Reflection

By learning to associate stimuli through everyday experience, we gain information about our environment, some of which we take for granted but which is nevertheless valuable. Classical conditioning can account for the learning of many relatively simple responses in everyday life, such as learning to pack up your books at the sound of the bell to end the lesson, to leave your umbrella at home when there is a clear blue sky, that a flash of lightning signals an impending crack of thunder and that a specific tone means that you have just received a text message on your mobile phone.

What are some other relatively simple responses you believe you may have acquired through classical conditioning?

Classical conditioning can also account for the acquisition of more complex behaviours. Think of an example and briefly explain how it could be acquired through classical conditioning.

Stimulus generalisation

Once a person or an animal has learned to respond to a conditioned stimulus, other stimuli that are similar to the CS may also trigger the CR, but usually at a reduced level. For instance, Pavlov observed that his dogs salivated to other noises that sounded like the bell. This is called stimulus generalisation.

Stimulus generalisation is the tendency for another stimulus that is similar to the original CS to produce a response that is similar, but not necessarily identical, to the CR. In stimulus generalisation, the greater the similarity between stimuli, the greater the possibility that a generalisation will occur. For example, if stimulus generalisation to the sound of a bell occurred with one of Pavlov's dogs, the dog might also salivate in response to the ringing of a front doorbell. However, the amount of saliva produced by the dog would tend to be less than the amount produced by the original bell to which the dog was conditioned.

Stimulus generalisation is evident in various aspects of everyday life. Many kinds of loud noises can make us flinch, and many kinds of food can make us salivate, even if it is something we've never eaten before. While stimulus generalisation is rarely an intentional or even a conscious process, it can have a valuable adaptive role. For example, consider the child who burns a finger while playing with matches. A lit match will probably become a conditioned fear stimulus. It is also likely that the child will develop a healthy fear of flames from other potentially harmful sources, such as lighters, fireplaces, stoves, and so on. In this case, it is fortunate that stimulus generalisation extends learning to related situations. Otherwise, it would be far less useful for adaptive purposes.

In some situations, stimulus generalisation can be non-adaptive or even harmful. For example, a dog that instinctively snaps at annoying flies may also snap at a wasp, with painful consequences. Similarly, people are also susceptible to non-adaptive stimulus generalisation. For example, a young girl who was pecked by her family's pet duck developed a bird phobia as an adult. Her fear and anxiety were so strong that she could not even tolerate being near caged birds such as a pet canary or hens at the market. This example also illustrates how stimulus generalisation can help us understand why some fear responses can be triggered by non-threatening stimuli.

Figure 5.11 Like most infants, this girl cried each time she was immunised with a painful injection by the doctor who wore a white jacket during the procedure. After the third vaccination, the girl had developed what appears to be a strong classically conditioned response — the sight of the white jacket worn by the local pharmacist and by the baker triggered an emotional outburst of fear and crying. Stimulus generalisation had occurred.

Stimulus discrimination

In classical conditioning, **stimulus discrimination** occurs when a person or animal responds to the CS only, but not to any other stimulus that is similar to the CS. For example, in a classical conditioning experiment, stimulus discrimination would be observed when a dog salivated *only* in response to the sound of the 'experimental' bell, and not in response to any other similar sound such as a front doorbell, the sound of a telephone ringing or the bell of an ice-cream van.

Stimulus discrimination would be evident in everyday life if someone who has a fear of a particular dog that has frightened them does not flinch at the sight of other breeds of dog. This occurs because the person has learnt to discriminate between the two similar stimuli.

Extinction

A conditioned stimulus–response association is not necessarily permanent. The strength of the association may fade over time or disappear altogether until it is extinguished.

Extinction is the gradual decrease in the strength or rate of a CR that occurs when the UCS is no longer presented. Extinction is said to have occurred when a CR no longer occurs following presentation of the CS. For example, Pavlov's dogs eventually ceased salivating (CR) in response to the bell (CS) presented alone after a number of trials in which the food (UCS) did not follow the sound of the bell (see Figure 5.12, trials 16–22 below).

There is some variation between individuals (people or animals) in the rate at which extinction of the same conditioned response will occur. There is also considerable variation between the rates at which different responses will be extinguished. For example, the simple behaviour of blinking in response to a pencil being tapped on a table (as described in Box 5.3 on page 282) will be extinguished relatively quickly. However, a more complex behaviour pattern, such as an intense fear response to being in a bathroom because it is associated with cyclones, is likely to take longer to extinguish.

Spontaneous recovery

Extinction of a conditioned response is not always permanent. In classical conditioning, **spontaneous recovery** is the reappearance of a CR when the CS is presented, following a rest period (i.e. when no CS is presented) after the CR appears to have been extinguished. For example, spontaneous recovery would occur if one of Pavlov's dogs started salivating again to the sound of a bell after extinction is intentionally achieved as part of the experimental research.

Spontaneous recovery does not always occur, and when it does it is often short-lived. Furthermore, the CR tends to be weaker than it was originally (during acquisition). If the extinction procedure is repeated several times, eventually the CR will disappear altogether and spontaneous recovery will not occur. The two separate instances of spontaneous recovery shown in Figure 5.12 below illustrate the relative weakness of the conditioned response compared with its strength during the acquisition phase.

study on

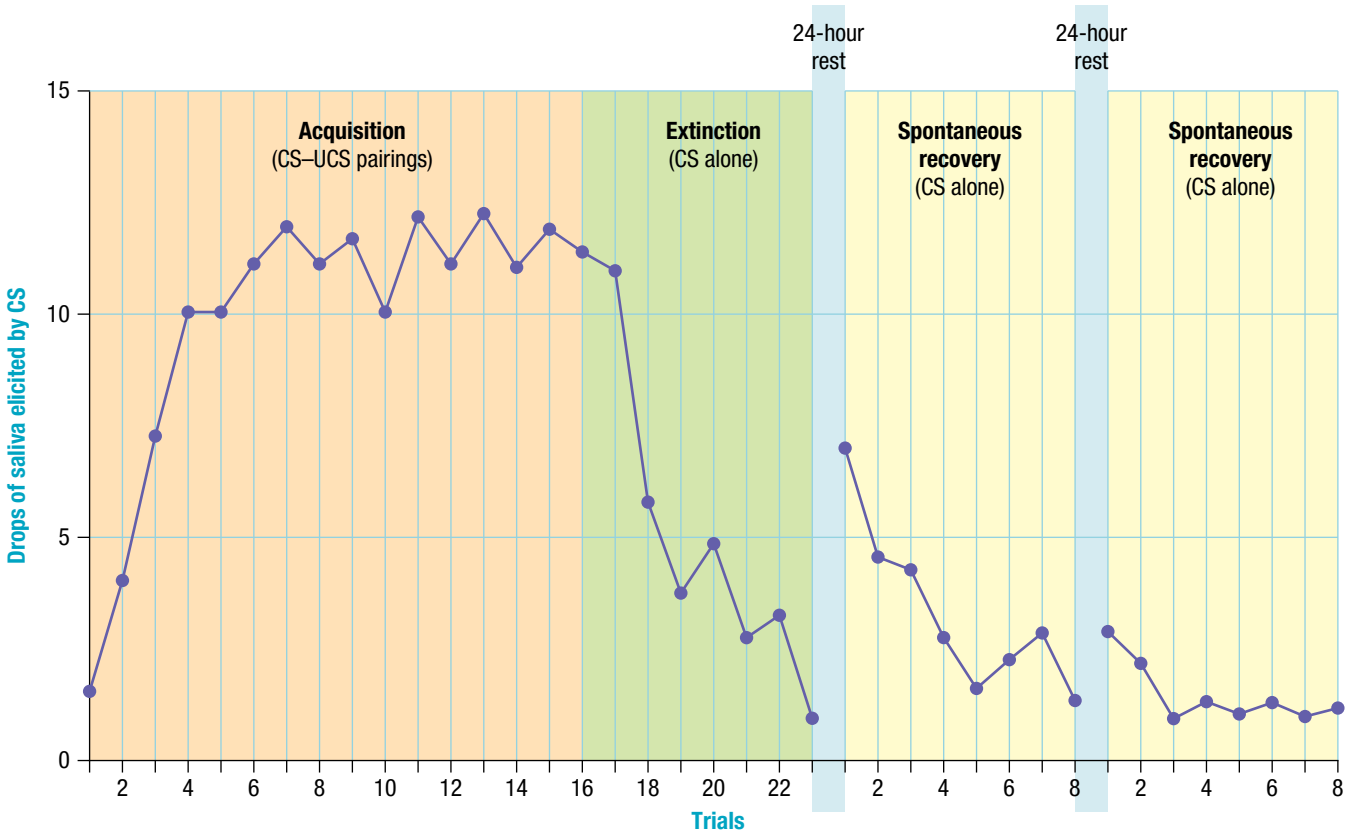

Figure 5.12 The results reported by Pavlov (1927) for one of his experiments. Note the amount of saliva produced by a dog in response to the CS and the UCS during the first 15 trials in the acquisition phase. The strength of the CR rapidly increases then levels off near its maximum. In trials 16 to 22 when the UCS is removed and the CS is presented alone, the CR declines irregularly until extinguished. The graph then shows two separate instances of spontaneous recovery, each of which is punctuated by a 24-hour 'rest' period. Note that the CR eventually drops back to the extinction level following each spontaneous recovery.

LEARNING ACTIVITY 5.4

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Word copy of table

Summarising principles of classical conditioning

Complete the following table to summarise key principles of classical conditioning.

Principle	Description	Example in Pavlov's experiments	Example in everyday life
stimulus generalisation			
stimulus discrimination			
extinction			
spontaneous recovery			

LEARNING ACTIVITY 5.5

Analysing classical conditioning scenarios

Part A

Select the correct terms from the list below to complete the sentences in each of the following scenarios.

- conditioned response
- extinction
- unconditioned stimulus
- spontaneous recovery
- conditioned stimulus
- stimulus generalisation
- stimulus discrimination
- neutral stimulus

Scenario 1

When she was about eight years old, Olivia decided to help her mother at the florist's store where her mother worked. She first helped on Valentine's Day. Olivia did such a good job bringing in all the red roses for her mother to arrange that she was paid $20. But at the end of the day, nearly every finger on Olivia's hands was bleeding because of the thorns on the red roses. On Mother's Day that year, Olivia worked at the florist's store again. Although she earned another $20, her hands were again very sore at the end of the day from the thorns on the red roses.

The following week when her mother asked Olivia to assist with preparing flowers for a large wedding, Olivia replied that she would help as long as there were no red flowers involved.

Olivia's refusal to handle red flowers is an example of _____ .

Scenario 2

One group of dogs was exposed to two different experimental conditions.

- In condition 1, an experimenter who always wore a white coat regularly fed the dogs.
- In condition 2, an experimenter who always wore a black coat prepared the food and got the feed bowls ready, but another experimenter then came in and actually gave the food to the dogs.

The dogs were exposed to these conditions in random order twice daily for ten days. The amount of saliva produced by the dogs each time the experimenter approached was measured and recorded. These results, together with the baseline data that were collected before the experiment began, are shown in the following table.

Baseline condition (before conditioning)	Experimental condition 1 (white coat)	Experimental condition 2 (black coat)
3.2 mL	6.8 mL	3.5 mL

The results in the table show that the dogs demonstrated _____ .

Scenario 3

a In attempting to classically condition an eye-blink response to the sound of a pencil tap, Sophia was the experimenter and Isabelle was the participant. During conditioning, Sophia noticed that Isabelle's conditioned response (the eye-blink to the pencil tap alone) was becoming stronger as the number of pairings of the _____ and the _____ increased.

b Once the experiment was over, Sophia was concerned that Isabelle might continue to blink every time she heard a pencil tap. Sophia made sure this would not happen by presenting the pencil tap alone for some time until she was sure that _____ had been achieved.

c The following week in their Psychology class, Sophia accidentally tapped her pencil and noticed that Isabelle blinked. This suggests that _____ may have occurred.

Part B
Identify the components that are the CS, UCS, UCR, and CR in the following scenario.

Scenario 4
Doctors treating cancer patients with chemotherapy found that their immune systems had been classically conditioned. Initially, only the chemotherapy treatment affected the patient's immune system, but after many treatments, cues related to the hospital environment where the treatment was administered produced reduced immune system functioning.

a The UCS in this example is the _____ _____, and the _____ is the UCR.
b After repeated treatments, the_____ related to the hospital environment became associated with chemotherapy treatment.
c Now the CS produced a response of _____ _____, which is the CR.

Part C
Using the terminology of classical conditioning, explain the acquisition of the conditioned response referred to in each of the following scenarios.

Scenario 5
A person under treatment for a gambling addiction often feels an urge to play the pokies whenever he again encounters cues such as driving past a gaming venue where he experienced a huge 'buzz' after hitting a jackpot, and hearing about someone else's big win on the machines.

Scenario 6
After swimming in the lake near his home one day, Glen emerged from the water covered with slimy blood-sucking leeches all over his back and legs. He was revolted as he removed the leeches. The next time he swam there, a leech attached itself to his cheek. Now, every time he passes the lake, Glen shudders in disgust.

Scenario 7
When Mardi and her sisters were toddlers, their mother frequently used their nap time to vacuum. Now, when Mardi and her sisters hear vacuum cleaners, they feel sleepy.

Scenario 8
Every time three-year-old Sienna heard the door bell ring, she raced to open the front door. On Halloween night, Sienna answered the doorbell and encountered a scary monster that intentionally startled her. Sienna screamed in fear and ran away. Her parents calmed her down but it happened again later that evening. Now Sienna whimpers and hides whenever the doorbell rings.

Scenario 9
A flashing light suddenly appearing on the control panel of an aeroplane triggers a burst of adrenaline in a pilot.

The 'Little Albert' experiment

Sometimes, an emotional reaction such as fear or anger in response to a specific stimulus is learned through classical conditioning. When this occurs, it is often called a *conditioned emotional response.* This type of response is observed when the autonomic nervous system produces a reaction to a stimulus that did not previously trigger that reaction. For example, many people cringe at the sound of the dentist's drill. This is not a naturally occurring response to the noise. One reason for the fear of the sound of the dentist's drill is the association we make between the sound and potential pain. In this case, the sound of the dentist's drill has become a conditioned stimulus, which, through association with the unconditioned stimulus (the drilling of the tooth), produces a conditioned emotional response (fear).

While it may be beneficial to develop a fear of something that could harm you, such as poisonous spiders, it may be mentally unhealthy to develop a fear of something that does not normally harm you, such as cotton wool or soft, furry animals. The latter is what happened in an experiment reported in 1920 to illustrate how classical conditioning can be used to condition an emotional response.

In their report, American psychologist John B. Watson and his graduate student Rosalie Rayner (1920) explained how they had intentionally conditioned an emotional response and gave detailed descriptions of their procedures and participant reactions. Their research was designed to test the belief that fears can be acquired through classical conditioning. Watson wanted to demonstrate experimentally that humans undergo the same process in acquiring fears as animals do. Their sole participant was Albert B. ('Little Albert'), the 11-month-old son of a woman who lived and worked at a hospital on the university campus where the experiment was conducted (APA, 2010). Watson and Rayner considered Albert to be a suitable participant for their experiment because, in their terms, he was:

> *on the whole stolid and unemotional . . . No-one had ever seen him in a state of fear and rage. The infant practically never cried . . . His stability was one of the principal reasons for using him as a subject. We felt that we could do him relatively little harm by carrying out [these] experiments.*

After pre-testing Albert to ensure he was actually capable of producing a fear response (UCR), Watson and Rayner placed him on a mattress in a room where a white laboratory rat (CS) was within reaching distance. Albert showed no initial

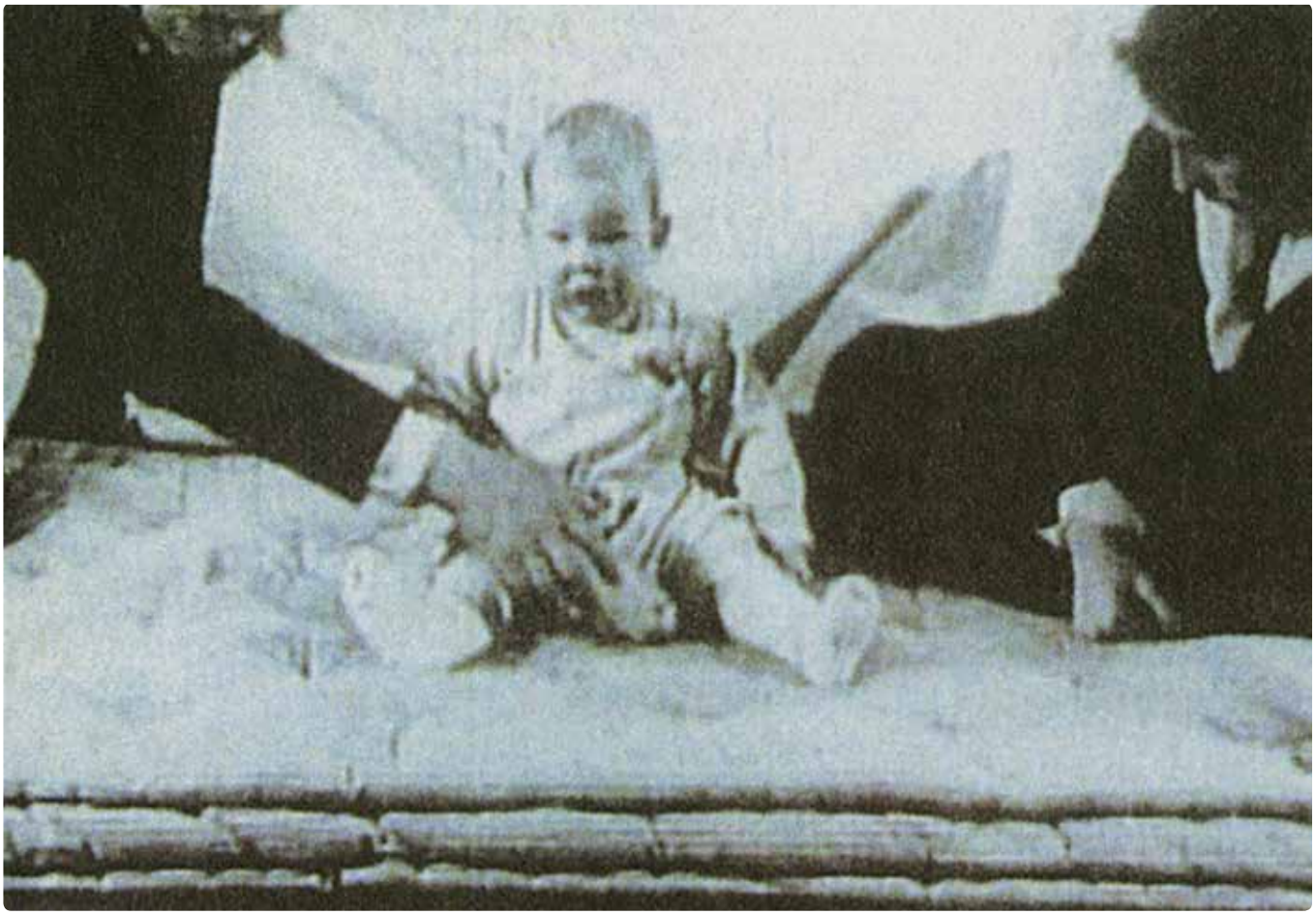

Figure 5.13 Watson and Rayner introduce 'Little Albert' to the white rat as he sits placidly on a mattress.

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Video showing 'Little Albert' experiment 5m 10s

fear of the furry animal and reached for it. As soon as his hand touched the white rat, one of the experimenters stood behind Albert and:

> *struck a hammer upon a suspended steel bar four feet [about 1 metre] in length and three-fourths of an inch [about 2 centimetres] in diameter.*

This produced a loud noise (UCS) that would startle most people regardless of what they were doing. Albert responded as follows:

> *The child started violently, his breathing was checked and the arms were raised in a characteristic manner. On the second stimulation the same thing occurred, and in addition the lips began to pucker and tremble. On the third stimulation the child broke into a sudden crying fit. This is the first time an emotional situation in the laboratory has produced any fear in Albert.*

Encouraged by this result, Watson and Rayner conducted a series of fear-conditioning procedures with Albert when he was 11 months and three days old. These were held irregularly over a 17-day period. Following are the laboratory notes describing the first procedure:

> *1 White rat suddenly taken from the basket and presented to Albert. He began to reach for rat with left hand. Just as his hand touched the animal the bar was struck immediately behind Albert's head. The infant jumped violently and fell forward, burying his face in the mattress. He did not cry, however.*
>
> *2 Just as the right hand touched the rat the bar was again struck. Again the infant jumped violently, fell forward and began to whimper.*

In the next procedure, conducted one week later, the loud noise was again sounded every time Albert attempted to play with the white rat. After seven pairings, Albert showed a distinct fear (CR) in response to the rat (CS) being placed anywhere near him.

> *The instant the rat was shown the baby began to cry. Almost instantly he turned sharply to the left, fell over on the left side, raised himself on all fours and began to crawl away so rapidly that he was caught with difficulty before reaching the edge of the table.*

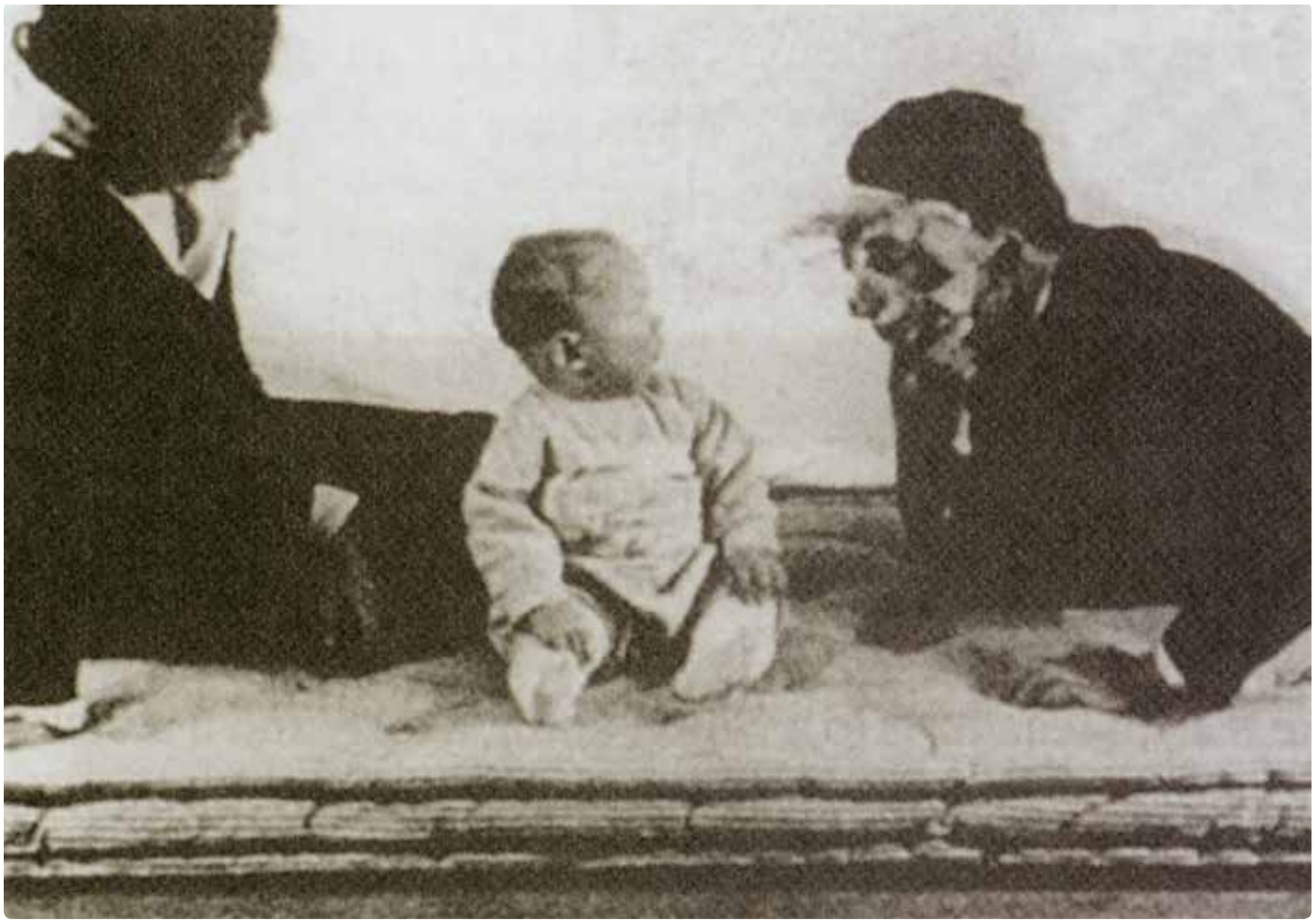

Figure 5.14 Watson tests Albert's reaction to a scary mask.

Watson and Rayner concluded that this response by Albert:

> *was as convincing a case of a completely conditioned fear response as could have been theoretically pictured. [Furthermore] it is not unlikely, had the sound been of greater intensity or of a more complex clang character, that the number of joint stimulations might have been materially reduced.*

Watson and Rayner also conducted 'tests' to find out if Albert's fear response would be generalised ('emotionally transferred') to other stimuli that were similar in some way to the white laboratory rat. They reported that Albert produced quite fearful reactions to a white rabbit, a dog and a sealskin coat. He showed slightly less fearful reactions to cottonwool balls and a Santa Claus mask, but showed reactions nonetheless.

Ethical implications of the experiment

Eventually, Albert's mother left her job at the clinic and the city of Baltimore where the experiments were being conducted. Watson and Rayner reported that they were denied the opportunity:

> *of building up an experimental technique by means of which we could remove the conditioned emotional responses.*

Other psychologists, however, have disputed this, stating that Watson and Rayner knew a month in advance that Albert's mother would be leaving, yet took no steps to extinguish Albert's fear response (Cornwell & Hobbs, 1976; Harris, 1979).

It is believed that Albert's mother may not have been fully aware that her son was to be used in an experiment on conditioning a fear response. This raises the ethical question of whether informed consent was obtained. However, the issue of informed consent is not referred to in the original journal article reporting the experiment, so it is difficult to make a judgment about this. It is also not clear whether any allowance was made for participant withdrawal rights to be exercised. To not explain this option to Albert's mother would be a breach of ethical standards.

It is possible also that Albert was more vulnerable to psychological harm as a result of the experimental procedures than another infant might have been. This is suggested by the notes the researchers made in their 1920 journal article (below). Yet Albert was subjected to severe distress and anxiety, and the experimenters made no attempt to end the experiment and appropriately attend to his distress.

Watson and Rayner reported an observation during the research that whenever Albert was emotionally upset he would:

> *continually thrust his thumb into his mouth [thus becoming] impervious to the stimuli producing fear. Again and again . . . we had to remove the thumb from his mouth before the conditioned response could be obtained.*

This seems to contradict Watson and Rayner's description of Albert as a suitable research participant on the grounds that he was 'stolid and unemotional'.

Although some psychologists have suggested that Albert's conditioned fears might have disappeared over time (if, in fact, he had acquired conditioned fears), it is reasonable to assume that Albert was not only emotionally traumatised by the experimental procedures to which he was subjected, but was also likely to have suffered some kind of lasting psychological harm.

Watson and Rayner had apparently demonstrated that an emotional response such as fear can sometimes result from classical conditioning, although results of later experiments by other researchers who attempted to replicate the procedure indicated that the learning process is not as simple as reported by Watson and Rayner (Samelson, 1980).

Importantly, experiments using any human participant in this way would be considered unethical today and would not be permitted. At the time of Watson and Rayner's experiment with Albert, professional organisations for psychologists such as the American Psychological Association were only in their formative stages, and ethical guidelines and standards for the professional conduct of researchers and practising psychologists had not yet been fully established. Ethical values such as *research merit and integrity, beneficence, justice* and *respect for human beings,* which, as described in Chapter 1, all guide and safeguard the proper conduct and reporting of contemporary psychological research, would all undoubtedly have been breached if they were in place at the time of the 'Little Albert' experiment.

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Figure 5.15 Watson and Rayner conducted the 'Little Albert' experiment at the Johns Hopkins University's Phipps Psychology Clinic.

BOX 5.4 Whatever happened to 'Little Albert'?

Many students of psychology ask 'Whatever happened to 'Little Albert'?' In 2009, American psychologist Hall Beck and two colleagues published a journal article in which they identified 'Albert'. They reported that he was Douglas Merritte, the foster son of a wet nurse (a woman employed to breast feed another woman's baby) named Arvilla Merritte who received $1 for her child's participation in the 'Little Albert' experiment (APA, 2010). They also reported that 'Albert' died at age six from the brain disease hydrocephalus (not from an animal phobia as some people believe). The disease can be present at birth or acquired soon after, suggesting that 'Albert' was far from the healthy boy shown in various videos of the experiments that can be seen on YouTube.

Other researchers have since challenged these findings about 'Albert'. In 2014, American psychologist Russell Powell and his colleagues presented evidence that a boy named William Barger might actually have been the real 'Little Albert'. They found that Barger was born on the same day as Merritte to a wet nurse who worked at the same hospital as Merritte's mother. While his first name was William, he was known his entire life by his middle name, Albert. Barger died in 2007, at the age of 87. The researchers also analysed the online videos of the 'Little Albert' experiment and found no evidence of health issues or developmental problems in 'Albert'.

While some psychologists continue to debate the true identity and health of 'Little Albert', there is little doubt that the young boy has left a lasting impression in the discipline.

Figure 5.16 Douglas Merritte's grave. He is buried in a cemetery about 45 minutes west of Baltimore in the US state of Maryland.

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Weblinks
- Video interview with Hall Beck 5m 22s
- Media article on 'The search for Psychology's lost boy'

LEARNING ACTIVITY 5.6

Review questions

1. Draw a diagram like that in Figure 5.7 on page 279 to illustrate the classical conditioning of Albert's conditioned fear response to the white rat.
2. Explain the role of long term potentiation in the development of Albert's conditioned fear response to the white rat.
3. To which objects did Albert demonstrate stimulus generalisation?
4. Consider Watson and Rayner's (1920) study from an ethical perspective. To what extent were ethical standards and guidelines for psychological research applied in the 'Little Albert' experiment? Explain with reference to procedures used by Watson and Rayner and relevant ethical standards.
5. Using the language of classical conditioning, suggest an ethically acceptable procedure that could be used to extinguish Albert's conditioned fear response to the white rat.

LEARNING ACTIVITY 5.7

Reflection

Consider the efforts by psychologists to find out 'Whatever happened to 'Little Albert'?' which are outlined in Box 5.4 above.

Comment on whether research to answer this question is appropriate use of resources and explain why you hold this view.

BOX 5.5 Higher order conditioning

Higher order conditioning is so named because there is another level of the associative process of classical conditioning. Higher order conditioning involves the introduction of another (or several) conditioned stimulus. In *higher order conditioning*, a second conditioned stimulus (CS2) is presented immediately after the first conditioned stimulus (CS1) until it alone produces the response.

For example, suppose your pet dog is accustomed to a routine each morning in which she goes to a nearby café with you to buy a coffee. She becomes aware that you are about to depart and gets excited when you put on her leash. This has become the conditioned stimulus (CS1) associated with the actual walk (UCS) that produces the excitable response (CR). Because these two events occur regularly, close together and always in the same order, the dog has also learned to associate the sound of a cash jar being rattled with the leash. Eventually the sound of rattling coins alone (CS2) produces the excitable behaviour (CR). In this case, one conditioned stimulus has been replaced by another.

A third order of conditioning is also possible. For example, your opening of the closet door to get your walking shoes may become the signal (CS3) for a walk, if this is what you regularly do immediately before getting the coffee coins.

Higher order conditioning is important because it can help explain how certain stimuli can acquire their ability to trigger responses, even when they don't seem to have been paired with any obvious unconditioned stimulus.

Before conditioning
UCS (walk) ⟶ leads to ⟶ UCR (excitement)

During conditioning (acquisition)
UCS (walk) ⟶ leads to ⟶ CR (excitement)
is associated with
CS1 (leash)

Higher order conditioning
CS1 (leash) ⟶ leads to ⟶ CR (excitement)
is associated with
CS2 (rattling coins)

Higher order conditioning may explain why the sight of a hand opening a specific door can excite a dog.

OPERANT CONDITIONING

Classical conditioning is one of two types of associative learning. The other type is operant conditioning (also known as *instrumental conditioning*). Unlike classical conditioning which involves associating stimuli, operant conditioning involves associating stimuli with responses (behaviours) which are in turn influenced by consequences.

The term operant conditioning was first used in the 1930s by American psychologist Burrhus Frederic Skinner. **Operant conditioning** is a type of learning whereby the consequences of behaviour determine the likelihood that it will be performed again in the future. More specifically, operant conditioning theory proposes that an organism will tend to repeat a behaviour (an operant) that has desirable consequences (such as receiving a treat), or that will enable it to avoid undesirable consequences (such as being given detention). Furthermore, an organism will tend *not* to repeat a behaviour that has undesirable consequences (such as disapproval or a fine).

An **operant** is any response (or set of responses) that acts ('operates') on the environment to produce some kind of consequence. Essentially, it is behaviour that has an impact on the environment in some way. In turn, the environment provides an event that makes the behaviour more or less likely to recur. Positive consequences strengthen the behaviour and make it more likely to recur and adverse consequences weaken the behaviour and make it less likely to recur. Since the consequence occurs in the environment, the environment determines whether or not the operant occurs (Skinner, 1953).

Unlike the classical conditioning process which involves involuntary, reflexive responses that are automatically elicited by a stimulus, operant conditioning involves *voluntary* responses. An operant is voluntary action that people and animals initiate and often perform on a daily basis. Smiling, drinking water, listening to music, watching TV, Googling for information and liking on Facebook are common human operants. Although operants first appear spontaneously and can be controlled by the organism, they are greatly influenced by their consequences.

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Figure 5.17 B. F. Skinner (1904–1990) conducting an experiment on operant conditioning.

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Video on operant conditioning with pigeons 3m 57s

Operant conditioning as a three-phase model

Skinner believed that virtually all behaviour can be analysed and explained by the relationship between the behaviour, its antecedents (what happens just before it) and its consequences (what happens just after it). The three-way relationship between these elements and the order in which they occur is called the three-phase model of operant conditioning.

The **three-phase model of operant conditioning** has three parts that occur in a specific sequence:

1. antecedent (A), a stimulus that occurs before the behaviour
2. the behaviour (B) that occurs due to the antecedent
3. the consequence (C) to the behaviour.

This is usually expressed as antecedent (A) → behaviour (B) → consequence (C) and is therefore sometimes called the *A-B-C model of operant conditioning*. Basically, a specific antecedent prompts relevant behaviour that is followed by a specific consequence.

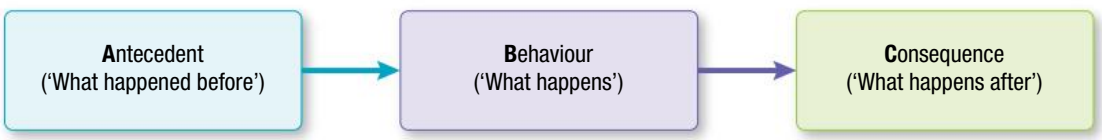

Figure 5.18 The three-phase model of operant conditioning

Anything in the organism's environment can be an antecedent. These stimuli are already in place before any behaviour occurs. Some are essentially neutral in the sense that they do not have any effect on behaviour at all, at least as far as the relevant operant conditioning behaviour is concerned. Other antecedents may signal that behaving in a particular way is likely to have a specific consequence. They are like cues ('prompts') in the environment that tell us what to do and set us up to behave in a particular way. When an antecedent does influence the likelihood of specific behaviour occurring, it is technically called an *antecedent stimulus*.

The antecedent stimulus must be present for the relevant behaviour to occur. The **antecedent** (A) is the stimulus (object or event) that precedes a specific behaviour, signals the probable consequence for the behaviour and therefore influences the occurrence of the behaviour. For example, your mobile phone ring tone when you are expecting a call from a friend is the antecedent stimulus that sets up the specific behavioural response of tapping 'Accept' on the screen for the desirable consequence of chatting with your friend.

Through its association with a consequence, the antecedent stimulus signals whether certain behaviour will lead to a particular consequence (but does not actually elicit a response as in classical conditioning). In this way, the antecedent stimulus enables the organism to predict the likely outcome of their behaviour. In the mobile phone example, your ring tone indicates that the behaviour of tapping 'Accept' is very likely to be followed by the desired chat with your friend. Consider another example of a car stopped at a red traffic light at a busy intersection. When the traffic light turns green, the car is driven through the intersection. In this situation, the green traffic light is the antecedent stimulus that prompts the behaviour of gently pressing on the accelerator for the known, likely and desirable consequence of safely travelling across the intersection.

The antecedent stimulus is sometimes referred to as the *antecedent condition* to emphasise that it occurs *before* the relevant behaviour. It may also be called a *discriminative stimulus* because it helps us distinguish between the consequences we have associated with different behaviours in different situations, for example, to tell the difference between the likely consequences of driving through a red or green traffic light at a busy intersection. We learn from experience to associate certain environmental cues with particular behaviours (operant responses). In this way, according to Skinner (1974), our behaviour is determined and controlled by stimuli that are present in the environment and our prior experience with the consequences of responding in particular ways to different stimuli.

In the A-B-C model, **behaviour** is the voluntary action that occurs in the presence of the antecedent stimulus. It may be one specific action (e.g. tapping 'Accept' on your mobile's screen) or a pattern of actions (e.g. checking the number of the incoming call, tapping 'Accept' and speaking). In all cases, it involves activity that has an effect on the environment in the form of a consequence that follows it.

The **consequence** is the environmental event that occurs immediately after the behaviour and has an effect on the occurrence of the behaviour. Skinner argued that any behaviour which is followed by

TABLE 5.2 Behavioural analysis using the three-phase model of operant conditioning

	Antecedent (A)	Behaviour (B)	Consequence (C)	Effect on future behaviour
Definition	The environmental stimulus that precedes the relevant behaviour and indicates the consequence	Voluntary activity that has an effect on the environment	The environmental event that follows the behaviour	Reinforcement (positive or negative) increases the likelihood of the behaviour being repeated. Punishment decreases the likelihood of the behaviour being repeated.
Examples	The word 'Men' on a toilet door	Enter if a male	Empty a full bladder	Positive reinforcement — more likely to enter again when bladder is full
	Petrol gauge almost on empty	Fill car with petrol	Avoid running out of petrol	Negative reinforcement — more likely to fill car when petrol gauge on empty
	Drink vending machine	Put in $2	Get no drink and lose money	Punishment (negative) — less likely to use that vending machine again
	In a small group in the schoolyard	Tell a 'bad' joke	Ridiculed by others	Punishment (positive) — less likely to tell 'bad' jokes to the group

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Consideration of future consequences scale

a consequence will change in strength (become more, or less, established) and frequency (occur more, or less, often) depending on the nature of that consequence (reward or punishment). Behaviour that is followed by a reward strengthens the behaviour and makes it more likely to occur again, whereas behaviour followed by punishment weakens the behaviour and makes it less likely to occur again. For example, if you wear a particular T-shirt and get lots of compliments (rewards), you are likely to wear it more often. If people give you strange looks or make uncomplimentary comments, you will probably wear it less often.

The nature of the consequence can often depend on the individual. For example, consider bungee jumping, for which a person dives off a very high tower (or place) with their feet connected to an elastic cord. The antecedent stimulus is the sight of the bungee tower and the behaviour is diving off the tower. The consequence, however, will be a reward in the form of a thrill for some people and punishing in the form of terror for others.

In more formal terms, the three-phase model of operant conditioning means that the probability of particular behaviour occurring in response (B) to an antecedent stimulus (A) is a function of ('depends on') the consequence (C) that has followed (B) in the past. For example, when waiting for a friend's phone call, tapping 'Accept' on your mobile phone's screen and speaking (B) when you hear your mobile's ring tone (A) leads to the consequence (C) of connecting with someone with whom you may wish to chat.

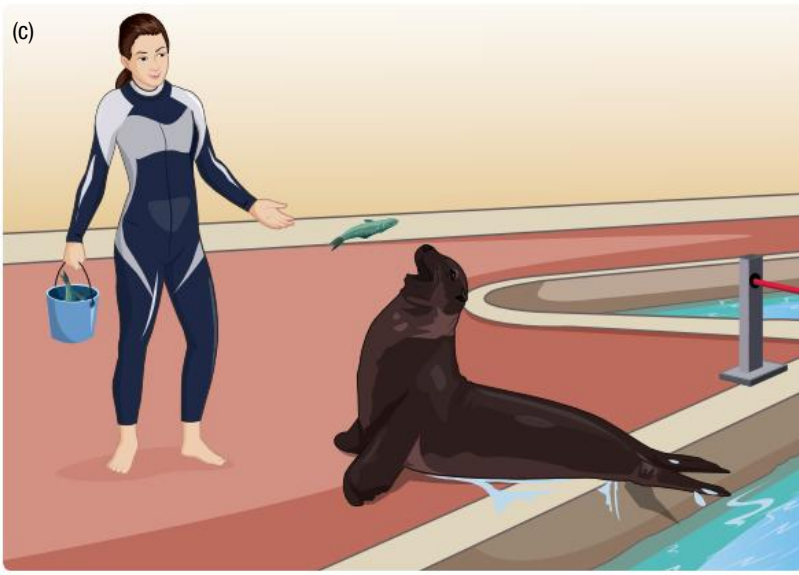

Figure 5.19 (a) Antecedent: the trainer presents a stimulus — a hand signal. (b) Behaviour: the sea lion immediately responds with the correct behaviour — leaping over a rope. (c) Consequence: the outcome is a tasty treat immediately after the behaviour, which strengthens the behaviour and makes it more likely to be repeated in the future when the stimulus is presented.

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Video — sea lion training using operant conditioning 5m 35s

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BOX 5.6 Skinner's experiments with rats

For his pioneering experiments on operant conditioning, Skinner created an apparatus that eventually came to be known as a 'Skinner box' (as shown in figures 5.20 and 5.21).

A *Skinner box* is a small operant conditioning chamber in which an experimental animal learns to make a particular response for which the consequences can be controlled by the researcher. It is equipped with a lever that delivers food (or water) into a dish when pressed. Some boxes are also equipped with lights and buzzers, and some have grid floors for delivering a mild electric shock. The lever is usually wired to a cumulative recorder, an instrument with constantly moving chart paper on which a pen makes a special mark each time a desired response (usually lever-pressing) is made. The recorder can indicate how often each response is made (frequency) and the rate of response (speed).

Most of Skinner's early experiments using the Skinner box were done with rats, while his later experiments were conducted with pigeons. Rats were usually conditioned to press the lever, and pigeons were conditioned to peck at a disk.

In 1938, Skinner used the box in a well-known experiment to demonstrate operant conditioning. When a hungry rat was placed in the box, it scurried around it and randomly touched parts of the floor and walls. Eventually, the rat accidentally pressed a lever mounted on one wall. Immediately, a pellet of rat food dropped into the food dish and the rat ate it. The rat continued its random movements and eventually pressed the lever again. Another pellet dropped immediately and was eaten. With additional repetitions of lever-pressing followed by food, the rat's random movements began to disappear and were replaced by more consistent lever-pressing. Eventually, the rat was pressing the lever as fast as it could eat each pellet. The pellet was a reward for making the correct response. Skinner referred to different types of rewards as *reinforcers*.

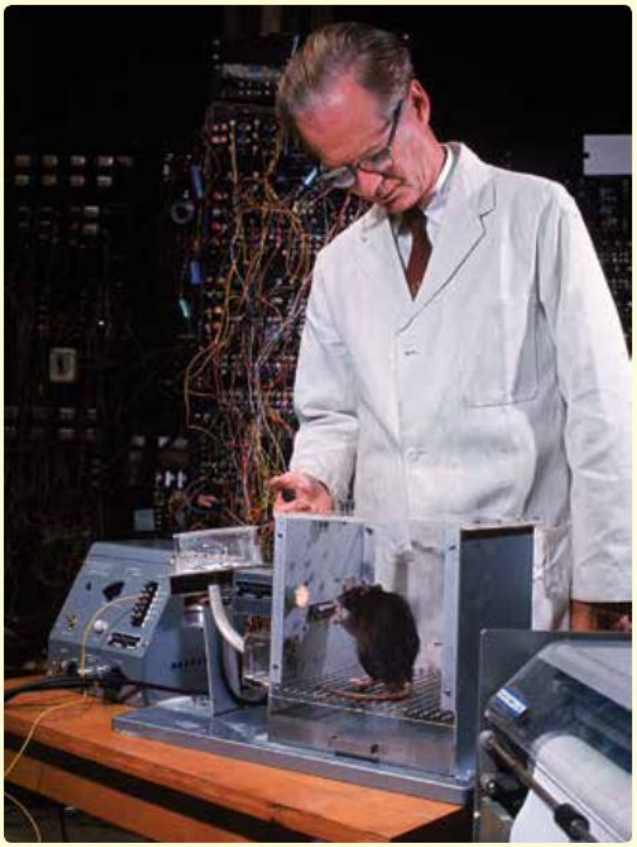

Figure 5.20 A rat in a Skinner box

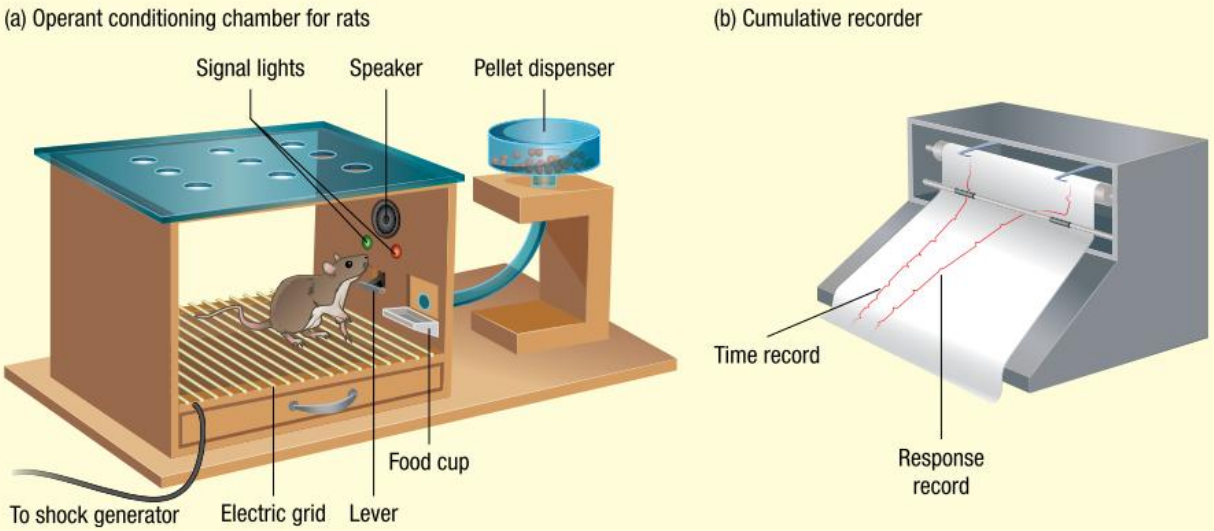

Figure 5.21 (a) The key components of an operant conditioning chamber, commonly referred to as a Skinner box; (b) a cumulative recorder that is connected to the lever in the box. It electronically records the correct responses and the rate at which they occur (their frequency). This type of cumulative recorder has been replaced with a computer.

Skinner had an interest in demonstrating the impact of reinforcers and his laboratory apparatus was able to reward the animals according to different types of programs or schedules of reinforcement; for example, providing a reinforcer every time a correct response was made as compared with every second correct response or several seconds after a correct response was made.

Skinner intentionally used hungry rats (and other laboratory animals) in his experiments. Their hunger was the motivation that increased the probability of responding in the desired way when they chanced upon the discovery of a reinforcer such as food pellets.

Skinner, however, believed that there was no need to search for factors within the organism to explain changes in behaviour. This view was based on the notion that behaviour can be understood in terms of environmental, or external, influences, without any consideration of internal mental states or processes.

The fundamental procedure used by Skinner in his 1938 experiment has been repeated thousands of times by Skinner, his colleagues and subsequent researchers. The records of their observations and measurements enabled Skinner and other researchers to identify reliable principles of operant conditioning that have been generalised to humans.

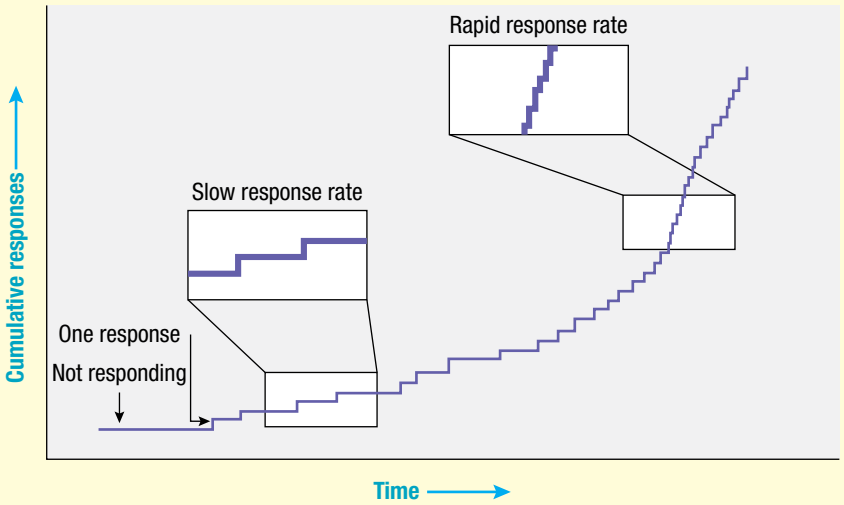

Figure 5.22 Typical response curve for a rat in a Skinner box learning to press a lever in order to get a reward

LEARNING ACTIVITY 5.8

Review questions

1. (a) What is operant conditioning?
(b) In what way is it a form of associative learning?

2. Explain what an operant is with reference to an example not used in the text.

3. (a) In what way do classical and operant conditioning differ in terms of the organism's control over the behaviour that may be elicited by a stimulus?
(b) Explain how classical conditioning occurs with reference to an antecedent stimulus.

4. (a) Explain what the three-phase model of operant conditioning is with reference to the relationship between each phase.
(b) What is the main difference between an antecedent and a consequence in relation to timing?
(c) Make a copy of the representation of the three-phase model in Figure 5.18 and include a more detailed description for each phase.

5. In what way is an antecedent stimulus a 'discriminative stimulus'?

6. Charlotte experienced the 'runner's high' (due to endorphin release) when she ran a mini-marathon and as a result has started running 10 kilometres three times a week. Explain Charlotte's changed behaviour using the language of the three-phase model of operant conditioning.

7. Consider toddler Alex who is being toilet-trained by her parents using operant conditioning. Her parents wait until after Alex has had a drink and her bladder is full, then put her on a potty seat and wait for nature to take its course. When Alex urinates in the potty, her parents provide verbal praise ('What a good girl you are, Alex!') or even some stickers that she loves. She is also punished when she has a wetting accident by verbal disapproval ('Mummy is very disappointed in you, Alex'). Gradually, Alex learns enough bladder control to recognise when urination is imminent, and to withhold the response long enough for a quick trip to the potty seat — thus obtaining a reward and avoiding punishment. Eventually, the behaviour becomes automatic enough that Alex continues to use the potty seat.
Explain Alex's successful toilet training using the language of the three-phase model of operant conditioning. Ensure you refer to each component with reference to the relevant aspect(s) of Alex's toilet training.

LEARNING ACTIVITY 5.9

Reflection

Skinner believed our behaviour is determined by events in the form of consequences for our actions that are sourced in the environment. In describing operant conditioning, he therefore avoided the term 'voluntary' because it would suggest that our behaviour was due to conscious choice or intention, while it is actually under the control of environmental variables.

Comment on whether our behaviour is truly voluntary or determined by consequences using an example to illustrate your view.

LEARNING ACTIVITY 5.10

Evaluation of research by Skinner

Consider Skinner's experiments with rats summarised in Box 5.6 on pages 296–7 and answer the following questions.

1. Briefly outline a procedure for an experiment using a Skinner box to:
   (a) operantly condition a rat to produce a particular response
   (b) operantly condition a rat *not* to produce a particular response.

2. (a) Identify the operationalised independent and dependent variables in Skinner's (1938) experiment with the hungry rat.
   (b) Formulate a research hypothesis that would be supported by the results.
   (c) Explain the rat's learning through operant conditioning using the three-phase model of conditioning.

3. What conclusion did Skinner draw about the main driving forces behind behaviour?

Reinforcers

When you are training your dog to 'shake hands' and you give it a treat, pat it on the head or say 'good dog' when it behaves the way you want it to, you are using reinforcement. Similarly, using an umbrella to prevent yourself from getting wet when it rains is a kind of reinforcement. So, reinforcement may involve receiving a pleasant stimulus (the dog receiving a treat) or 'escaping' an unpleasant stimulus (avoiding getting wet by using an umbrella). In either case, the consequence or outcome is one that is desired by the organism performing the behaviour.

Reinforcement is said to occur when a stimulus strengthens or increases the frequency or likelihood of a response that it follows. This may involve using a positive stimulus or removing a negative stimulus to subsequently strengthen or increase the frequency or likelihood of a preceding response or operant. An essential feature of reinforcement is that it is only used *after* the desired or correct response is made. A **reinforcer** is any stimulus that strengthens or increases the frequency or likelihood of a response that it follows. Note that the term reinforcement may be used in relation to the process of administering a reinforcer, in relation to the consequence of a reinforcer, and sometimes in relation to the stimulus and therefore interchangeably with the term reinforcer.

Note also that the term 'reinforcer' is often used interchangeably with the term 'reward'. Although they are not technically the same, many psychologists accept that they are similar enough to be used interchangeably. One difference is that a reward suggests a consequence that is positive, such as satisfaction or pleasure. A stimulus is a reinforcer if it *strengthens* the preceding behaviour. In addition, a stimulus can be rewarding because it is pleasurable, but it cannot be said to be a reinforcer unless it increases the frequency of a response or the likelihood of a response occurring. For example, a person might enjoy eating chocolate and find it pleasurable, but chocolate cannot be considered to be a reinforcer unless it promotes or strengthens a particular response.

Positive reinforcer

Many of Skinner's early experiments on operant conditioning were conducted with hungry rats in an apparatus that has come to be known as a 'Skinner box' (see Box 5.6). In some experiments, the rats were conditioned to press a lever to obtain a food pellet. This was used as a positive reinforcer for making the correct response — pressing the lever would achieve a satisfying consequence, especially when hungry. Similarly, a high grade on a SAC is a positive reinforcer for a student who works hard, as is the thanking of a friend for doing you a favour. These examples also illustrate why the term *reward* is often used to describe a positive reinforcer.

A **positive reinforcer** is a stimulus that strengthens or increases the frequency or likelihood of a desired response by providing a satisfying consequence. The process of **positive reinforcement** involves giving or applying a positive reinforcer after the desired response has been made.

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Figure 5.23 A positive reinforcer strengthens or increases the frequency or likelihood of a desired response by providing a satisfying consequence. The reinforcer does not have to be a physical object. For example, teacher praise for answering a classroom question can be a reinforcer.

Negative reinforcer

On a rainy day, if you want to avoid the unpleasant experience of having wet clothes, you could use an umbrella. If the umbrella successfully kept you dry, the next time it rained you would probably use it again. The increased likelihood of using an umbrella makes this behaviour one that has been negatively reinforced. The increase in its likelihood is based on the avoidance of something unpleasant (wearing wet clothes).

A **negative reinforcer** is any unpleasant or aversive stimulus that, when removed or avoided, strengthens or increases the frequency or likelihood of a desired response. For example, a Skinner box has a grid on the floor through which a mild electrical current can be passed continuously. If a rat is placed in the box it can be given a foot shock that is an unpleasant stimulus. When the rat presses the lever on a wall of the box, the electric current is switched off and the mild shock is taken away. The removal of the shock (negative reinforcer) is referred to as negative reinforcement.

The process of **negative reinforcement** involves the removal of an unpleasant stimulus. It has the effect of increasing the likelihood of a response being repeated, thereby strengthening the response. Thus, the likelihood of the lever-pressing response will increase because the negative reinforcer (the shock) is removed as a consequence of this lever-pressing behaviour.

An important distinction between the processes of positive and negative reinforcement is that positive reinforcers are *given* and negative reinforcers are *removed* or *avoided*. However, because both procedures lead to desirable or satisfying consequences, each procedure strengthens ('reinforces') the behaviour that produced the consequence.

Negative reinforcers are evident in many aspects of everyday life. For example, when you turn off a scary movie, cover your eyes or walk away, you remove a negative event (fear associated with the movie) and the avoidance behaviour is negatively reinforced. The next time you watch a movie and a frightening scene comes on, you are more likely to repeat your avoidance behaviour. In this way, operant conditioning can *perpetuate* avoidance behaviour

Figure 5.24 In real life, reinforcement is not necessarily a one-way street. Children and parents continually reinforce each other. By stopping a tantrum when they get their way, the child negatively reinforces the parent. However, by giving in to the child and providing what was sought, the parent is positively reinforcing the tantrum-throwing behaviour.

through negative reinforcements (also see Chapter 13, specific phobia, page 640). Similarly, if after taking an aspirin the pain from a headache subsides, the behaviour of taking an aspirin has been negatively reinforced and it is likely you will take an aspirin the next time you have a headache. And when a P-plate driver decides not to drink alcohol at a party for fear of losing their licence if caught driving, a negative reinforcer (loss of licence) is at work. In these examples, the *removal* of the negative reinforcer is providing a satisfying or desirable consequence.

Positive and negative mean good and bad. But do not fall into the trap of giving them these meanings when using them in relation to operant conditioning. In operant conditioning, 'positive' and 'negative' mean 'added' and 'subtracted'.

To help you remember this difference, consider linking the terms with mathematical symbols:

- positive (+) reinforcer = adding something pleasant
- negative (−) reinforcer = subtracting something unpleasant.

Figure 5.25 Vasco drives safely and obeys all the road laws so that he can become a 'Rating 1' driver and save on his insurance premium (positive reinforcement). Emma drives safely and obeys all the road laws to avoid getting any more traffic fines and licence demerit points (negative reinforcement).

BOX 5.7 Shaping behaviour through operant conditioning

In one experiment, Skinner decided to train a pigeon to turn a full circle in an anticlockwise direction. This behaviour, like most other behaviour in everyday life, does not occur spontaneously. In order to provide reinforcement and condition the desired behaviour, Skinner would have had to wait around for a long time for that behaviour to occur spontaneously. When Skinner placed the pigeon in a Skinner box its behaviour was, not surprisingly, entirely random. In order to get the pigeon to perform the target behaviour, Skinner used the operant conditioning procedure called shaping to gradually 'mould' or 'edge' the pigeon's responses to the target behaviour.

Shaping is a procedure in which a reinforcer is given for any response that successively approximates and ultimately leads to the final desired response, or target behaviour. Consequently, shaping is also known as the *method of successive approximations*.

In using a shaping procedure, Skinner initially continuously reinforced the pigeon. He reinforced it with a food pellet, which was delivered through a mechanically operated door every time it turned slightly to the left. All other responses were ignored. Once the pigeon's response of making a slight turn to the left had been conditioned, reinforcement was no longer provided for this response. Instead, Skinner waited until the pigeon turned a little further left before giving any further reinforcement. By limiting reinforcement to only those responses that gradually edged towards the target behaviour, and ignoring all other responses, Skinner was able to train the pigeon to turn complete circles regularly.

The pigeon learned to perform the desired response because it was reinforced for each successive step leading to the target behaviour, but not for any of the former responses. This reinforcement strategy increased the likelihood of progressive steps ('approximations') being taken towards the final response of turning a full circle in an anticlockwise direction.

Shaping is used when the desired response has a low probability of occurring naturally. Through programmed use of successive reinforcements, animals and people can be conditioned to perform many complex behaviours, as long as the organism is capable of performing the behaviour.

Figure 5.26 The operant conditioning procedure called shaping can be used to teach a chicken to play a tune on the xylophone. Can you explain how this could be done?

Many 'tricks' performed by animals in TV and movie productions, and in animal shows such as at Sea World, have been learned through shaping. The shaping to train animals has not been restricted to entertainment purposes. It has also been used to benefit society. For example, shaping is used to teach dogs tracking skills for use in search-and-rescue operations and detection skills to 'sniff out' bombs, drugs and restricted items at airports or public venues, and to do guide work and be companions for individuals with serious visual impairments.

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Document
How to shape the chicken

Video
Training a dog to turn on a light switch 4m 04s

eGuide*plus*

Shaping behaviour activity

LEARNING ACTIVITY 5.11

Review questions

1. Define the term reinforcement with reference to an example.
2. Explain the meaning of the terms positive reinforcer and negative reinforcer.
3. In what way are positive reinforcers and rewards similar and in what way are they different?
4. For each of the following examples involving negative reinforcement, identify the aversive (unpleasant) stimulus and the behaviour being strengthened by its avoidance or removal.
   (a) Smoking a cigarette in order to relieve anxiety.
   (b) Giving in to an argument.
   (c) Turning down the volume of a very loud radio.
   (d) Hurrying home to escape a thunderstorm.
   (e) Fanning oneself on a very hot day to escape the heat.
   (f) Putting on a car safety belt to stop an irritating clanging sound.
   (g) Obeying prison rules in order to be released from solitary confinement.
5. (a) What do positive and negative reinforcers have in common in relation to their consequences?
   (b) Identify three positive and negative reinforcers that you have observed teachers use in the classroom and three that you have observed in other real-life contexts.
   (c) How are positive and negative reinforcers different?
6. Arup is an excellent athlete who plans to become an Olympian sprinter. Last time he raced competitively he forgot to take off the red sweat band around his wrist and he won his only event. Arup will now wear the red sweat band every time he competes because he believes it is his lucky charm.
   (a) Using the language of the three-phase model of operant conditioning, explain how Arup has learned to wear the red sweat band every time he competes.
   (b) Wearing the red sweat band in all future races is an example of what Skinner considered to be superstitious behaviour. Give another example of a superstitious behaviour and explain how it may have been acquired through operant conditioning.

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Practical activity
Operant conditioning of a verbal response

Punishment

If you are caught exceeding a speed limit while driving, you will receive a fine and one or more demerit points. This is an unpleasant consequence intended to reduce this type of speeding behaviour in future. Alternatively, if you continue to exceed a speed limit after receiving a number of speeding fines and demerit points, you may have your licence taken away (an unpleasant consequence). In both examples, the consequence is punishment of the unwanted behaviour with the intention of weakening, reducing the frequency of or eliminating the behaviour.

Punishment is the delivery of an unpleasant consequence following a response, or the removal of a pleasant consequence following a response. Punishment has the same unpleasant quality as a negative reinforcer, but unlike a negative reinforcer, the punishment is given or applied, whereas the negative reinforcer is prevented or avoided. The consequence or outcome of punishment is the opposite to removal of a negative reinforcer. When closely associated with a response, punishment *weakens* the response or *decreases* the probability of that response occurring again over time.

As with reinforcement, Skinner (1953) distinguished between positive and negative punishment. Again, as with reinforcement, consider the mathematical terms of adding (+) and taking away (–), rather than good and bad or the 'feelings' of the recipient.

Positive punishment involves the presentation (or introduction) of a stimulus, thereby decreasing (or weakening) the likelihood of a response occurring again. For example, an electric shock for a rat in a Skinner box, or having to run extra laps around a basketball court for being late to training, or being given extra chores at home for doing something wrong all involve positive punishment.

Negative punishment involves the removal or loss of a stimulus and thereby decreasing (or weakening) the likelihood of a response occurring again. For example, taking food away from a hungry rat, not being allowed to join basketball training because you are late, or your parents taking away your internet access for doing something wrong all involve negative punishment. Note that in *both* positive and negative punishment, the intended effect on the punished behaviour is to weaken and prevent it from recurring.

Response cost

Since negative punishment involves taking a stimulus away as a consequence of a particular response, it is often referred to as response cost. More specifically, **response cost** may be described as involving removal of any valued stimulus, whether or not it causes the behaviour. There is a 'cost' for making a 'response'; therefore, the term 'response cost'.

For example, if you get a speeding fine, your money (a valued stimulus) is taken away from you. In addition, the stimulus of money was unlikely to have been the reason (or 'cause') for your speeding! Therefore, a speeding fine is considered to be a response cost, but also negative punishment, as something of value has been taken away. It is a form of punishment because it decreases the likelihood of a behaviour occurring.

Response cost does not necessarily involve something of *monetary* value. For example, loss of a grade or two for late submission of a SAC (without medical evidence) is a response cost that can decrease the likelihood of lateness in the future. Similarly, making a rude comment during a conversation might result in the loss of a smile. This would be the response cost if the smile is a valued stimulus. Response cost for rudeness to a classroom teacher might be loss of valued recess time through detention.

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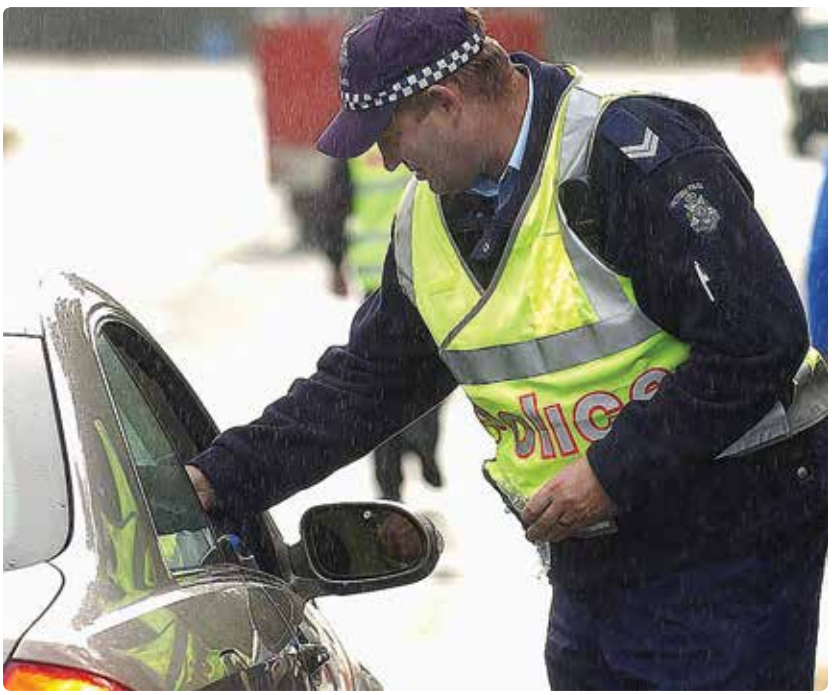

Figure 5.27 A speeding fine is negative punishment involving response cost. The use of the term response cost describes the fact that the specific 'response' of driving too fast has a 'cost' to the individual when caught.

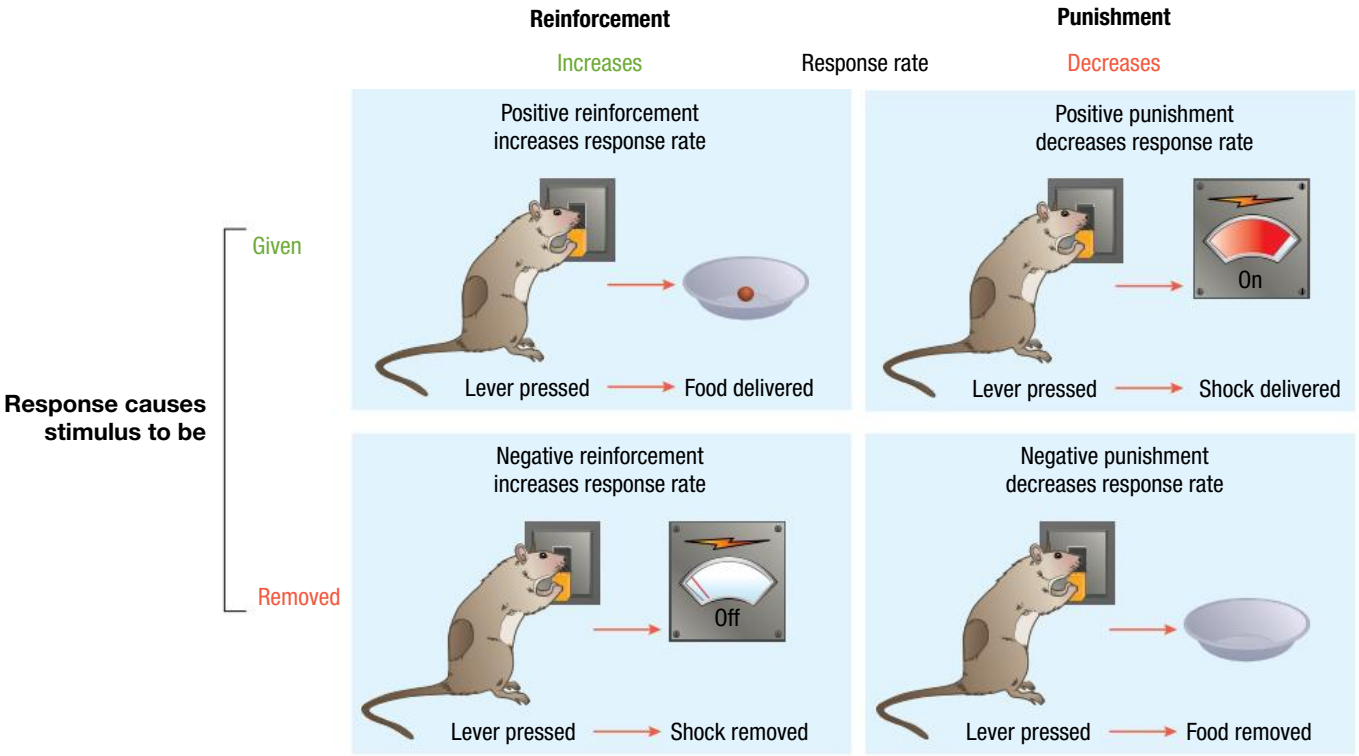

Figure 5.28 Comparing types of reinforcement and punishment

BOX 5.8 Factors that influence the effectiveness of reinforcement and punishment

In operant conditioning, what happens *after* the correct or desired response is performed is very important in determining the strength of learning and the rate at which it occurs. In addition, it is not just *whether* a response is reinforced or punished that influences the learning process. Other factors associated with reinforcement also play important roles in affecting learning. For instance, *when* in the process of operant conditioning the consequence (reinforcer or punisher) is presented, the *time lapse* between the response and consequence, and the *appropriateness* of the consequence are all important in determining the effectiveness of reinforcement and punishment, and therefore learning through operant conditioning.

Order of presentation

To use a reinforcer and punisher effectively it is essential that either be presented *after* a desired response, never before. This helps to ensure that the organism learns the consequences of a particular response.

Timing

Use of either reinforcement or punishment is most effective when given *immediately after* the response has occurred. This timing helps to ensure that the organism associates the response with the reinforcer or punisher, without interference from other factors during the time delay. Timing also influences the strength of the response. If there is a considerable *delay* between the response and the consequence, learning will generally be very slow to progress and in some cases may not occur at all.

Appropriateness

For any stimulus to be a reinforcer, it must provide a pleasing or satisfying consequence for its recipient. For example, a place in a course at a university would not be an effective reward to a student who intends to work in their family's business at the end of Year 12. However, a holiday at a tropical resort before the student started paid work might be considered much more desirable, and would therefore be a more effective reinforcer.

Similarly, for any stimulus to be an appropriate punisher, it must provide a consequence that is unpleasant and therefore likely to decrease the likelihood of the undesirable behaviour. An inappropriate punisher can have the opposite effect and produce the same consequence as a reinforcer. For example, a talkative, attention-starved Year 8 boy may respond to being verbally reprimanded in class — his teacher's intended punisher — by increasing his talkative behaviour. For him, the verbal scolding at least gives him the attention he desires, and this attention then acts as a reinforcer for the talkative behaviour.

(continued)

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Although punishment may temporarily decrease the occurrence of unwanted responses or behaviour, it does not promote more desirable or appropriate behaviour in its place. Throughout his career as a behavioural psychologist, Skinner remained strongly opposed to the use of punishment in everyday life. Instead, he advocated the greater use of positive reinforcement to strengthen desirable behaviours or to promote the learning of alternative behaviours to punishable behaviours (Skinner, 1974).

(a)

(b)

Figure 5.29 (a) For any stimulus to be a reinforcer, it must provide a pleasing or satisfying consequence for its recipient, such as a cake provides for this girl. (b) Similarly, for any stimulus to be a punisher, it must provide a consequence that is unpleasant for its recipient, such as loss of access to their mobile phone.

BOX 5.9 Token economies: Applying reinforcement and response cost

Token economies are a form of behaviour modification involving application of operant conditioning principles to influence behaviour change. More specifically, a *token economy* is a setting in which an individual receives tokens (reinforcers) for desired behaviour and these tokens can then be collected and exchanged for other reinforcers in the form of actual, or 'real', rewards.

Reinforcement is a crucial component of a token economy. For example, in a prison, a token (or a substitute such as a point(s), a docket, play money or whatever) may be received for being quiet after lights out and this may be 'cashed in' for rewards such as snacks and privileges. In the psychiatric ward of a hospital, certain psychotic symptoms of a patient with schizophrenia may be reduced by ignoring their descriptions of delusions (false beliefs) and positively reinforcing appropriate 'social talk' by providing tokens when this occurs.

Response cost may also be used in a token economy. For example, in many of these miniature economies that are similar in some ways to an actual larger economy in the real world, penalties are used and individuals are 'fined' a certain number of tokens for inappropriate behaviour.

Token economies have been successfully established in a variety of settings such as schools, play therapy groups, psychiatric wards, prisons and family homes. They have been used to increase reading by students, decrease television watching or digital media use by children, improve social skills of people with an intellectual disability, and so on.

Figure 5.30 In this token economy classroom, student behaviour is reinforced with varying amounts of points which can be used to 'buy' reinforcers, such as free time, playing an iPad game or a treat.

LEARNING ACTIVITY 5.12

Review questions

1. (a) Define the term punishment.
(b) Explain what punishment involves and why it is used, with reference to an example not given in the text.
2. Distinguish between positive and negative punishment with reference to an example not used in the text.
3. (a) What is response cost?
(b) Explain why it is a form of negative punishment with reference to an example not used in the text.
(c) 'Time out' involving removal of a child from a situation is sometimes used as a punisher by parents and teachers. Explain how it can be a form of response cost at home and in a classroom.
4. How does punishment differ from negative reinforcement? Explain with reference to an example.
5. Describe a situation in which a punisher might *reinforce* a behaviour rather than weaken it or reduce its frequency.
6. Analyse and describe the following scenario using the language of the three-phase model of operant conditioning. Also indicate whether the scenario is an example of positive or negative reinforcement, or punishment. Explain your choice.

Zeta's dog Belle keeps escaping from the backyard by crawling through a gap under the fence. Zeta purchases a small detector that she places either side of the gap and puts a collar on Belle that makes a high-pitched noise whenever she gets too close to the gap. The first time Belle tries to escape under the gap, the noise plays and distresses her. Soon Belle learns to avoid the noise by staying inside the backyard.

LEARNING ACTIVITY 5.13

Distinguishing between reinforcement and punishment

Identify the operant conditioning process that is being illustrated in each of the following examples. Choose from positive reinforcement (PR), negative reinforcement (NR), positive punishment (PP) and negative punishment (NP). Write the initials of the correct responses in the spaces provided.

1. When Lina turns the shopping trolley down the lolly aisle, her two-year-old son, Ali, starts screaming, 'Want lollies! Lollies!' Lina moves to another aisle, but Ali continues to scream. As other customers begin staring and Lina starts to feel embarrassed, she finally gives Ali a bag of lollies. Ali is now more likely to scream in a supermarket when he wants lollies because he has experienced _____.
2. If Lina is more likely to give in to Ali's temper tantrums in public situations in the future, it is because she has experienced _____.
3. Feeling sorry for an apparently homeless person sitting outside a bakery, Christopher offers him a $2 coin. The person snarls at Christopher and tries to grab his leg in a threatening manner. Christopher no longer offers money to homeless people in the street because of _____.
4. Justin is caught using Facebook on his work computer and is reprimanded by his team leader. Justin no longer accesses Facebook on his work computer because of _____.
5. As you walk down the corridor between classes, you spot a student you greatly dislike. You immediately duck into an empty classroom to avoid an unpleasant interaction with them. Because _____ has occurred, you are more likely to take evasive action when you encounter people you dislike in the future.
6. Having watched Superman fly in a movie, three-year-old Tran climbs onto the kitchen table, then launches himself into the air, only to fall onto the tiles and hurt himself. Because Tran experienced _____, he tried this stunt only once.
7. Thinking she was making a good impression in her new job by showing how knowledgeable she was, Sana corrected her team leader in two different meetings. Not long after the second meeting, Sana lost her job because the company said it was making her position redundant. Because she experienced _____, Sana no longer publicly corrects her superiors.
8. Vitas is told to wash out the rubbish bin when caught hitting his brother. He hates this chore.

Source: Adapted from Hockenbury, D.H. & Hockenbury, S.E. (2006). *Psychology* (4th ed.). New York: Worth. p. 218.

LEARNING ACTIVITY 5.14

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Word copy of table

Concept summary

Complete the following table to summarise reinforcers and punishers.

Concept	Description	Example
positive reinforcer		
negative reinforcer		
positive punisher		
negative punisher		
response cost		

LEARNING ACTIVITY 5.15

Reflection

On the basis of relevant operant conditioning theory, comment on which you believe to be most effective — reinforcement, punishment or a combination of both — in promoting desirable behaviour by children. Explain whether your answer would equally apply to adolescents and adults.

Stimulus generalisation

In operant conditioning, **stimulus generalisation** occurs when the correct response is made to another stimulus that is similar (but not necessarily identical) to the stimulus that was present when the conditioned response was reinforced. This response usually occurs at a reduced level (frequency or strength), as illustrated by an experiment in which a pigeon was trained to peck at a switch mounted on the wall of a Skinner box. The switch was lit by a green light. When the pigeon was presented with lights of varying colours, it generalised the original stimulus (pecking the switch lit by a green light) and pecked at the other coloured switches as well. However, as shown in Figure 5.31 below, as the stimulus (light) shifted further away from the original colour (green), the less frequent was the pigeon's response (Olson & King, 1962).

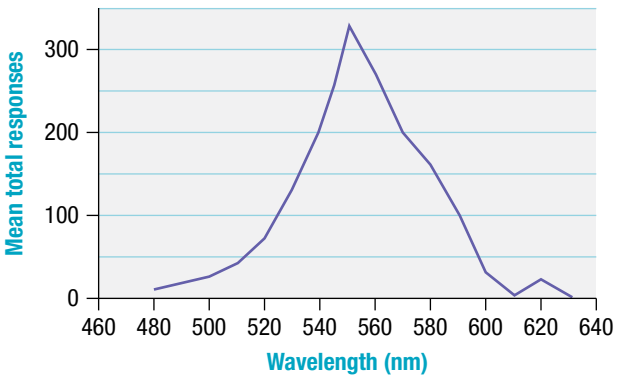

Figure 5.31 Results showing the pigeon's generalisation of the original stimulus of a green light to other colours. The numbers for wavelengths of light indicate different colours.

Outside the laboratory, in our everyday life, we frequently generalise our responses from one stimulus to another. For example, our generalisations from past experiences with people, events and situations influence many of our likes and dislikes of new people, events and situations.

Stimulus discrimination

In operant conditioning, **stimulus discrimination** occurs when an organism makes the correct response to a stimulus and is reinforced, but does not respond to any other stimulus, even when stimuli are similar (but not identical).

Skinner taught laboratory animals to discriminate between similar stimuli by reinforcing some responses and not others. For example, a pigeon in a Skinner box could be taught to discriminate between a red and a green light. If the pigeon was reinforced every time it pecked at a disk while a green light was illuminated, but never reinforced for pecking the disk when a red light shone, it would soon learn to discriminate by responding only when the green light was on. When this occurs, the green light has become an antecedent or discriminative stimulus.

A useful application of conditioning an animal to learn and then use an antecedent (discriminative) stimulus is with sniffer dogs by police, customs and border protection officers to find hidden drugs, explosives and other illegal goods but to ignore other smells.

Figure 5.32 Stimulus discrimination is demonstrated by sniffer dogs trained to detect the presence of illegal drugs or banned produce.

Extinction

In operant conditioning, extinction may also occur, and the process is similar to its occurrence in classical conditioning. In operant conditioning, **extinction** is the gradual decrease in the strength or rate of a conditioned (learned) response following consistent non-reinforcement of the response. Extinction is said to have occurred when a conditioned response is no longer present.

In classical conditioning, extinction takes place over a period when the unconditioned stimulus (UCS) is withdrawn or is no longer present. With operant conditioning, extinction also occurs over time, but after reinforcement is no longer given (see Figure 5.33a below). For instance, when Skinner stopped reinforcing his rats or pigeons with food pellets, their conditioned response (e.g. of lever-pressing or turning circles) was eventually extinguished.

Spontaneous recovery

As in classical conditioning, extinction is often not permanent in operant conditioning. After the apparent extinction of a conditioned response, **spontaneous recovery** can occur and the organism will once again show the response in the absence of any reinforcement. The response is likely to be weaker and will probably not last very long (see Figure 5.33b). A spontaneously recovered response is often stronger when it occurs after a lengthy period following extinction of the response than when it occurs relatively soon after extinction.

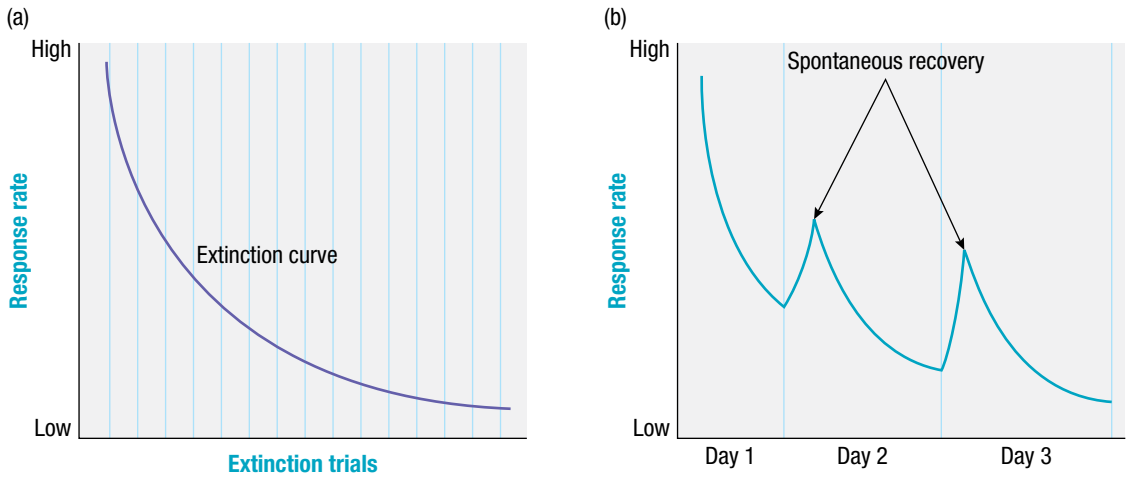

Figure 5.33 (a) An 'ideal' curve for the extinction of an operantly conditioned response following the withdrawal of the positive reinforcer. (b) The spontaneous recovery of the conditioned response following its extinction. Note that the recovered response does not last very long and appears to be weaker than the original response.

Comparing classical and operant conditioning

While classical and operant conditioning are two different types of learning, they have some common features. In both classical and operant conditioning there is an *acquisition* process whereby a response is conditioned or learned. In classical conditioning, the association of two stimuli, the NS and UCS, provides the basis of learning. In operant conditioning, behaviour is associated with consequences that follow it. In addition, both types of conditioning are achieved as a result of the repeated *association* of two events that follow each other closely in time.

In both types of conditioning, *extinction* of the learned response can occur. In classical conditioning, extinction takes place over a period when the UCS is withdrawn or is no longer present and the CS is repeatedly presented alone. For instance, when this happened in Pavlov's experiments, the dog eventually ceased salivation (CR) in response to the bell (CS) alone (which had been previously paired with the UCS). In operant conditioning, extinction also occurs over time, but after reinforcement is no longer given. For instance, when Skinner stopped reinforcing his rats with food, their lever-pressing was eventually extinguished. In both classical and operant conditioning, extinction can be interrupted by *spontaneous recovery*. In addition, *stimulus generalisation* and *stimulus discrimination* can occur with both types of conditioning.

Figure 5.34 Is this an example of classical or operant conditioning?

These similarities in the two types of conditioning have led some psychologists to propose that both classical and operant conditioning are variants of a single learning process, especially as classical and operant conditioning often occur in the same situation. For instance, when 'Little Albert' learned to fear the rat, his response (trembling) was classically conditioned. But when he learned to avoid the rat by crawling away (a response that had the effect of reducing his fear), that was an example of operant conditioning. In relation to the acquisition of conditioned emotional responses, psychologists now use classical conditioning to account for the *acquisition* of the response and operant conditioning to account for the *perpetuation* (or maintenance) of the response (see page 641).

There are a number of other major differences between classical and operant conditioning. In operant conditioning the *consequence* of a response is a vital component of the learning process in that a behaviour becomes more or less likely, more or less frequent, or strengthened, depending on its consequence. In classical conditioning, the behaviour of the organism does *not* have any environmental consequence. For example, in Pavlov's experiments, the dog receives food whether or not it salivated. But in operant conditioning, the organism's response (such as lever-pressing) operates or produces effects on the environment (such as the dispensing of a food pellet). These effects or consequences, in turn, influence the recurrence of the response.

Classical and operant conditioning also generally involve different types of responses. In classical conditioning, the response is *involuntary*; an automatic reaction to something happening in the environment (such as the sight of food or the sound of a bell). Operant conditioning, however, involves *voluntary* responses that are initiated by the organism (such as throwing a tantrum or doing homework), as well as involuntary responses.

The role of the learner

In classical conditioning, the learner is a *passive* participant in the conditioning process. The learner does not have to do anything for the NS, CS or UCS to be presented. Furthermore, the response made by the learner occurs automatically without them having to make any effort or actively do anything. The learner essentially has no control over the learning process.

In operant conditioning, the learner is an *active* participant in the learning process. The learner must operate on the environment before reinforcement or punishment is received. The learner is neither reinforced nor punished without performing the behaviour that produces the consequence. In this sense, the learner has control over the learning process.

Timing of the stimulus and response

In classical conditioning, the response (e.g. salivation) depends on the presentation of the UCS (e.g. meat powder) occurring first. In operant conditioning, the presentation of the reinforcer or punisher depends on the response occurring first. The response (e.g. pushing the lever) occurs in the presence of a stimulus (e.g. the lever). The reinforcement (e.g. the food pellet) or punisher received as a consequence of the response strengthens or weakens the stimulus–response association.

In classical conditioning, the timing of the two stimuli (NS, then UCS) produces an association between them that conditions the learner to anticipate the UCS and respond to it even if it is not presented. In operant conditioning, the association that is conditioned is between the stimulus (i.e. the lever in a Skinner box) and the response (to push the lever). The response is either strengthened by reinforcement or weakened through punishment.

In classical conditioning the timing of the two stimuli (NS, then UCS) needs to be very close (ideally about half a second) and the sequencing is vital — the NS must come before the UCS. In operant conditioning, while learning generally occurs faster when the reinforcement or punishment occurs soon after the response (behaviour), there can be a considerable time difference between them (especially in humans).

The nature of the response

In classical conditioning, the response by the learner is usually a reflexive involuntary one (e.g. salivating or blinking). In operant conditioning, the response by the learner is usually a voluntary one (e.g. pressing a lever, using an umbrella) but may also be involuntary.

In classical conditioning, the response is often one involving the action of the autonomic nervous system, and the association of the two stimuli is often not conscious or deliberate. In operant conditioning, the response may involve the autonomic nervous system but often involves higher order brain processes because the response is conscious, intentional and often goal-directed.

Figure 5.35 In operant conditioning, the learner is an 'active' participant in the learning process; in classical conditioning, the learner is a 'passive' participant. This pokie machine player must pay then push a button to receive reinforcement, but he is left guessing as to when a payout might occur.

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TED-Ed animation on the difference between classical and operant conditioning 4m 12s

LEARNING ACTIVITY 5.16

Review questions

1. Define each of the following terms in relation to operant conditioning and give an example of their occurrence in (a) a laboratory experiment, and (b) everyday life:
- stimulus generalisation
- stimulus discrimination
- extinction
- spontaneous recovery

2. How does punishment differ from extinction? Explain with reference to an example.

3. Which of the following scenarios involve stimulus generalisation? Which involve stimulus discrimination?
(a) Lauren asks Gino out on a date but he declines. Lauren decides that she will not ask another boy out again.
(b) Toula is paid for doing chores around the home and expects to be paid for doing chores at her aunty's place when she stays there.
(c) Jackson is scared of the sound of a lawnmower but not the sound of an electric toothbrush.
(d) Sam is scared of the sound of his dad's electric drill. When his dad stops using the drill Sam relaxes. Sam's dad then reaches for the electric saw. As soon as Sam sees this, he is scared and runs inside.

4. A teacher cannot conduct her lesson because the students are rowdy and inattentive in the last period, so she lets them out early.
(a) What are the students learning?
(b) Explain with reference to operant conditioning processes.

5. Maria had enjoyed attending the same P–12 college for ten years. Quite suddenly this year, her friendship group drifted away from her. She is now being bullied by some other girls because she has become a 'loner'. After an unsuccessful attempt to solve her problems by speaking with her year-level coordinator, Maria started to take days off school, telling her mother she wasn't feeling well. Her absenteeism increased. Although she was concerned about missing school, she couldn't face the unpleasant actions of the bullies.
(a) Which operant conditioning process explains the increase in Maria's behaviour of deceiving her mother and staying home from school? Explain how this process worked in Maria's situation.
(b) Which operant conditioning process describes the consequence of the bullying behaviour for Maria? Explain its effect on Maria's attendance behaviour.

6. Choose one of the following examples and briefly explain how operant conditioning could be used for a solution. Your explanation should use operant conditioning terms where relevant.
- increase the number of people who use a car-pooling arrangement to travel to and from work
- encourage energy conservation in homes and at work
- encourage motor vehicle drivers and passengers to use seatbelts
- encourage students to use rubbish bins in the schoolyard during recess and lunchtime
- discourage cigarette smoking by adolescents
- discourage gambling on pokie machines
- improve the study habits of a VCE student

LEARNING ACTIVITY 5.17

Analysis of data

An inexperienced teacher was having difficulties controlling the behaviour of students in his Year 10 English class. This was stressing him considerably so he consulted a psychologist, who agreed to help him. In order to precisely identify the nature of the difficulties experienced by the teacher, the psychologist unobtrusively observed him in the classroom for twelve 50-minute lessons over three weeks. He prepared a report from which extracts are presented below.

Read the report and answer the questions that follow.

Teacher: male, 24-years-old, fully qualified with a Bachelor of Arts and a Diploma of Education, one month's experience as a replacement teacher and four months' full-time teaching experience

Students: 14 boys and 16 girls with a mean age of 16.2 years; many have reading difficulties or other language problems; two students are repeating Year 10; all live locally

Class behaviour: measurements of students' behaviour during class time included:
- inappropriate talking: 29% of class time
- inappropriate turning around: 17% of class time
- walking around the classroom without permission: 12% of class time
- calling out to the teacher: 9% of class time.

Teacher's behaviour: responded to inappropriate talking about 25% of the time, usually with 'shhh' and 'be quiet' (most of these responses were directed at the whole class and rarely to offending individual students); responded to 6% of the turning around behaviour, always with the comment 'turn around'. Other inappropriate student behaviour was generally ignored and he continued trying to teach 'over the top' of this. On eight occasions he made general threats; for example, detention for the class, not allowing the class to go on a planned excursion. These were never carried out. During the observation period in which the baseline data was recorded, he was never observed to take notice of appropriate behaviour; for example, give praise for not talking.

1. What is the purpose of baseline data in this particular study?

2. Explain the difficulties experienced by the teacher with reference to the data and three operant conditioning processes.

3. Make two suggestions involving operant conditioning processes to help the teacher overcome the difficulties with his class.

LEARNING ACTIVITY 5.18

Evaluation of research and procedures to change a student's behaviour

A group of preschool teachers worked with a team of psychologists in applying operant conditioning processes to help a young girl overcome her shyness when playing with her peers. The girl spent most of her time at the preschool standing close to her teachers rather than playing with children her own age, and the teachers were concerned that this was interfering with her social development. Like most young children, the girl enjoyed teacher praise, so it was decided that the teachers would only praise her when she played with her peers, and ignore her when she stayed close to them. The results of using praise in this way are shown in Figure 5.36 below.

In order to measure learning of the desired response, the teachers initially recorded the frequency with which the little girl played with other children and the frequency with which she interacted with adults. They then began using praise whenever she played with her peers, but gave her very little attention for other interactions. To be certain that the praise alone was responsible for the behavioural change, the teachers stopped using it for a time and then reintroduced it. This is shown in the third and fourth sections of Figure 5.36. These graphs indicate that the little girl began interacting with adults again once the praise ceased (third section), and recommenced interacting with her peers once the praise was used again (fourth section).

1. What is the operationalised independent variable?
2. On which days was the 'control' condition conducted?
   (i) What was the purpose of this condition in this particular study?
   (ii) Write a single word header for section 1 of the graph.
3. In which condition was the young girl's interaction with other children at its lowest? At its highest? What do these data tell you about the success or failure of the program devised by the team of psychologists and undertaken by the teachers?
4. Identify the key elements of operant conditioning, in terms of the three-phase model, that are evident in this study during the
   (i) 'control' condition before intervention
   (ii) post-intervention.
5. What are two key features of the reinforcement strategy used for behaviour change?
6. Why did the teachers stop using praise with the young girl for a time and then recommence its use?

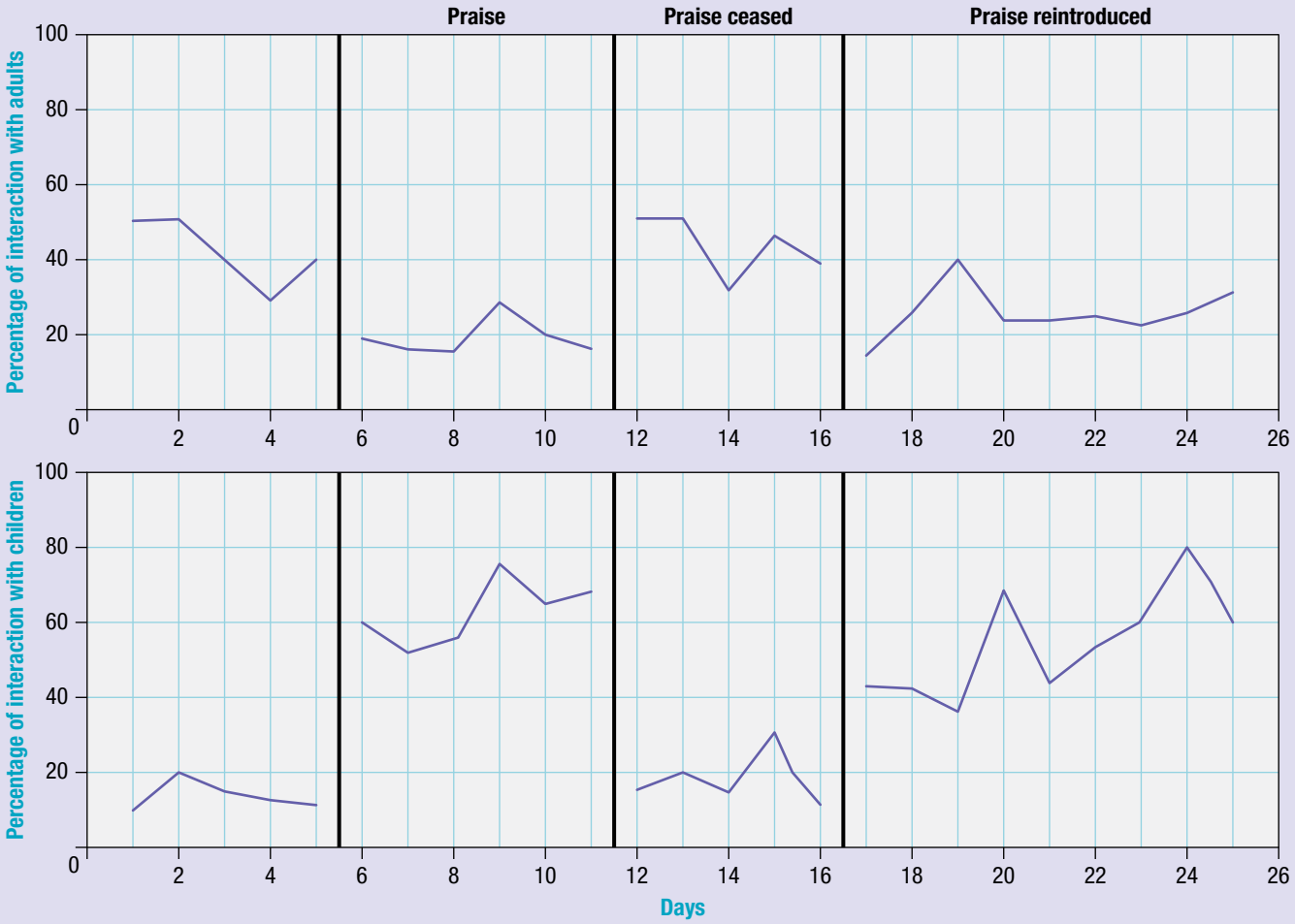

Figure 5.36 Effect of praise on social interaction

Source: Based on Allen, et al. (1964). Effects of social reinforcement on isolate behaviour of a nursery school child. *Child Development*, *35*, 511–518.

LEARNING ACTIVITY 5.19

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Word copy of table

Comparing classical and operant conditioning

Complete the table below to summarise similarities and differences between classical and operant conditioning.

Feature	Classical conditioning	Operant conditioning
how a response is acquired		
stimulus generalisation		
stimulus discrimination		
extinction		
spontaneous recovery		
role of learner		
timing of stimulus and response		
nature of response (reflexive/ voluntary)		

LEARNING ACTIVITY 5.20

Classical versus operant conditioning

Consider each of the following scenarios and state whether the behaviour that is described is best explained by classical conditioning, operant conditioning or a combination of both these types of learning. Give a reason for each answer.

1. Stephanie cries whenever she hears a barking dog. Before this, Stephanie had reached out to pat a stray dog and the dog barked and bit her hand. The next time Stephanie tried to pat the dog, it barked and bit her hand.
2. Hamish's ex-girlfriend always wore a musk perfume. Hamish still cringes whenever he comes across someone wearing musk perfume.
3. A father refuses to let his daughter borrow his car after she has 'borrowed' it previously and returned it with a near-empty petrol tank.
4. Emilia arrives home on time after having been grounded for being home late the last time she went out with her friends.

OBSERVATIONAL LEARNING

We also learn by watching and/or listening to others. The 'others' may be people with whom we directly interact, such as parents, friends and teachers, or real or fictional characters in the media. Through observation, we can acquire new behaviours without having to personally experience them. Watching others helps us avoid dangerous stimuli in our environment, teaches us how to think and feel, and shows us how to act and interact socially.

Behaviours acquired by observing what others do include physical routines such as a particular dance style, socially appropriate behaviours such as shaking hands when being introduced to someone, and emotional reactions such as a fear at the sight of a spider. Furthermore, many of the behaviours expected of us in the roles we undertake throughout life as females or males, students, friends, employees, partners, parents and so on are established by observing others performing those roles. Watching the actions of others can help us to learn skills such as how to make a milkshake, take a screenshot with an iPad or drive a car. This has obvious value. Imagine trying to *tell* someone how to do some of these things.

Similarly, in many work situations the most effective learning takes place through observing more experienced staff. For example, medical students learn surgery by watching and listening while competent surgeons perform various procedures on patients, and trainee teachers observe qualified teachers in the classroom. Apprenticeship programs for trades such as carpentry, pastry cooking and plumbing involve learning by watching and listening to qualified tradespeople. It is not only responses in the form of behaviour that are acquired by observing others. Many of our attitudes, values and beliefs are also the products of observing others.

Figure 5.37 Observational learning has played an important role in training medical students for well over a century.

This type of learning is called observational learning. **Observational learning** occurs when someone uses observation of a model's actions and the consequences of those actions to guide their future actions. A *model* is who or what is being observed and may be live or symbolic. A *live* model is a real-life person who may be demonstrating, acting out and/or describing or explaining a behaviour. A *symbolic model* is a real or fictional character displaying behaviour in books, movies, television programs, online and other media. As observational learning involves watching models, it is often called *modelling*.

Observational learning has been extensively researched and described by Canadian-born psychologist Albert Bandura. Bandura's studies of observational learning processes, particularly with children, led him to develop social learning theory and explain observational learning as a method of social learning.

Bandura's (1977a) **social learning** theory emphasises the importance of the environment, or 'social context', in which learning occurs. Bandura proposed that from the time we are born we are surrounded by other people displaying a huge variety of behaviours, all of which we are able to observe. This provides us with a rich source of information about our environment. Through observation we learn many behaviours, not by actually carrying out the behaviour and experiencing the consequences, but simply by watching the behaviour and its consequences being experienced by someone else. Moreover, we are more likely to model, learn and reproduce responses that are observed to be desirable and reinforcing. According to Bandura (p. 22):

> *Learning would be exceedingly laborious, not to mention hazardous, if people had to rely solely on the effects of their own actions to inform them what to do.*

Bandura believes that observational learning is not a totally separate form of learning from conditioning. His experiments have demonstrated that both classical and operant conditioning can occur vicariously through observational learning. This means that observational learning involves being conditioned *indirectly* by observing someone else's conditioning. During **vicarious conditioning**, the individual watches a model's behaviour being either reinforced or punished, and then subsequently behaves in exactly the same way or in a modified way, or refrains from the behaviour, as a result of

Figure 5.38 Albert Bandura (1925–) has extensively researched and described observational learning and explained how it occurs. His studies of observational learning processes with children led him to develop social learning theory and explain observational learning as a method of social learning.

what they have observed. Bandura uses the terms 'vicarious reinforcement' and 'vicarious punishment' to describe the different processes of vicarious conditioning.

Vicarious reinforcement increases the likelihood of the observer behaving in a similar way to a model whose behaviour is reinforced. Thus, the observer is conditioned through observing someone else being reinforced without personally experiencing the reinforcement or consequence directly. For example, a student who sees another student being allowed to leave a class early after correctly finishing all their work may be more inclined in another class to model the behaviour and respond in a similar way if they consider leaving class early a desirable outcome (a reinforcer).

Similarly, **vicarious punishment** occurs when the likelihood of an observer performing a particular behaviour decreases after having seen a model's behaviour being punished. For example, a student may observe someone else in class receiving detention for calling out without permission. The observer is likely to refrain from that behaviour in the future if they view detention as an undesirable outcome (a punisher).

Bandura emphasised that observational learning involves crucial cognitive processes. A person does not simply 'see' and then automatically reproduce a behaviour without any intervening mental activity. As with the student who observes someone else getting detention for calling out, the observer must become aware of and consciously process information relevant to the observed event. For example, mental processing of information on the consequences for doing what is observed is required, which can in turn influence the observer's expectations of the likely outcome of reproducing the behaviour. A mental representation must also be stored in memory of what was observed so that it is available for reproduction if the learner chooses to do so. This means that we sometimes learn through observation but what is learnt remains *latent* (unexpressed or 'hidden') without any immediately observable change in our behaviour simply because there is no motivation or need to reproduce it.

In 1986, Bandura revised his social learning theory and now refers to it as *social cognitive theory* in order to emphasise the importance of cognition in the learning process. Both his initial and revised social learning theories are considered to be a 'bridge' between the purely conditioning theories of Pavlov and Skinner and contemporary cognitive learning theories. This is because social learning theory encompasses cognitive processes such as attention, memory and motivation, as well as learning processes such as conditioning, reinforcement and punishment.

Figure 5.39 The reproduction of behaviour modelled by a real-life model (a) and a symbolic model (b)

LEARNING ACTIVITY 5.21

Review questions

1. Define observational learning with reference to an example.
2. Why is observational learning also referred to as modelling?
3. What are two key assumptions of Bandura's social learning theory?
4. What does vicarious conditioning involve when observing a model?
5. Distinguish between a live model and symbolic model with reference to relevant examples.
6. Give two examples of learned behaviours that are *not* acquired through observational learning. Explain your choice of examples.

LEARNING ACTIVITY 5.22

Reflection

Try to think of three behaviours, ranging from relatively simple to more complex, that you probably acquired through observational learning.

For each one, what model did you observe, what did you observe, and how similar were your responses to theirs?

Observational learning processes

According to Bandura's social learning theory, observational learning involves a sequence of processes called attention, retention, reproduction, motivation and reinforcement. All are essential if observational learning is to occur. First, the learner must pay *attention* to the model, then *retain* in memory what was seen. Next, the learner must be able to *reproduce* (physically perform) the behaviour. If the behaviour is associated with *reinforcement* or punishment, the learner will be more or less *motivated* to imitate the observed behaviour thereafter.

Attention

In order to learn through observation, we must pay attention to or closely watch a model's behaviour and the consequences. If we do not attend to the model's behaviour, we will not recognise the distinctive features of the observed behaviour. And we may fail to notice the consequences.

Attention may be influenced by several factors. These include the perceptual capabilities of the observer, the motivation and interest level of the observer, the situation in which the behaviour is being observed, the kinds of distracters that are present and the characteristics of the model, such as attractiveness.

Our level of attention is also influenced by such factors as the importance of the behaviour (e.g. whether we consider it to be a necessary behaviour, such as keyboarding skills required to obtain a particular job), its distinctiveness (such as whether it is unique, different, unusual) and the effect it might have on us (such as satisfaction, convenience, security).

According to Bandura (1977a), we pay closer attention and are more likely to imitate models who have the following characteristics:

- the model is perceived positively, is liked and has a high status
- there are perceived similarities between features and traits of the model and the observer, such as age and sex
- the model is familiar to the observer and is known through previous observation
- the model's behaviour is visible and stands out clearly against other 'competing' models
- the model is demonstrating behaviour that the observer perceives themselves as being able to imitate.

Figure 5.40 An Australian specialist batter for cricket is a suitable model to whom one could pay attention to develop an excellent batting technique.

In general, the greater the similarity between the model and the observer, and the more attractive or successful the model, the more likely we are to follow their example. Research studies also indicate that the higher the status of the model, the more the observer will imitate the behaviour — which is why many advertisements feature celebrities. Similarly, a cricket coach advising a batter on how to play a straight drive during a cricket match will suggest the batter pays more attention to an elite professional cricketer's style than to that of a weekend cricketer at a local oval.

Retention

Having observed the model, we must be able to remember the model's behaviour. Behaviour learned through observation is often not needed until some time after it has been acquired. We need to store in memory a mental representation of what we have observed, and the more meaningful we can make that representation, the more accurately we will be able to replicate the behaviour when necessary. For example, linking a visual image with a verbal description of the model's actions is an effective strategy to assist the memory processes.

Therefore, the cricketer in the previous example might try to visualise the batting style of the model cricketer, while describing the action as something like: 'He (or she) leans in towards the ball with his front shoulder while his eyes are fixed on the ball. His front foot steps towards the pitch of the ball and he has a high back swing. At the moment of contact his bat is kept straight with wrists relaxed, and his head is over the ball. He also ensures he has a high follow-through after striking the ball.'

Reproduction

When the model's behaviour has been closely attended to and retained in memory, we can attempt to reproduce, or imitate, what has been observed. We must, however, have the ability to put into practice what we observed. For example, we would not be able to imitate someone riding a surfboard if we were paralysed. Similarly, we must have the potential to be competent enough to develop the necessary skills to imitate the behaviour. For example, no matter how well the cricket stroke-making style of a professional cricket player is lodged in an observer's memory, it is unlikely that this behaviour will be reproduced with the same skill. The professional cricketer may well possess attributes that cannot be learned: his reflexes and agility, his balance and poise, his perceptual judgments of the trajectory and distance of an incoming ball, and his superior motor coordination.

Figure 5.41 This Turkish girl is able to reproduce the weaving skills she has learnt by observing her mother and grandmother.

Motivation

The observer must also be motivated to perform the behaviour; that is, they must have the desire and want to reproduce what was observed. Unless the behavioural response is useful or provides an incentive or reward for the observer, it is unlikely that they will want to learn it in the first place, let alone perform it or continue to perform it.

Reinforcement

Reinforcement influences the motivation to reproduce the observed behaviour and increases the likelihood of reproduction. Bandura distinguished between different types of reinforcement that impact on motivation, in addition to the standard types described by Skinner.

External reinforcement is comparable to learning by consequences. Thus, if the girl in Figure 5.41 above receives a reinforcer such as praise or money for her work, then her motivation to become more highly skilled at her craft will be influenced in a positive way.

Vicarious reinforcement, as discussed previously, occurs indirectly by observing the modelled behaviour being reinforced without personally experiencing the reinforcement. For example, a young child observing the positive reinforcement received by an older sibling who works hard at school to get into the tertiary course of her choice may well model the same studious behaviour as a result of vicariously experiencing the reinforcement.

Self-reinforcement occurs when we are reinforced by meeting certain standards of performance we set for ourselves; for example, the sense of pride, achievement or fulfilment you may experience if you achieve the end-of-year VCE results you would like to achieve and believe you are capable of achieving. Although this sense of pride, achievement and fulfilment typifies positive reinforcement, self-reinforcement can also include negative reinforcement. For example, avoiding a future of being bored in a mindless job may also be the self-reinforcement for achieving academic success.

If the modelled behaviour is reinforced, this will motivate the person to repeat those actions; the next time, the person will expect the behaviour to be reinforced. If the behaviour is not reinforced, it is less likely to be repeated. In this case, it could be said that the person lacks the motivation to behave in that particular way. Of course, seeing modelled behaviour being punished also influences a person's motivation to reproduce the observed behaviour — the observer will be less likely to do something when punishment is the observed consequence.

Bandura found that certain personal characteristics of the observer can influence each of the observational learning processes. For example, our perception of a model and whether or not we pay attention to what they are doing, as well as the social context in which the modelled behaviour occurs, can be influenced by perceptions of our 'self'. We are more likely to imitate a model's behaviour if we have low self-confidence and low self-esteem, as compared with people who do not. Self-confidence and self-esteem influence our level of *self-efficacy* — our belief in our ability to accomplish tasks and succeed in particular situations. According to Bandura (1977b), self-efficacy underlies how we think, feel and behave, and plays a major role in how we approach tasks and goals. Individuals high in self-efficacy are those who believe that they are capable of performing well, and are more likely to view challenges as something to be mastered rather than something to be avoided.

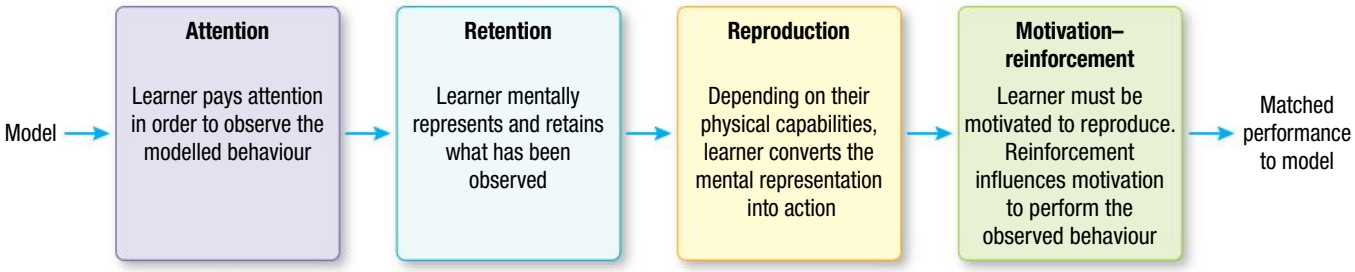

Figure 5.42 Observational learning processes

LEARNING ACTIVITY 5.23

Review questions

1. What is the role of the learner in observational learning?
2. Describe and explain how one of the following ways of thinking, feeling or behaving may have been acquired by someone through observational learning with reference to the sequence of processes. You may present your answer in a flow chart format, as in figure 5.42 above.
   - littering in public places
   - offering one's seat on a crowded bus to an elderly person
   - abusing umpires as a spectator of a football match
   - voting preference at a Federal election
   - being empathetic to a friend who is very upset by providing a cuddle, reassurance and an offer of support.
3. Explain how one of your characteristic behaviours may have been acquired through observational learning.
4. Identify one similarity and one difference between operant conditioning and social learning theory.
5. Pick a bad habit and describe a specific learning procedure, other than punishment, that could eliminate it. The technique may involve classical conditioning, operant conditioning and/or observational learning processes.

Bandura's experiments with children

In the 1960s, Bandura conducted a series of experiments to investigate different aspects of observational learning by young children. He was particularly interested in observational learning of aggression. In these experiments, preschoolers were required to passively sit and watch a model engaging in aggressive behaviour, and then given an opportunity to imitate the model's behaviour. Their responses were compared with those of preschoolers in a control group who were not exposed to an aggressive model. Different types of models, such as cartoon characters and real-life male and female adults were used, and responses by male and female children were measured to study sex differences in observing male and female models.

In one of the best known experiments, Bandura (1965) used 66 pre-schoolers with a mean age of 51 months as participants. The children were randomly allocated to one of three groups (in equal numbers of boys and girls). All of the children attended the pre-school at Stanford University where Bandura worked. Two adult males served in the role of models, and one female experimenter conducted the study for all 66 children.

Each group of children watched one of three movies. Each movie showed an adult model punching, hitting, kicking and verbally abusing a large air-inflated BoBo doll (shown in Figure 5.43 below). In all versions of the movie, the model walked into a room in which the BoBo doll was placed and shouted 'Clear the way!' The model then knocked down the doll, yelling 'Pow, right in the nose' and struck it with a mallet saying 'Sockeroo, stay down'. Each of the three groups of children, however, saw a different version of the movie. Consequently, the experiment had three conditions:

- Condition 1: The aggressive model was rewarded with lollies, soft drink and praise by another adult.
- Condition 2: The aggressive model was punished with a spanking and verbal criticisms such as 'Hey there, you big bully! Quit picking on that clown.'
- Condition 3: There were no consequences whatsoever for the aggressor's behaviour — the model was neither rewarded nor punished.

Following exposure to the model in the movie, each child was placed individually in a room that had many toys and a BoBo doll. The child's behaviour was then observed through a one-way mirror to see whether they imitated the aggressive model's behaviour in any way. Some children were offered rewards such as fruit juice, stickers and praise for imitating the model's behaviour, while others were not.

Figure 5.43 Bandura used a hidden camera to record children's responses in several experiments. These photos were copied from one of the movies in an experiment that used adult females in the role of models. The top series shows the model being aggressive with the BoBo doll. The middle series shows a young boy imitating the model. The bottom series shows a young girl imitating the model.

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Weblink
Video: Bandura describes a BoBo doll experiment 5m 3s

The results, shown in Figure 5.44 below, indicate that the consequences (or lack of them) for the adult model in the movie made a difference to the subsequent behaviour displayed by the children who saw them. This finding supports Bandura's argument that observational learning is not totally separate from conditioning. Children who watched the aggressive model either being reinforced or experiencing no consequences for their aggressive behaviour imitated aggressive behaviour more than the children who watched the aggressive model being punished. When children were offered a reward (positive reinforcer) for imitating the model's aggressive behaviour, even children who had seen the model punished tended to imitate the model's behaviour by behaving more aggressively.

Although the boys were more aggressive than the girls in all three conditions, the girls were nearly as aggressive as the boys if they were offered a reward. Importantly, the results also indicate that observational learning can sometimes occur by simply viewing a model even if the model is neither reinforced nor punished.

Clearly the boys and girls had learned something from observing the model. This highlights an important distinction between *learning* and *performance* (the actual production of a learned response). If someone observes a model's behaviour and does not perform the actions they have observed, it does not mean that the behaviour was not learned. The results of Bandura's experiment indicate that probably all the children learned the model's behaviour, regardless of whether they observed the model being reinforced or punished, or experiencing no consequences for aggressive behaviour.

Some children simply did not perform what they had learned until they were offered an incentive (reward) to do so. As shown in Figure 5.44, differences in the level of aggressive responses by children in the three conditions were almost eliminated when the offer of a reward was made.

Bandura suggested that although an individual may make no observable response to a behaviour performed by a model, the acquisition of the modelled response in cognitive form has still occurred and can be elicited with an appropriate reinforcer.

Bandura proposes in his social learning theory that when observers pay attention to something going on around them, they form *cognitive representations* (mental images or codes) of what they observe. What they have learned, therefore, is not so much a response but a cognitive or mental representation of a response.

Bandura also makes a clear distinction between the *acquisition* of a learned response and the *performance* of that response. People can acquire and store many behavioural responses learned by observation. For example, a person who regularly listens to music on the radio may never sing along while they listen, yet they may be acquiring a great deal of information. This can eventually be revealed when the person is asked by a friend for the lyrics to a popular song and they are able to recite them. In Bandura's view, learning has clearly taken place. The individual has formed a mental representation of the lyrics, but has not previously demonstrated this knowledge through performance.

We also learn by observation whether or not a particular behaviour is likely to be rewarded. For example, if a student observes that when their classmates ask questions the teacher reacts approvingly, the student will be more likely to follow suit. However, if the student observes that the questioners are treated disapprovingly, the student will probably learn to avoid asking questions. Thus, we learn by observation not only *how* to acquire or modify behaviour but also about *what* behaviours can be expected to lead to particular consequences. And as demonstrated by Bandura's experiment, those observed behaviours most likely to be performed are the behaviours that will be reinforced.

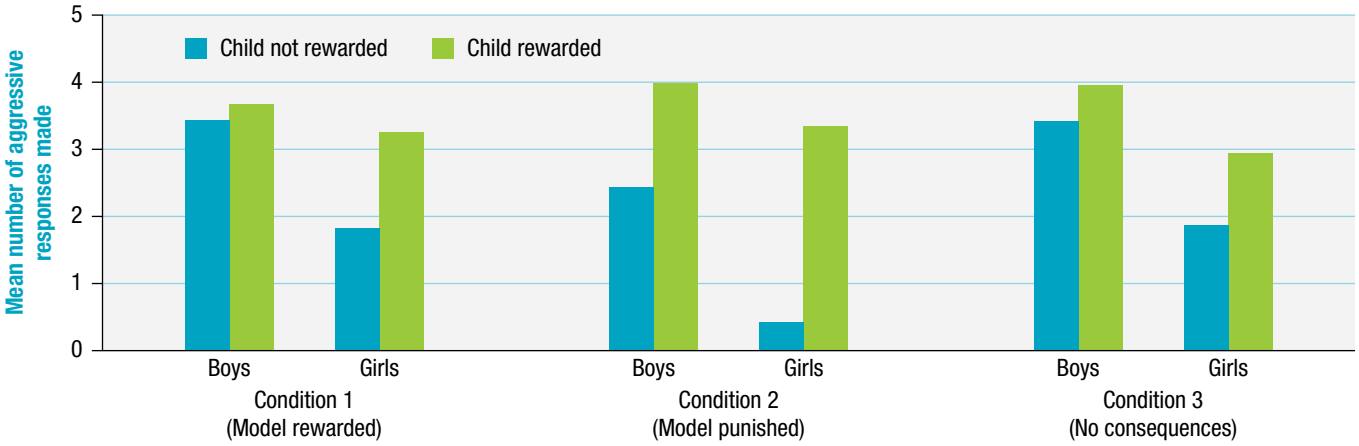


Figure 5.44 Results of Bandura's (1965) experiment on observational learning and aggression

BOX 5.10 Observational learning of the Suzuki method

In the 1940s, Japanese violinist and teacher Shinichi Suzuki (1898–1998) developed a successful method for teaching the violin to very young children. Called the Suzuki method, it was brought to Australia in the 1970s and generated a great deal of enthusiasm among children, parents and music teachers. The Suzuki method has since been applied to the learning of all types of musical instruments. Bandura's observational learning processes are evident in the Suzuki method.

Suzuki advised parents to teach violin information only when the child is actually looking at and watching the parent. Parents are told to stop teaching and wait if the child is distracted or talks about unrelated things.

Suzuki had parents present information in ways that a young child can mentally picture or code in some way. Because a three- to four-year-old child has limited language and verbal skills, little time is spent giving verbal instructions. Instead, the child is taught to play the violin through games and musical activities. For example, children are taught how to hold the violin, use the bow and press the strings by playing games with their hands. They are taught how to read musical notes only when they have reached a certain stage of technical skill at playing the violin.

Suzuki suggested that children start at the earliest age that they can physically perform the required movements and imitate their parents and teachers. Taking account of the physical capabilities of three- to four-year-olds, the violins used are small replicas. Girls are generally allowed to start learning violin at a younger age than boys as they physically mature earlier.

Suzuki emphasised that the most important role of the parents is to constantly reinforce the child for observing and doing what 'mummy, 'daddy' or 'the teacher' says. Suzuki suggested several ways to maintain motivation at a high level, such as being an active and interested model for the child, playing violin games that are fun for the child, and avoiding games or lessons that involve competition.

LEARNING ACTIVITY 5.24

Evaluation of Bandura's (1965) experiment with children

1. Prepare a flow chart or written summary of the key features of Bandura's experiment. Include:
   (a) a research hypothesis that could have been tested in the experiment
   (b) the operationalised independent and dependent variables
   (c) identification of the different conditions of the experiment
   (d) an outline of key results
   (e) conclusions from results
   (f) two ethical issues of relevance to this particular experiment.

2. Write a title for the graph in Figure 5.44 as if it were to be used in a research report.

3. What type of data were collected: primary or secondary? Qualitative or quantitative?

4. Identify any extraneous or confounding variables that may have influenced the results in an unwanted way.

5. What generalisations can be made to:
   (a) other children of about the same age?
   (b) younger and older children?
   (c) other types of modelled behaviour?
   Explain your answers.

6. Explain why children in Bandura's experiment modelled aggressive behaviour in terms of the sequence of processes in the observational learning model as shown in Figure 5.42 on page 317.

LEARNING ACTIVITY 5.25

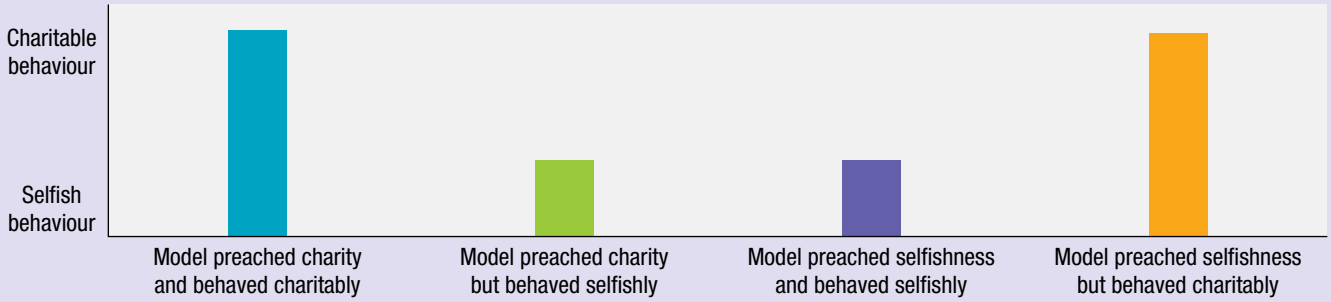
Evaluation of other research on observational learning

Read the following research and then answer the questions that follow.

A psychologist had four groups of five- to seven-year-olds hear and see an adult engage in specific behaviour. Group 1 heard and saw an adult being generous and saying that it was good to donate things to poor children. The adult was then seen giving some valuable items to charity. Group 2 heard the adult talking generously, but the adult did not give anything away. Group 3 heard an adult saying that it was all right to be greedy and asking why they should give their money to anyone else. The adult then refused to make a donation. Group 4 heard the greedy adult talking, but then saw the adult being generous.

The children were then each given some stickers that could be traded for lollies. They were asked if they would like to donate some of their lollies to poor children. The results are shown in the graph below.

1. Suggest an aim for the research.
2. Formulate a research hypothesis that could have been tested in the experiment.
3. Identify the operationalised independent and dependent variables.
4. Name the type of experimental research design.
5. Construct a title for the graph below.
6. Draw a conclusion from the results in relation to your hypothesis.
7. Are the results consistent with Bandura's observational learning theory? Explain your answer.
8. Explain the relevance of informed consent and debriefing to this particular study and how these ethical standards could be adhered to.



LEARNING ACTIVITY 5.26

Applying the observational learning method to the Suzuki method

Describe the processes of Bandura's observational learning theory that are apparent in the Suzuki method described in Box 5.10 opposite.

Present your description in the form of a diagram or flow chart showing the process as a series of steps in their correct order such as in Figure 5.42 on page 317.

LEARNING ACTIVITY 5.27

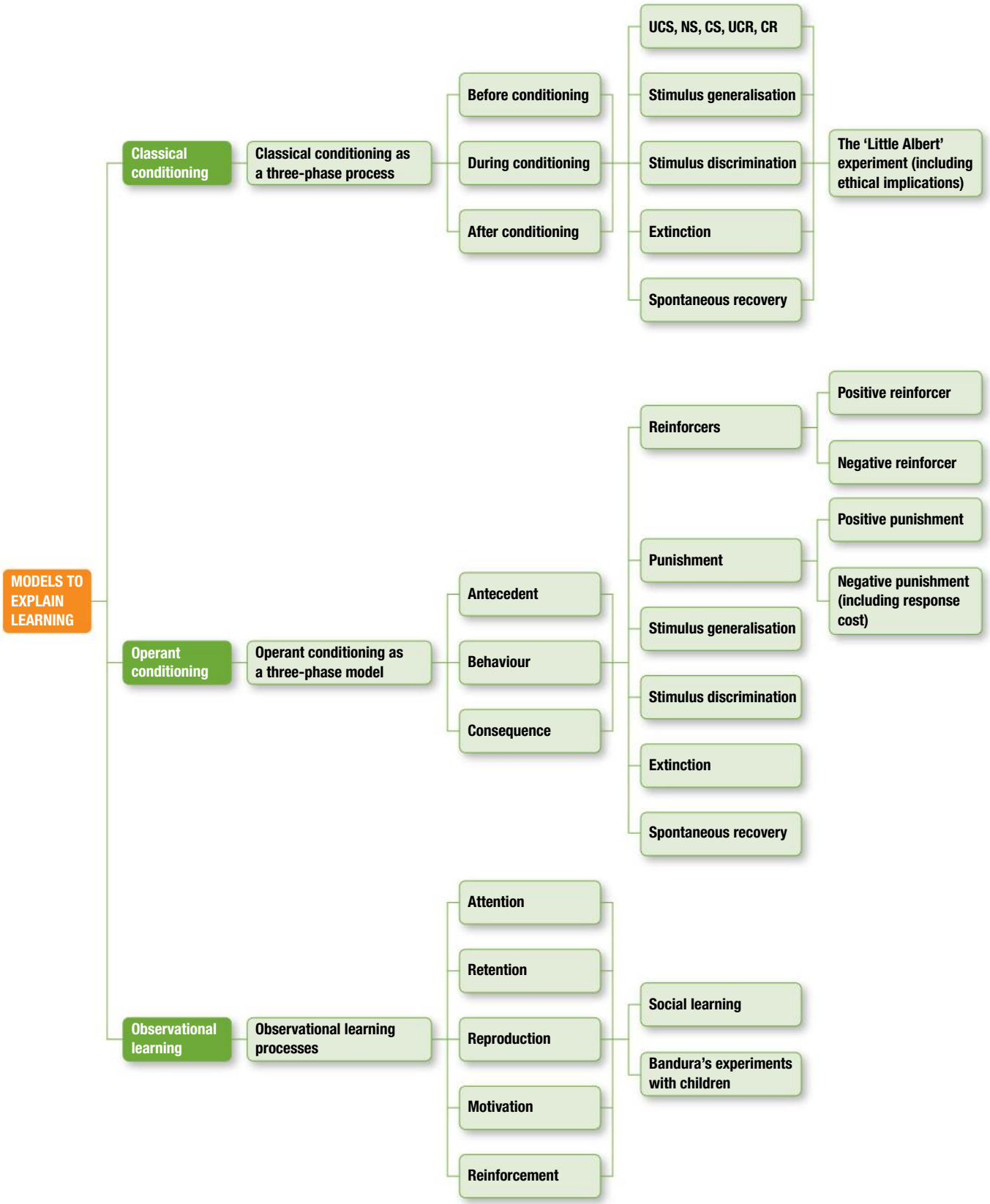
Reflection

Many people believe that violent behaviour is learnt by observing violence in television programs, movies, and/or through playing violent video games or using other media.

(a) What does research evidence suggest about such learning?

(b) What other variables may have an impact on observational learning of violence?

CHAPTER SUMMARY



KEY TERMS

antecedent p. 294
antecedent stimulus p. 294
associative learning p. 275
behaviour p. 294
classical conditioning p. 277
conditioned emotional response p. 287
conditioned reflex p. 280
conditioned response (CR) p. 279
conditioned stimulus (CS) p. 279
conditioning p. 275
consequence p. 294
discriminative stimulus p. 294
extinction pp. 285, 307
involuntary association p. 277
learning p. 274
'Little Albert' experiment p. 287
model (in observational learning) p. 313
modelling p. 313
motivation p. 316
negative punishment p. 302
negative reinforcement p. 299
negative reinforcer p. 299
neutral stimulus (NS) p. 279
observational learning p. 313
observational learning process p. 315
operant p. 292
operant conditioning p. 292
positive punishment p. 302
positive reinforcement p. 298
positive reinforcer p. 298
punishment p. 302
reinforcement p. 298
reinforcer p. 298
response p. 277
response cost p. 302
social learning p. 313
spontaneous recovery pp. 285, 307
stimulus p. 277
stimulus discrimination pp. 284, 306
stimulus generalisation pp. 284, 306
three-phase model of operant conditioning p. 293
three-phase process of classical conditioning p. 279
unconditioned response (UCR) p. 279
unconditioned stimulus (UCS) p. 279
vicarious conditioning p. 313
vicarious punishment p. 314
vicarious reinforcement p. 314

LEARNING CHECKLIST

Complete the self-assessment checklist below, using ticks and crosses to indicate your understanding of this chapter's key knowledge (a) before and (b) after you attempt the chapter test. Use the 'Comments' column to add notes about your understanding.

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Word copy of checklist

Key knowledge I need to know about models to explain learning	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
Learning			
Characteristics			
Conditioning			
Stimulus			
Response			
Classical conditioning			
Classical conditioning as a three-phase process			
• Before conditioning			
• During conditioning			
• After conditioning			
• UCS, NS, CS, UCR, CR			
Stimulus generalisation			
Stimulus discrimination			
Extinction			
Spontaneous recovery			
'Little Albert' experiment			
• procedures			
• ethical implications			

(continued)

Key knowledge I need to know about models to explain learning	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
Operant conditioning			
Operants			
Operant conditioning as a three-phase model			
• Antecedent			
• Behaviour			
• Consequence			
Reinforcers			
• positive reinforcer			
• negative reinforcer			
Punishment			
• positive punishment			
• negative punishment			
• response cost			
Stimulus generalisation			
Stimulus discrimination			
Extinction			
Spontaneous recovery			
Differences between classical and operant conditioning			
• how a response is acquired			
• stimulus generalisation			
• stimulus discrimination			
• extinction			
• spontaneous recovery			
• role of learner			
• timing of stimulus and response			
• nature of response (reflexive/voluntary)			
Observational learning			
Social learning			
Observational learning processes			
• Attention			
• Retention			
• Reproduction			
• Motivation			
• Reinforcement			
Bandura's experiments with children			
Differences between observational learning and classical and operant conditioning			

studyon

Unit 3 > Area of study 3 > Topic 2

Concept screens and practice questions

CHAPTER 5 TEST

SECTION A — Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Question 1

Which of the following is the simplest form of learning?

A. social learning
B. observational learning
C. classical conditioning
D. operant conditioning

Question 2

A young child who has a white guinea pig at home sees a white rabbit in a pet shop and calls the rabbit a 'guinea pig'. This illustrates the process known as

A. stimulus generalisation.
B. stimulus discrimination.
C. conditioning.
D. a conditioned response.

Question 3

In classical conditioning, an unlearned involuntary response to an unconditioned stimulus is called a/an

A. neutral stimulus.
B. conditioned stimulus.
C. unconditioned response.
D. conditioned response.

Question 4

In operant conditioning, an antecedent stimulus enables the organism to

A. respond automatically to a specific stimulus.
B. perform a previously learned response that has remained unexpressed due to the absence of a reinforcer.
C. predict the likely consequence of a specific response.
D. distinguish between responses that will and will not impact on the environment.

Question 5

In classical conditioning, the learner is relatively _____ when either the neutral or unconditioned stimulus is presented, whereas in operant conditioning the learner must be _____ to obtain a reinforcer.

A. active; neutral
B. passive; active
C. passive; neutral
D. active; passive

Question 6

Social learning theory was devised by

A. Watson.
B. Skinner.
C. Pavlov.
D. Bandura.

Question 7

A mother asks her daughter to switch off the television. The daughter refuses because her favourite program is on. The mother reacts to her daughter's disobedience by sending her to the laundry, where she is required to sit and do nothing for 10 minutes.

In this example, sending the daughter to the laundry is an example of

A. positive reinforcement.
B. negative reinforcement.
C. positive punishment.
D. negative punishment.

Question 8

In classical conditioning there is always a specific _____ that elicits the desired response, whereas in operant conditioning the _____ must first produce the desired response.

A. operant; stimulus
B. reflex; learner
C. stimulus; learner
D. reflex; reinforcer

Question 9

A factory worker decides that timing a trip to the toilet to coincide with weekly team meetings with his supervisor and other factory workers allows him to avoid being reprimanded for not working hard enough. In this situation, going to the toilet to avoid being told off is an example of

A. positive reinforcement.
B. negative reinforcement.
C. punishment.
D. stimulus generalisation.

Question 10

Which of the following is **not** an example of observational learning?

A. A new student learns vicariously that Mr Brown puts poorly behaved students on detention.
B. A piano student watches the technique of her instructor to learn how to play a difficult piece of music.
C. A teacher works alongside a school principal for a week to learn about the role.
D. A student whose VCE results are very disappointing learns how much work was required to achieve the university entrance score she needed.

Question 11

As a child you were playing in the backyard one day when a big black crow landed near you. Your father suddenly screamed and snatched you into his arms. His unusual behaviour caused you to cry. You now have a fear of big black birds.

Your reaction of crying when your father grabbed you is the _____ , and the fear of big black birds you now have is the _____ .

A. unconditioned response; conditioned response
B. conditioned response; unconditioned response
C. neutral stimulus; unconditioned response
D. unconditioned stimulus; neutral stimulus

Question 12

During classical conditioning, the _____ is paired with the _____.

A. conditioned stimulus; conditioned response
B. neutral stimulus; unconditioned stimulus
C. unconditioned stimulus; unconditioned response
D. conditioned stimulus; neutral stimulus

Question 13

When spontaneous recovery occurs,

A. the organism demonstrates the conditioned response without the presentation of any stimulus.
B. the conditioned stimulus elicits a conditioned response even though it had previously been extinguished.
C. the organism demonstrates a much stronger conditioned response than it had during acquisition.
D. the conditioned response is elicited by a stimulus that is different from the antecedent or conditioned stimulus.

Question 14

According to social learning theory,

A. learning may be unexpressed unless a person is motivated to reproduce observed behaviour.
B. learning may be described as any change in behaviour.
C. an antecedent must be present for a particular learned response to occur.
D. reinforcement is a vital element of classical conditioning.

Question 15

Jason remembers seeing his brother James sustain a serious injury as a result of sticking his arm out of a car window. Since the incident, Jason has never attempted to put his arm, or any other part of his body, out the window of a moving vehicle.

In this example, Jason has observed _____ , and has been vicariously _____ not to repeat his brother's behaviour.

A. reinforcement; punished
B. modelling; conditioned
C. punishment; conditioned
D. reinforcement; conditioned

Question 16

Which of the following presents observational learning processes in the correct order?

A. attention, retention, reproduction, motivation, reinforcement
B. attention, retention, motivation, reinforcement, reproduction
C. attention, reproduction, retention, motivation, reinforcement
D. attention, reproduction, retention, reinforcement, motivation

Question 17

Bianca teaches her pet rabbit to come to her when she makes a short, high-pitched whistling sound. At first, she gently approaches the rabbit, whistling and holding a carrot, but stops within half a metre or so of the rabbit. The rabbit approaches and nibbles the carrot. Gradually, Bianca expands the distance between herself and the rabbit. Every time Bianca whistles, she presents the carrot. Eventually, the rabbit learns that approaching Bianca after hearing a whistle generally results in a reward.

This example illustrates the use of

A. spontaneous recovery.
B. negative reinforcement.
C. stimulus generalisation.
D. positive reinforcement.

Question 18

A difference between negative reinforcement and punishment is that negative reinforcement _____ a response, whereas punishment _____ a response.

A. strengthens; weakens
B. always involves an unpleasant consequence for; does not necessarily elicit
C. weakens; strengthens
D. always involves a pleasant consequence for; always elicits

Question 19

If a rat in a Skinner box presses a lever for reinforcement when a buzzer is sounded but never when a bell is sounded, then _____ is apparent.

A. involuntary behaviour
B. stimulus discrimination
C. stimulus generalisation
D. extinction

Question 20

An operant is any behaviour that

A. is triggered by a stimulus from the environment.
B. is reflexive or involuntary.
C. elicits a response.
D. affects the environment.

SECTION B

Answer **all** questions in the spaces provided. Write using blue or black pen.

Question 1 (2 marks)

Define the meaning of learning.

Question 2 (2 marks)

What distinguishes response cost as a form of punishment?

Question 3 (2 marks)

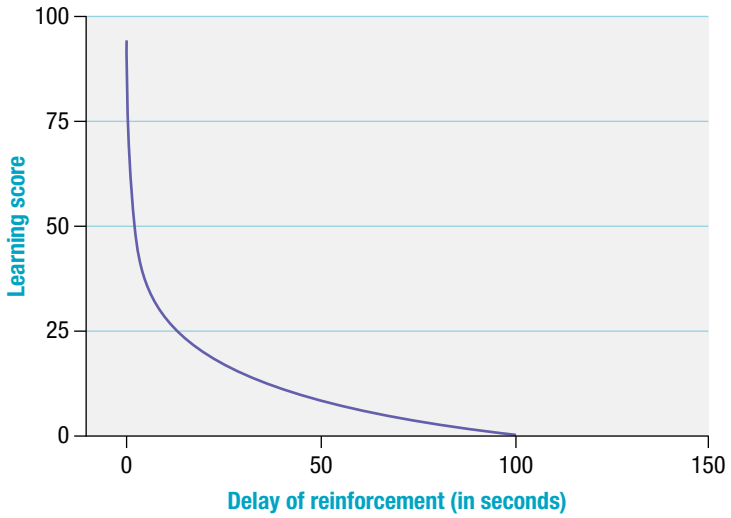
Distinguish between classical and operant conditioning in relation to each of the following features.

(a) timing of the stimulus and response 1 mark

(b) nature of the response 1 mark

Question 4 (2 marks)

What do the experimental results in the following graph suggest about the timing of reinforcement as a variable that influences its effectiveness?



Question 5 (3 marks)

William winces and covers his ears whenever someone blows up a balloon as he is fearful that it will burst with a loud bang. Explain how William may have acquired this fear through classical conditioning.

Question 6 (4 marks)

Mr Ying is a young, handsome Psychology teacher who has just been appointed to a girls' college. Unfortunately, his Psychology class is so distracted by his appearance that they find it difficult to focus on their work and on his instructions. There is a lot of giggling, whispering and a general lack of attention. Mr Ying is determined to make a good impression with his classroom control and with his teaching methods. He decides to use detention as a means of pulling the girls' behaviour into line. He runs a lunchtime detention session for six girls whose behaviour has been the worst. In the next class, not only do these six girls misbehave, but they are joined at the next detention by four others. This trend continues until it is not long before almost the entire class is on detention.

(a) Which operant conditioning procedure is Mr Ying trying to use to change the girls' behaviour? 1 mark

(b) Explain whether this procedure will be effective. 2 marks

(c) How could Mr Ying change his strategy with the girls and still use operant conditioning? 1 mark

Question 7 (5 marks)

Research studies have found that adolescents are more likely to begin smoking cigarettes if their parents, siblings and friends smoke. Explain this finding in terms of the observational learning model.

Question 8 (8 marks)

During a close soccer match, an opponent tackles Jack roughly. Jack retaliates by starting a fight with the opponent. Jack's coach considers the behaviour unacceptable and suspends him for one match, which also means Jack will not get paid for playing at a time when he needs the money. When Jack next plays and is again tackled roughly, he reacts by telling off the player and complaining to the referee, stopping short of starting another fight.

(a) Explain whether the scenario is an example of positive reinforcement, or negative reinforcement or punishment. 2 marks

(b) Analyse and describe the scenario in terms of the three-phase model of operant conditioning. 6 marks

The following information relates to questions 9–12.

A researcher wanted to demonstrate that children of three and four years of age could be influenced by behaviour they observed around them.

The researcher selected two groups of ten children, ensuring that they were as alike as possible in age, intelligence and personality. The children were then randomly allocated to each of two different groups. Each group watched a different Punch and Judy puppet show. Group A, which consisted of seven girls and three boys, saw Punch behaving very badly. He laughed when he saw Judy fall over and wouldn't help her to stand up. Group B, which consisted of six girls and four boys, saw Punch become upset when Judy fell over and went to help her straight away.

The children were then observed in their playgroups for the next week and the number of times each child ignored another who was upset or went to help was counted.

The results are shown in the following table.

Group	Offers to help	Times ignored
Group A	7	18
Group B	21	5

Question 9 (1 mark)

Name the experimental research design.

Question 10 (2 marks)

Identify the operationalised independent and dependent variables.

Question 11 (2 marks)

Formulate a research hypothesis for the experiment that would be supported by the results obtained.

Question 12 (2 marks)

Explain whether the results support Bandura's observational learning model.

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The answers to the Section A multiple-choice questions are in the answer section at the end of this book and in eBookPLUS. The answers to the Section B questions are in eBookPLUS.

6 PROCESS OF MEMORY

KEY KNOWLEDGE

- the multi-store model of memory (Atkinson–Shiffrin) with reference to the function, capacity and duration of sensory, short-term and long-term memory
- interactions between specific regions of the brain (cerebral cortex, hippocampus, amygdala and cerebellum) in the storage of long-term memories, including implicit and explicit memories.

Source: © VCAA, VCE Psychology Study Design (June 2017 update), p. 26.

CHAPTER CONTENT

Atkinson–Shiffrin's multi-store model of memory 333
- Sensory memory 335
- Short-term memory (STM) 343
- Long-term memory (LTM) 348

Brain regions involved in the storage of long-term memories 356
- Roles of the cerebral cortex 356
- Roles of the hippocampus 357
- Roles of the amygdala 359
- Roles of the cerebellum 361

Human memory is not a single 'thing' or process located in one specific area of the brain. Psychologists describe it as consisting of a collection of interconnected and interacting systems, each of which has distinguishable functions and is represented throughout the brain by different neural mechanisms. This means that we do not have *a memory* — we have different *memory systems*.

Despite their differences and the uncertainty about precisely how many memory systems we have, where they are all located and how they interact, human memory operates in a unitary way, as if it were a single system. Although the systems share a common function of storing whatever we learn so that we can retrieve and use it when required, they process and store different types of information in different ways.

Given the amount of information processed by our memory over a lifetime, its accuracy and reliability is remarkable. However, human memory is not perfect. Every moment of our lives is not automatically stored somewhere in the brain as if on an SD card or DVD, to be filed away for future reference. Often we fail to properly process, store or access information that we need to retrieve and use at a later point in time. And when we retrieve information, it is not always entirely accurate because of the reconstructive nature of memory.

Given the relationship between memory and learning, human **memory** is often defined as the processing, storage and retrieval of information acquired through learning. This is an information processing approach which likens memory to how a computer works. Some psychologists, however, describe memory more simply as the expression of learning. Furthermore, given that a stored memory can be viewed as a neurological representation of prior experience, an increasing number of psychologists are now defining memory with reference to neural processes; for example, as 'an internal record of a prior experience' or 'the capacity of the nervous system to acquire and retain information and skills'.

Psychologists have devised a number of models to describe and explain human memory. These models usually include boxes to represent components and arrows to represent the movement of information from one component to another. Despite their differences, all models typically refer to memory as involving three fundamental yet essential, core processes:

- **encoding:** conversion of information into a usable form so that it can be neurologically represented ('placed') and stored in memory
- **storage:** retention of the encoded information over time
- **retrieval:** recovery of stored information for use when needed.

As shown in Figure 6.2 at the right, these three processes occur in a sequence, interact and are interdependent. Encoding is first because it occurs at the time of learning. It is through encoding that the brain can 'acquire' and represent incoming sensory information in a usable form. How well information is encoded determines how well that information is stored and how efficiently the information can subsequently be retrieved.

Consider a simple physical device intended to aid memory — a shopping list. If it is to be an effective memory aid, you need to write legibly in a language that whoever uses the shopping list can understand. If the list were to get wet, the ink would blur (impaired storage), making it less distinct and harder to read (retrieval). Retrieval would be harder if your handwriting was poor (an encoding–retrieval interaction) and if the writing was smudged (a storage–retrieval interaction) (Baddeley, 2009).

Figure 6.1 Human memory is not a single 'thing' or process located in one specific area of the brain. Nor are memories automatically stored somewhere in the brain as if on an SD card.

Although many models have advanced understanding of the process of memory, no single model is viewed as having captured all aspects of human memory. However, some models have been more influential than others.

In this chapter we consider the best-known and most widely used model to describe and explain human memory. We then examine specific regions of the brain that are involved in the storage of different types of long-term memories.

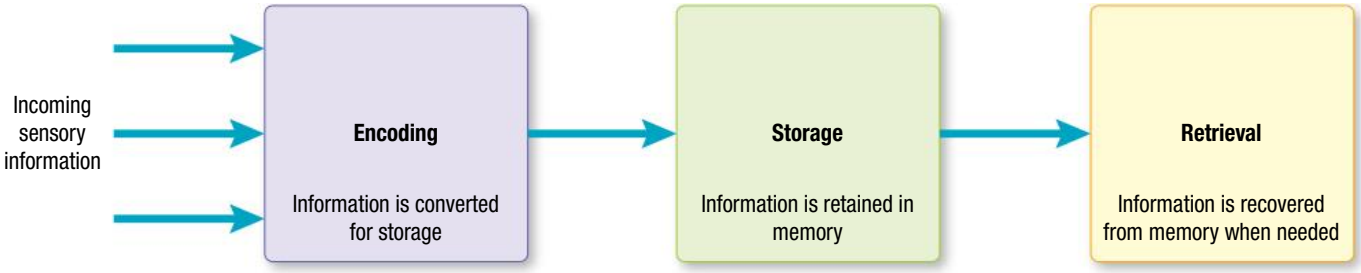

Figure 6.2 A simplified representation of the three fundamental processes required for human memory: encoding, storage and retrieval. If any one of these processes fails, memory will fail. Some researchers include *consolidation* as a part of encoding or as a fourth process that enables long-term storage and retrieval.

ATKINSON–SHIFFRIN'S MULTI-STORE MODEL OF MEMORY

In the 1960s, psychology had shifted from the assumption that human memory was a single system towards the idea that two, three or perhaps more memory systems were involved. A very influential model that represented this change in thinking was proposed by American psychologists Richard Atkinson and Richard Shiffrin in 1968.

The **Atkinson–Shiffrin multi-store model** represents memory as consisting of three separate stores (components) called sensory memory, short-term memory and long-term memory. Each store processes information in different ways and also differs in terms of its *function* (purpose and roles), *capacity* (the amount of information it can hold at any given moment) and *duration* (the length of time it can hold information). Despite their distinguishing features, the three stores operate simultaneously and interact in an integrated way.

According to the multi-store model, *sensory memory* is the entry point for new information. It stores vast quantities of incoming sensory information for up to several seconds. If we pay attention to any of the information in sensory memory, it is transferred to short-term memory. Sensory information that is not attended to is lost from memory completely. Information received in *short-term memory* is processed (encoded) and stored for up to about 18–20 seconds, depending on the type of information and whether a conscious effort is made to keep it there longer (Atkinson & Shiffrin, 1968). The transfer of information from short-term memory involves a further level of processing (encoding) for storage in long-term memory. Information transferred to *long-term memory* may be stored for up to a lifetime. Information may also be retrieved from long-term memory and brought back to short-term memory when needed. Sometimes, however, we may be unable to retrieve information from the long-term store, which we commonly refer to as 'forgetting'.

The Atkinson–Shiffrin multi-store model also describes memory in terms of its *structural features* and *control processes*. In distinguishing between these, Atkinson and Shiffrin used a computer analogy. They likened structural features to the computer and control processes to the computer programmer who determines the operation of the computer.

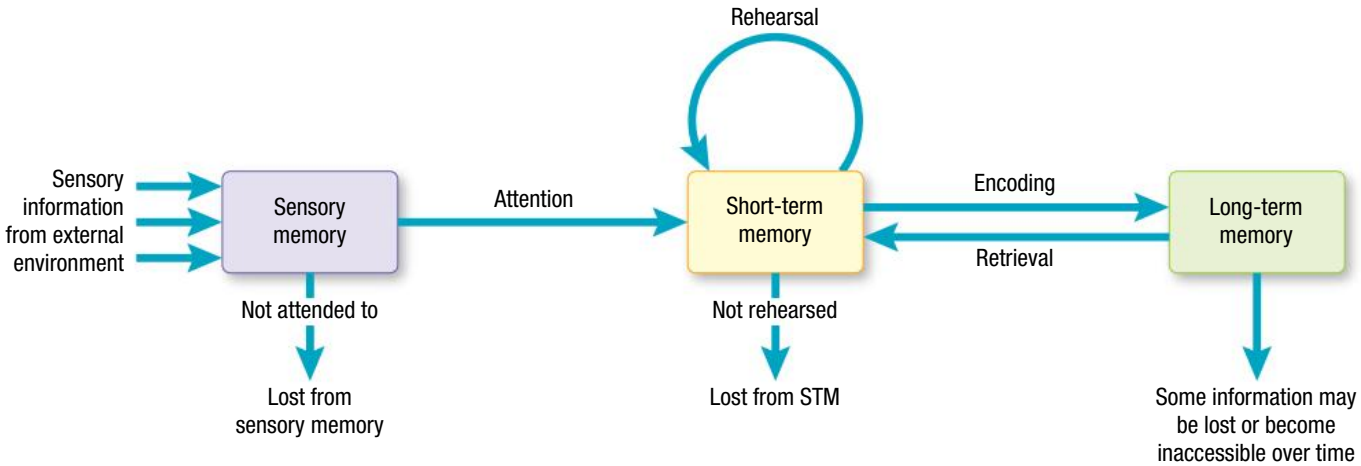

Figure 6.3 A contemporary representation of the Atkinson–Shiffrin multi-store model showing the transfer of information through the memory stores. The original model refers to short-term memory as 'working memory' and the two terms are often used interchangeably.

Structural features are the permanent, built-in fixed features of memory that do not vary from one situation to another. The three different stores are the basic structural features. Other structural features include the amount of information each store can hold at any given moment (i.e. storage capacity) and the length of time information can be held by each component (i.e. storage duration).

Control processes are selected and used by each individual and may vary in different situations. They are under the conscious 'control' of the individual and which control process is used depends on what the individual does. For example, *attention* is a control process. Whether or not the individual chooses to attend to and select incoming sensory information will determine whether that information is transferred from the sensory store to the short-term store. *Rehearsal* is also a control process and its use determines whether information is retained in the short-term store, how long it will be held there and whether it is transferred to the long-term store. An example of rehearsal is intentionally repeating new information over and over, such as when we try to remember a telephone number. *Retrieval* is a third control process. The specific retrieval method used by the individual will determine whether some or all of the required information in the long-term store will be located, recovered and brought into conscious awareness.

TABLE 6.1 Key features of the three memory stores

Store	Function	Capacity	Duration
Sensory memory	• Receives sensory information from the environment • Enables perceptual continuity for the world around us	Vast, potentially unlimited	Momentary — about 0.2–4 seconds
Short-term memory (STM)	• Receives information from sensory memory and transfers information to and from LTM • Maintains information in conscious awareness for immediate use	7 ± 2 pieces of information	• Temporary — 18–20 seconds, possibly up to 30 seconds • Longer if renewed (e.g. maintenance rehearsal; using for 'working memory')
Long-term memory (LTM)	Information storage for re-access and use at a later time	Vast, potentially unlimited	• Potentially permanent • Some information may be lost or inaccessible over time • Indefinite

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LEARNING ACTIVITY 6.1

Review questions

1. How is memory commonly defined in psychology?
2. (a) Describe the processes of encoding, storage and retrieval.
(b) Explain the interrelationship between these processes with reference to an example.
(c) Explain whether memory is possible without any one of these processes.
3. Explain the meaning of the term model of memory.
4. (a) What is the Atkinson–Shiffrin multi-store model of memory?
(b) Give an example of when the different stores could be operating simultaneously and interacting.
5. (a) Distinguish between structural features and control processes in memory, with reference to examples.
(b) Explain whether each of the following is a structural feature or control process:
(i) deciding whether retrieved information is correct
(ii) a neural representation of a memory at a synapse
(iii) shifting attention from one conversation to another
(iv) encoding when learning something new
(v) remembering the answer for an exam question
6. How might forgetting from each of the following stores be explained in neurological terms?
(a) STM
(b) LTM
7. Suggest a biological and a psychological explanation for why we don't remember everything that happens in our lives.

LEARNING ACTIVITY 6.2

Reflection

Some psychologists believe that comparing human memory to information processing by a computer may misrepresent or oversimplify human memory. What do you think?

Sensory memory

In the course of a typical day, thousands of sights, sounds, smells and other stimuli from the external environment bombard your sensory receptors. All this information, whether you pay attention to it or not, is briefly held in sensory memory.

Sensory memory is the entry point of memory where new incoming sensory information is stored for a very brief period. The information received there is assumed to be retained as an exact copy of its original, 'raw', sensory form (rather than in an encoded form). We can store vast amounts of sensory information in sensory memory and it is commonly described as having a potentially unlimited storage capacity.

An important function of sensory memory is that it stores sensory impressions long enough for each impression to slightly overlap the next. This helps ensure we perceive the world around us as continuous, rather than as a series of disconnected visual images or disjointed sounds. To test this, quickly wave a pen back and forth in front of your face. You should see the fading image trailing behind the pen. This is assumed to be an example of your visual sensory memory at work. It seems as if our visual sensory memory momentarily stores a snapshot of the image, then replaces it with another overlapping image.

Sensory information remains in sensory memory just long enough for us to attend to and select the information to be transferred to short-term memory (STM) for processing. It is therefore a *temporary* storage system for information that may subsequently undergo further processing.

We are not consciously aware of most information in our sensory memory. Nor can we consciously manipulate it or extend the time it is retained there. When we direct our attention to information in sensory memory, this has the effect of transferring it to STM where we become consciously aware of it. For example, if your attention is focused on reading this page, you will be unaware of many of the sounds around you. Although this auditory information is received by your sensory memory, it is not until you direct your attention to the sounds that you become aware that this information was initially 'registered' in your sensory memory.

Figure 6.4 When queuing in a busy cafe, your senses would be bombarded by millions of different sights, sounds, smells and other stimuli. These would initially be received in your sensory memory.

Figure 6.5 If you went to a popular nightclub, your senses would be bombarded by hundreds of different sights, sounds, smells and other stimuli. These would initially be stored in separate sensory stores called sensory registers. It is believed that there probably is a separate register for each of the senses.

It is assumed that any stimulus received in sensory memory is available to be selected for attention and processing in STM. For example, all the objects in your visual field and all the sounds loud enough for you to hear are available for transfer to STM at any given moment. If the sensory information is not attended to and no further processing occurs, its impression fades and therefore cannot be transferred to STM or subsequently to long-term memory (LTM), and is permanently lost from experience.

Incoming sensory information is assumed to be stored in separate sensory systems called *sensory registers*, each of which retains sensory information for different periods. Many psychologists believe that there probably is a separate sensory register for each of the senses. For example, the numerous visual images you process while at a nightclub will be stored in your visual sensory register (called *iconic memory*), while the sounds of music and voices of people will be stored in your auditory sensory register (called *echoic memory*).

Iconic memory

The term **iconic memory** is used to describe visual sensory memory — the brief sensory memory for incoming visual information. We usually retain visual images in their original sensory form in iconic memory for about a third of a second. However, they last just long enough to recognise and process the sensory information.

To experience iconic memory, close your eyes for a minute. Near the end of the minute, hold your hand about 25 centimetres in front of your eyes. Then open your eyes and rapidly close them again. You should see an image of your hand that fades away in less than a second (Ellis, 1987).

When you go to the movies, you see what appears to be a continuous scene in which people, animals and objects move quite normally. What is actually presented to your eyes, however, is a series of individual still images, interspersed with brief periods of darkness. In order to see a continuously moving image it is necessary for your visual system, which includes iconic memory, to store the information from one frame until the next frame is presented (Baddeley, 1999).

Figure 6.6 (a) The persistence of the image of the sparkler allows the child to 'draw' a series of circles. (b) Without iconic memory, your world would disappear into darkness during each eye blink.

studyon

BOX 6.1 Research demonstrating iconic memory

American psychologist George Sperling (1960) first demonstrated the existence of a sensory register for visual sensory information in a well-known study involving a series of experiments.

There were five participants – four students and a colleague of Sperling's. Each person took part in 12 sessions, three times weekly. There were seven different experiments during the 12 sessions, the first two of which 'were essentially control experiments' (p.2). Each participant completed hundreds of trials throughout the course of the experiments.

All participants were informed about the nature of the experiment and given prior training. According to Sperling (p.4), 'the nature of the experiments made it more economical to use small numbers of trained subjects rather than several large groups of untrained subjects'.

Sperling used stimulus materials comprising sets of letters arranged in patterns such as that shown below.

G	K	B	L
M	V	X	P
R	W	Z	C

The number of letters and rows varied according to the nature of a particular experimental task and its purpose. Only letters that are consonants were used, no vowels.

Overall, the stimuli were presented using a partial versus whole report technique in which participants were sometimes required to report a specific part of the pattern and sometimes all of it.

Sperling projected the sets of letters on a screen, usually for about one-twentieth of a second. He chose this amount of time because it is too brief for any eye movements to occur during the presentations of the letters. The participants were required to verbally report as many of the letters as they could recall. Most could recall only four or five letters in each set no matter how many letters they were shown. Sperling found that with such short exposure, reporting all the letters in a set was impossible.

However, most of Sperling's participants reported that, for an instant, they had seen *all* the letters that had been briefly flashed on the screen. But, by the time they could say four or five of them, the image of the remaining letters had faded. Sperling reasoned that all letters in each set were seen because they had been initially registered in some way and should therefore all be available for a brief time. But because the image disappeared so quickly, only a few letters could be named before they were lost from iconic memory.

To test whether all the letters were actually retained in iconic memory, Sperling conducted a further experiment in which he sounded a tone just after a pattern of letters was flashed on the screen. On hearing a high tone, the participants were told to report only the letters from the top row, on a medium tone the middle row, and

(continued)

(continued from previous page)

on a low tone the bottom row. This is shown below. Under this condition, the participants had to select a line from the visual image they held in iconic memory.

G	K	B	L	High tone
M	V	X	P	Medium tone
R	W	Z	C	Low tone

Once participants learned this partial report procedure, they were able to repeat any row of letters with about 75% accuracy. For example, after seeing a pattern of letters flashed on the screen, they would hear the medium tone, direct their attention to the middle line of letters in their iconic memory and 'read them off' with considerable accuracy on most trials.

These results indicated that an image of all the letters (i.e. the whole pattern) had been momentarily stored in iconic memory *after* the pattern left the screen. By delaying the tone for longer and longer intervals (from about one-tenth of a second to 1 second), Sperling was able to determine how quickly images in iconic memory fade. As the time-delay lengthened, Sperling found that a participant's ability to recall letters in a designated row declined more and more. Subsequent research by other psychologists has found that the typical duration of iconic memory is about 0.2–0.4 seconds (Cowan, 1995).

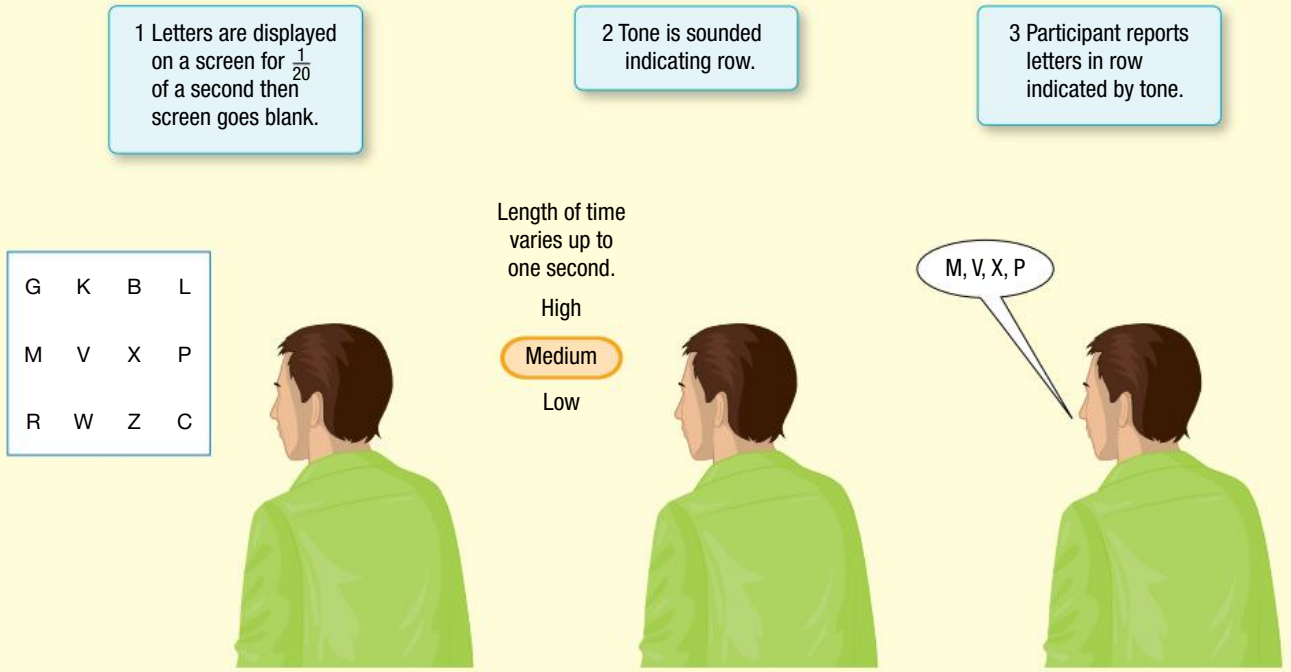

Figure 6.7 Sperling's (1960) experimental procedure to investigate the duration of iconic memory

LEARNING ACTIVITY 6.3

Evaluation of Sperling's (1960) research on iconic memory

Consider Sperling's (1960) experimental research on iconic memory summarised in Box 6.1 and answer the following questions.

1. Name the type of experimental research design.
2. Identify the operationalised independent and dependent variables for the experiments described in the summary.
3. Formulate a research hypothesis that could have been tested by the procedures used in the experiments.
4. What would be the purpose of the 'control experiments' for this particular research?
5. Sperling was not concerned about the small sample size. Should he have been? Justify your opinion.
6. Why were only consonants used in the stimulus materials?
7. Briefly state the results obtained from the research.
8. Briefly state a conclusion based on the results obtained.
9. Suggest two potential limitations of this particular experimental research study.
10. Comment on the extent to which the results can be generalised, ensuring you justify your comment.

BOX 6.2 Photographic memory

Some individuals are able to recall highly detailed scenes as if the actual event were occurring before them. People who are unusually good at this task are said to have eidetic memory, popularly referred to as 'photographic memory'. *Eidetic memory* is the ability to remember with great accuracy visual information on the basis of short-term exposure. Eidetic memories involve eidetic images.

An *eidetic image* is an exact replica of a visual image that persists over time without distortion. People who have eidetic memory are so good at maintaining an image that they literally 'see' the relevant page of a textbook as they recall the information during an exam.

Eidetic images can apparently last for prolonged periods — sometimes days or even weeks — and seem to contain all the information in the original experience. Eidetic images occur most often during childhood (in about 5% of children tested), but are less frequent in adolescence, and are very rarely reported in adulthood (Hilgard, Atkinson & Atkinson, 1979).

In one of the original experiments on eidetic memory, English schoolchildren were shown a complicated street scene displayed in the form of a storybook picture for 35 seconds and then withdrawn from view. Some of the children were able to describe this scene as if describing the information with the actual picture in front of them. A few of these children (who, it would seem, had eidetic memories) could spell out the name of a street that had appeared in the picture even though the street name was a 13-letter German word and the children knew no German (Allport, 1924).

Contrary to popular belief, 'memory experts' generally don't have eidetic memory. Their skill is usually in organising material in memory using mnemonic ('memory-improving') techniques rather than storing information as long-lasting visual images.

Testing for eidetic memory

Look at the picture below for about 30 seconds, then answer the questions on page 341 without referring back to the picture.

Figure 6.8 Stimulus image for testing eidetic memory

LEARNING ACTIVITY 6.4

Reflection

Is it possible that photographic (eidetic) memory is a long-lasting version of the iconic memory that we all have? What do you think?

Echoic memory

The term **echoic memory** is used to describe auditory sensory memory — the brief sensory memory for incoming auditory information. Echoic memory registers and retains all kinds of sounds, such as speech, the barking of a dog and the sirens of emergency vehicles. It is called echoic memory because sounds linger in it like an echo. To experience echoic memory, clap your hands once and notice how the sound remains for a very brief time and then fades away.

Studies of echoic memory indicate that it functions like iconic memory, storing sounds (rather than visual images) in their original sensory form. Apart from the sensory register involved, the main difference between iconic and echoic memories seems to be the length of time it takes for information to fade. Echoic memory stores information for longer periods than does iconic memory — typically 3 or 4 seconds — while visual information is retained in iconic memory for an average of 0.3 of a second.

Figure 6.9 Echoic memory stores information for a longer duration than iconic memory. If you hear this galah's squawk, your echoic memory will retain the auditory information for about 3 to 4 seconds. However, if you see a photograph of this bird flashed on a screen for a split second, your iconic memory will hold the visual information for about one-third of a second.

TABLE 6.2 Storage duration of iconic and echoic memories

iconic (visual) memory	about 0.2–0.4 of a second
echoic (auditory) memory	about 3–4 seconds

Although the retention period is brief, the availability of auditory information for 3 or 4 seconds is generally long enough to select what has been heard for further processing and interpretation before the sound disappears completely. Consider the times when your attention has been focused on a book you are reading, a television program you are watching or a social media activity, and someone asks you a question. Often you are aware they are speaking, but since your attention is focused elsewhere, you do not immediately comprehend the message. However, within a couple of seconds you say 'What?' and then answer the question before the person has time to repeat it. It is believed that because the sound of the original question is held in echoic memory for a few seconds, when you directed your attention to what the person said, the information was then passed on to STM where it was processed and interpreted. The tail-end of the question was temporarily stored in echoic memory while earlier parts of the incoming message were being processed. The response of 'What?' may have occurred just before the last bit of the message in echoic memory was transferred to STM where it became a complete message in conscious awareness.

The relatively longer duration of echoic memory is important for understanding speech. You perceive speech by blending successive spoken sounds you hear. When you hear a word pronounced, you hear individual sounds, one at a time. You cannot identify a word until you have heard all the sounds that make up the word, so auditory information must be stored long enough for you to receive all the sounds involved. For example, if someone says 'compare', you will think of judging something against something else, but if someone says 'compute', you will think of something completely different. The first syllable you hear (*com*) has no meaning by itself in English, so you do not identify it as a word. However, once the last syllable is heard, you can put the two syllables together, recognise the word and give it meaning. If echoic memory storage were as brief as iconic memory storage, speech might sound like a series of separate, distinct sounds instead of meaningful words, phrases and sentences.

Findings from the results of various experiments suggest that although sensory memory can store virtually all the information provided by our sensory receptors, this information fades rapidly (with the rate varying among the senses). Information is lost and replaced so rapidly in the sensory registers that we are rarely aware of our capability for retaining sensory information.

Considering the many trillions of bits of information detected by our senses in a lifetime, if we processed everything that reached sensory memory, it would

probably lead to confusion, frustration and inefficiency in daily living. For example, when walking through the Melbourne CBD, your echoic memory will register thousands of different sounds but you will attend to and remember only a select few. While crossing Flinders Street, if you hear the screech of car brakes nearby, you will probably pay attention to and act on that information because of the potential threat to your safety. At that moment when you are attending to and processing the sound of the screeching brakes, you will ignore many other sounds that enter echoic memory, such as people talking, the clicking sound of the traffic lights, the sound of a tram bell or that of a bus departing. It would be chaotic and even dangerous at times if we attended to all of the sensory information detected by our receptors.

When you attend to information in sensory memory, it is transferred to STM. Only the information selected for transfer to STM is encoded and has a chance of being stored permanently. Information in sensory memory that is not attended to is lost very quickly — usually within seconds.

Figure 6.10 Selective attention helps ensure the huge amount and variety of incoming information that reaches sensory memory is filtered to keep out irrelevant and unimportant information.

BOX 6.2 Questions

1. What colour is the girl's dress?
2. Where are the girl's arms?
3. Is the cat looking to its right or its left?
4. How many red flower 'spikes' are there?
5. What colour is the girl's hair?
6. How many stripes are there on the bottom of the girl's dress?

If you correctly answered all these questions, then you may have eidetic memory.

BOX 6.3 Déjà vu

You arrive somewhere for the first time when suddenly you have a weird feeling that you've been there before. This is called déjà vu (French for 'already seen'). In psychology, *déjà vu* is described as the brief and intense feeling that something happening now has happened before in exactly the same way, but without you being able to recall exactly when or where.

Some people believe that déjà vu is evidence of psychic or paranormal experiences, reincarnation or even dreams coming true, but there is no scientific evidence supporting any of these views.

How common are déjà vu experiences? After analysing the results of more than 30 studies on déjà vu that used the survey method, American psychologist Alan Brown (2004) found that about two-thirds of individuals (68%) reported having had one or more déjà vu experiences in their life. He also found that the incidence of déjà vu steadily decreases over the lifespan.

Young adults in the 20–24 years age range tend to have the highest yearly incidence, averaging almost three déjà vu experiences per year. By the time people reach their early forties, they are averaging less than one déjà vu per year. However, a small minority of people seems to be especially prone to déjà vu experiences: about 16% claim to have a déjà vu experience about once a month.

According to Brown (2003), a typical déjà vu experience is triggered by some kind of visual scene, and the intense feelings of familiarity last for just a few seconds. Déjà vu experiences are most common when people are feeling fatigued or emotionally distressed, in the evening and in the company of others rather than alone. Well-educated people and people who travel frequently tend to have a higher incidence of déjà vu experiences (Hockenbury & Hockenbury, 2006).

Many scientific explanations have been proposed for déjà vu. These include inattentional blindness, memory malfunction and brain malfunction. For example, according to the inattentional blindness hypothesis, déjà vu experiences can be produced when you're not really paying attention to your surroundings. When you do focus your attention on the situation a split second later, those surroundings are suddenly perceived as familiar but you cannot quite work out why.

Figure 6.11 'Haven't I been here before?' The French term *déjà vu* is used to describe the sensation of having experienced a current situation at some time in the past.

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Weblink
Some explanations of déjà vu

LEARNING ACTIVITY 6.5

Review questions

1. What is sensory memory?
2. Distinguish between the terms sensory memory and sensory register.
3. Why can sensory memory be described as a memory system or sub-system rather than a perceptual system?
4. (a) Define iconic memory and echoic memory with reference to relevant examples.
(b) Prepare two lists of the main distinguishing characteristics of iconic and echoic memory. Refer to the type of sensory information received, storage duration and storage capacity.
5. In what way might sensory memory have an adaptive function and assist us in adjusting to ongoing environmental change?
6. Is information in sensory memory subject to an encoding process? Explain your answer.
7. (a) What is required for information to transfer from sensory memory to STM?
(b) What happens to information that is not transferred to STM?

Short-term memory (STM)

Short-term memory (STM) is a memory system with limited storage capacity in which information is stored for a relatively short time, unless renewed in some way. STM stores information temporarily, but for a longer time than sensory memory (and less than LTM). In STM, the information is no longer an exact replica of the sensory stimulus, but an encoded version.

When you pay attention to information in your sensory memory (or to information retrieved from LTM), the information enters your STM. For example, because you are paying attention to this sentence, it has now entered your STM. In contrast, other information in your sensory memory, such as the feeling of your socks against your skin, did not enter your STM until you directed your attention to it. STM holds all the information you are consciously aware of at any moment in time. Consequently, STM has been described as the 'seat of conscious thought' — the place where all conscious perceiving, feeling, thinking, reasoning and other mental processes take place.

Duration of STM

Generally, most types of information can be retained fairly well in STM for the first few seconds. After about 12 seconds, however, recall starts to decline and by about 18 seconds almost all of the information disappears entirely if it has not been renewed in some way. A commonly used method of renewal is continual repetition (called *maintenance rehearsal*). Some research findings indicate that information can occasionally linger in STM for up to 30 seconds (especially 'muscle memory' type information associated with body position and movement), so STM duration is sometimes described as 'up to 30 seconds'.

Figure 6.12 When you have to wait for a while to make a point in a conversation, the information you wanted to share may fade from your STM if the waiting time is more than about 18 seconds.

The best-known and most influential experiment on the duration of STM was conducted by American psychologists Margaret Peterson and Lloyd Peterson (1959). Participants were given 'trigrams' (meaningless groups of three consonant letters such as *qlg*, *jfb* and *mwt*) to memorise. Immediately after the trigrams were presented, the participants were given a distracter, or interference task, requiring them to start counting backwards by threes from an arbitrary three-digit number; for example, '634, 631, 628, . . .'. This was done to prevent practice of the trigrams. Following a time interval delay that varied from 3 to 18 seconds, a light was used to signal that participants were required to recall the trigrams.

As shown in Figure 6.13, below, the longer the interval delay, the less likely a participant was able to accurately recall the trigrams. By 18 seconds after

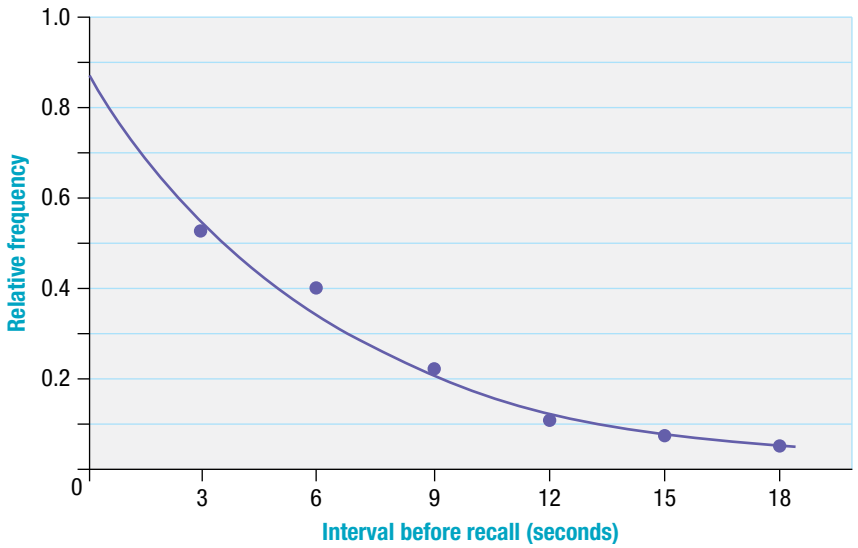

Figure 6.13 Peterson and Peterson (1959) demonstrated that information is retained in STM for about 18 seconds. This time frame continues to be widely described as the approximate duration of STM.

Source: Peterson, L.R., & Peterson, M.J. (1959). Short-term retention of individual verbal items. *Journal of Experimental Psychology, 58*(3), 193–198.

the presentation of the trigrams, participants had forgotten almost all of the trigrams. When participants did not have to count backwards, their performance was much better, possibly because they were practising or repeating the items to themselves.

Similarly, if you repeat a phone number over and over to yourself, it can be retained in STM indefinitely. But if someone tells you their phone number and you are then distracted by something else that requires your attention, you are likely to forget the number almost immediately. The distraction not only prevents rehearsal, resulting in loss of the information, but the new information acquired when distracted may exceed the limited capacity of STM and displace, or 'push out', the number from STM, thereby causing you to forget it.

eGuide*plus*

Practical activity
Peterson task

Capacity of STM

Compared to sensory memory and LTM, STM has a very limited storage capacity. The amount of information it can hold at any one time is about seven 'bits of information'. This was first described by American psychologist George Miller (1956) in a journal article called 'The magical number seven, plus or minus two'. Miller reached this conclusion after analysing the results of many research studies showing that STM has a capacity of between five and nine units of information at any given moment. Some individuals have a smaller or larger STM capacity. More recent studies have found that Miller may have over-estimated STM capacity.

Estimates of STM capacity are obtained by asking research participants to memorise simple lists of data of different lengths; for example, randomly ordered numbers, letters, nonsense syllables or unrelated words. The length of the list is continually increased until the person is correct only 50% of the time (Miller, 1956). Research in non-western cultures using Chinese characters has also shown an STM capacity of 7 ± 2 pieces of information (Yu et al., 1985).

Figure 6.14 STM has a storage capacity of 7 ± 2 bits of information. This shopper probably needed a written list to remember all the items he wanted to buy unless he used a strategy that can overcome the limited capacity of STM, such as 'chunking' described in Box 6.4 on page 346.

When STM is 'full', new items can only be added by pushing old items out (as shown in Figure 6.15 below). Space in STM is also filled when we think and when information is temporarily retrieved from LTM to be used or updated. This is one reason why you cannot remember a new phone number you have just heard if you begin thinking about what you might say before you dial the number. You can check your STM capacity by completing the digit span task in Learning Activity 6.6 below.

Information stored in STM is lost primarily through *decay* (not being used) and *displacement* (being pushed out) by new information (Reitman, 1974). Decay of information in STM occurs when information is not renewed (e.g. through repetition) and simply fades away with the passage of time. For example, this occurs when you forget what you want to say in a conversation while you wait for another person to finish what they are saying. Your thoughts quickly fade from STM because listening to what the speaker is saying prevents you from repeating the information and therefore maintaining in STM the point you wanted to make.

Displacement of information from STM was demonstrated in a well-known study for which participants called a telephone directory assistance service and requested a long-distance telephone number. They showed poorer recall of the number if the person providing the information said 'have a nice day' after giving the number than if they said nothing. The researchers concluded that the friendly message had displaced the phone number from STM (Schilling & Weaver, 1983).

When you think, your 'working space' in STM is used up. The limited capacity of STM explains why it is difficult to think about problems involving more than 7 ± 2 issues (or 'items' of information). We forget some aspects of the problem because they exceed the capacity of STM.

Similarly, fading or displacement can explain the experience of forgetting someone's name straight after they have been introduced to you. If you engage the person in a conversation, the lack of opportunity for 'rehearsal' of their name can result in fading from STM. Furthermore, the new additional items of information introduced during the conversation may result in the capacity of STM being exceeded and displacement of the person's name.

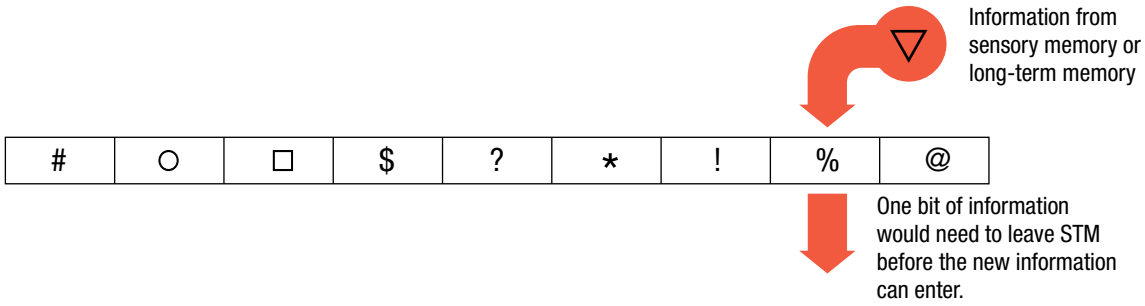

Figure 6.15 When STM is 'full', new items can only enter though displacement — by pushing an old item out.

LEARNING ACTIVITY 6.6

Measuring STM capacity using a digit span test

Using a piece of paper (or some other object), cover all the numbers below. Then, progressively move the paper to uncover each row of numbers, one row at a time.

Read the first set of numbers, cover it up, then write the numbers down in their correct order. Repeat this procedure until you reach a row where you begin making errors. The longest string you are able to reproduce without error is your STM digit span.

9 1 5
3 7 2 4
8 6 9 7 3
1 9 2 8 0 5
4 8 2 6 3 9 1
2 5 3 9 6 0 8 7
5 8 9 5 1 6 9 0 2
7 2 9 6 1 0 9 4 3 6
6 9 4 0 5 8 1 7 2 5 8
2 0 8 4 1 9 7 6 3 2 7 5

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Practical activity
STM capacity

BOX 6.4 Chunking

We can get around the limited capacity of STM. One way is to learn information well enough to transfer it to LTM, which probably has an unlimited storage capacity. Another way is to put more information into each of the 7 ± 2 units that can be stored in STM. To illustrate this, read the sequence of letters below:

W N V D C E I V D C S V

Now close your eyes and try to repeat the letters aloud in the same order. Unless you have an exceptional STM, you probably could not repeat the whole sequence correctly. Now try this sequence of letters:

N S W V I C V C E D V D

People usually recall more of the second sequence, even though it is made up of exactly the same letters. The increased ability to recall the second letter sequence demonstrates chunking.

Chunking is the grouping, or 'packing', of separate bits of information into a larger single unit, or 'chunk', of information. The first sequence of letters was probably perceived as 12 separate items, which probably exceeded your STM capacity. The second letter sequence can be perceived as four 'chunks' — NSW, VIC, VCE, DVD — which is within the capacity of STM and is therefore more likely to be remembered. Note also that these chunks are more meaningful, which makes them easier to remember than the nonsense single units comprising a single letter. Meaningful units are easier to remember because they are based on information we already know.

Chunks can take many forms. They can be numbers, images, words, sentences, phrases or abbreviations (such as AFL, RACV or VCAA). Some waiters pride themselves on being able to remember orders of large groups of people without using a notepad, which they do by chunking the information. We also find it easier to remember numbers in chunks (319–528–7451) than as a string of single digits (3195287451). This is why phone numbers, credit card numbers, tax file numbers and other long strings of numbers (or letters) are typically broken up and organised in groups.

Figure 6.16 Chunking shows that we can increase the capacity of STM, just as repetition (rehearsal) shows that we can increase the duration of STM storage. (a) Some waiters chunk information to remember big orders without using a notepad. (b) Interpreters must store long and often complicated segments of speech in STM while checking LTM for equivalent expressions in the language they are translating into. This task is assisted if the speaker's words are chunked into phrases or sentences.

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Practical activity
Chunking and STM

STM functions as working memory

Many psychologists now prefer to use the term *working memory* instead of STM to emphasise the active processing and use of information that occurs there. Generally, it is believed that the term 'short-term memory' understates its roles and importance, not only in human memory, but also in our conscious experience of the world and our ability to function effectively in everyday life.

As our 'working memory', STM enables us to actively 'work on' and manipulate information while we undertake our everyday tasks. Information from sensory memory is processed in working memory and information is retrieved from LTM to be used and manipulated in working memory.

Often, we combine information from sensory memory and LTM to perform all kinds of mental activities in our short-term 'working' memory. Interpretation of emotions and feelings, language comprehension, daydreaming, creativity, problem solving, analysing, reasoning, planning and decision making all involve 'working memory'. For example, when you think about past events, such as who you shared a cabin with at the last school camp you attended, or when you mentally add the numbers 17 + 5 + 12, the information is temporarily held in 'working memory' while it is being used. Your 'working memory' enables you to read by holding words from the beginning of a sentence while you continue to process the rest of the sentence. Thus, 'working memory' provides a temporary storage facility and mental 'workspace' for information currently being used in some conscious cognitive activity (Baddeley, 1999).

In both the language and arithmetic examples, temporary storage of information was needed in order to perform some other task — in these examples, understanding and calculating. Information only remains in 'working memory' while we consciously process, examine or manipulate it. Once the required task has been achieved, the information stored there is no longer required and is either transferred to LTM or discarded.

Figure 6.17 We combine information from sensory memory and LTM to perform all kinds of mental activities, such as when texting on a mobile phone.

LEARNING ACTIVITY 6.7

Review questions

1. Define short-term memory (STM).

2. (a) Give an example of an experimental research procedure that could be conducted to test the storage duration of STM.
(b) Propose a research hypothesis for the experiment.
(c) Would you expect storage duration to depend on the type of information to be stored?
(d) How could you temporarily extend the duration of your STM?

3. (a) Give an example of an experimental research procedure that could be conducted to test the capacity of STM.
(b) Formulate a research hypothesis for the experiment.
(c) Suggest an example of a strategy that could be used to increase the capacity of STM and explain why this strategy would actually increase the number of items that could be retained in STM at any given moment.

4. Many of the classic laboratory experiments on STM have been criticised for 'lacking ecological validity'.
(a) Explain the meaning of ecological validity with reference to the Peterson and Peterson (1969) experiment.
(b) In what way does lack of ecological validity limit research findings?

5. In what ways is STM like sensory memory and unlike sensory memory?

6. (a) Distinguish between sensory memory and STM with reference to conscious awareness.
(b) Explain why STM can be described as the 'seat of consciousness' but neither sensory memory nor LTM can be described in this way.
(c) Explain why information transferred from sensory memory to STM is considered to be an encoded version of that information.

7. Explain, with reference to an example, why STM may be described as working memory.

8. In what two ways is information most commonly lost from STM?

9. You walk from one room to another to pick something up, and when you arrive you have forgotten why you went to the room. You realise that you were thinking about something else and this made you forget the reason for being in the room. Explain why this forgetting occurred in terms of STM capacity and duration.

LEARNING ACTIVITY 6.8

Reflection

Is 'short-term memory' or 'working memory' the more appropriate term to describe the memory system that receives information from both sensory memory and LTM? What do you think? Which term better reflects capacity? function? Suggest a possible alternate term and explain why it could be a better term.

Long-term memory (LTM)

Long-term memory (LTM) stores a potentially unlimited amount of information for a very long time, possibly permanently. LTM is not considered to be a single store for all kinds of information. Different types of LTM are associated with different kinds of information and memory processes.

As shown in Figure 6.18 below, the two main LTM types are called explicit and implicit memory, each of which has two (or more) sub-types. Generally, explicit and implicit memory differ in terms of the way information retrieved from memory is expressed; that is, with or without conscious awareness. Each of these memory types is associated with distinctive neural mechanisms and operates relatively independently of one another. Many psychologists consider them to be separate sub-systems of LTM, processing different types or aspects of information but interacting when required (Schacter, 1992).

Psychologists first identified explicit and implicit memory when reviewing the results of studies with patients who had amnesia due to brain damage. It was found that some could demonstrate implicit memory but not explicit memory, thereby suggesting two memory types, each of which was associated with damage to different brain areas or structures (Graf & Schacter, 1985).

Explicit memory

Explicit memory involves memory that occurs when information can be consciously or intentionally retrieved and stated. Consequently, it is a process that is commonly described as 'memory with awareness'.

Explicit memories can involve words or concepts, visual images, or both. Remembering someone's name, a password, a phone number, the colours of the Italian flag or when a pet died are all examples of explicit memory. You would also rely on explicit memory when identifying a type of flower, explaining a statistics formula to someone, remembering what you ate for dinner last night and whenever you recall a happy or sad event from some time in the past. When explicit memory is used, there is a deliberate and conscious attempt to retrieve previously stored information.

Explicit memories are also called *declarative memories* because, if asked, we can consciously retrieve the information and can 'declare' (state) or 'explicitly' (openly) express it.

The most commonly used tests of explicit memory involve recall and recognition (which are examined in Chapter 8). A prominent feature of these tests is that they refer to and require conscious retrieval of specific information that the individual being tested knows they have previously learnt.

Explicit memory has two sub-types that are commonly called episodic memory and semantic memory.

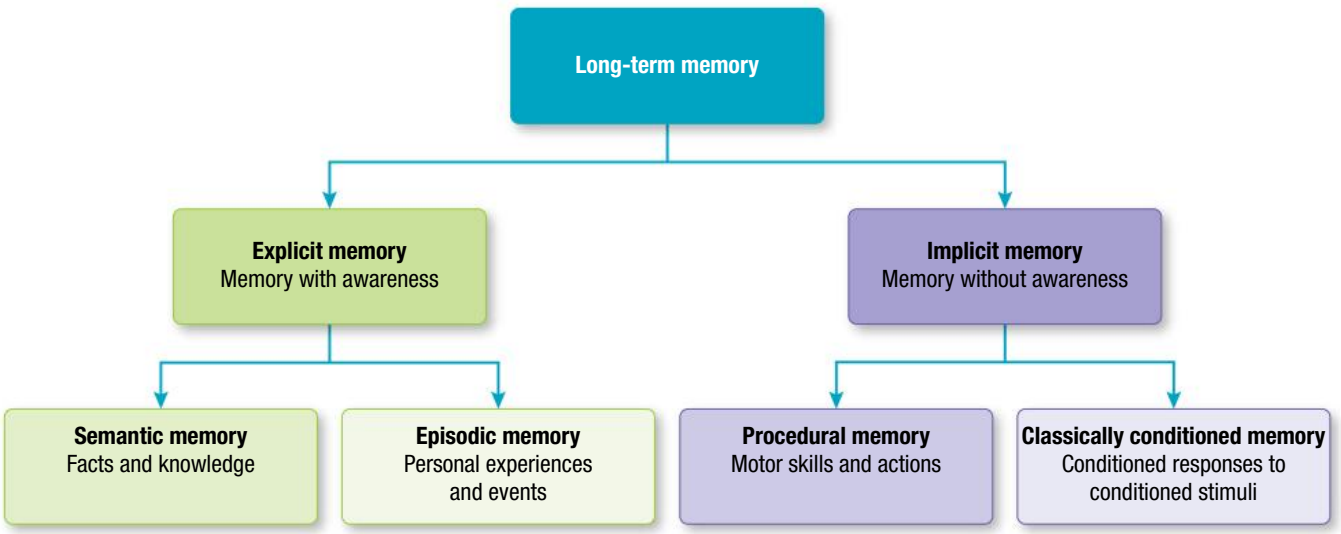

Figure 6.18 Long-term memory types and sub-types

Episodic memory

Episodic memory is the memory of personally experienced events. These memories often include details of the time, place and our psychological and physiological state when the event occurred. Episodic memory therefore makes it possible for us to be consciously aware of an earlier experience in a certain situation at a certain time (Tulving, 1993).

Episodic memory is considered to be like a mental 'personal' diary with records of 'autobiographical' episodes we directly or indirectly experience. It is unique as it is the only memory that allows you to travel mentally through time, to remember thoughts and feelings from the recent or distant past. This ability allows you to connect your past and your present and construct a cohesive story of your life. Your memory of your first day at school, where you went for a holiday during the last Christmas vacation, how you felt during a dental visit a week ago, and what you ate for breakfast this morning and how the food tasted, are all examples of episodic memories.

Figure 6.19 Episodic memory involves memories of personally experienced events that we consciously retrieve and can express to others. For example, these veterans are recalling and describing their war experiences.

Semantic memory

Semantic memory is the memory of facts and knowledge about the world. It includes our specialised knowledge of:

- facts and knowledge of the kind learned in school — e.g., that humans are mammals and a pie chart is a circular graph
- everyday facts and general knowledge — e.g., that hair can be dyed blonde or that the 2016 summer Olympic Games were held in Rio de Janeiro
- the meaning of words — e.g., that 'assist' means to help
- rules — e.g., the spelling rule 'i before e except after c', or the formula for calculating a mean score
- areas of expertise — e.g., that in a game of chess, a king can be moved only one space in any direction.

Unlike episodic memories, semantic memories are not 'tagged' with details of time and place. For example, you can access a fact such as 'Mick Jagger is the lead singer of the Rolling Stones' that you know you have learnt at some time in the past and not have any idea of when and where you first learned this piece of information.

Some psychologists believe that the distinction between semantic and episodic memories is not as clear-cut as others suggest. They point to memories that seem to be neither purely episodic nor purely semantic but fall into an area in between. For example, consider your memory for a homework task you worked on last night. You probably added knowledge to your semantic memory, which was the likely reason you were asked to do the work. However, you probably also remember details about where you were studying, as well as what time you started and about when you stopped. You may also remember some minor incidents, such as some shouting from a nearby room that upset you or having difficulty finding a reference, all of which are episodic in nature.

Canadian psychologist Endel Tulving (1993), who first described episodic memory, argues that the semantic and episodic memories are sub-systems that store different kinds of information but often work together when we form new memories. In such instances, the memory that is ultimately encoded may consist of an autobiographical episode *and* semantic information. The two might be related, like a container and its contents. For example, your episodic memory of having studied last night also contains semantic knowledge about what you learned.

Other psychologists have proposed that semantic memories may simply be greatly overlearned episodic memories that do not require the 'time stamping' that occurs with episodic memories. For example, when did you first learn the meaning of the word 'tomato'? You probably don't remember because the information is so well-known to you and when it was learnt matters so little that you can't remember when you actually first learned it (Thompson, 2000).

studyon

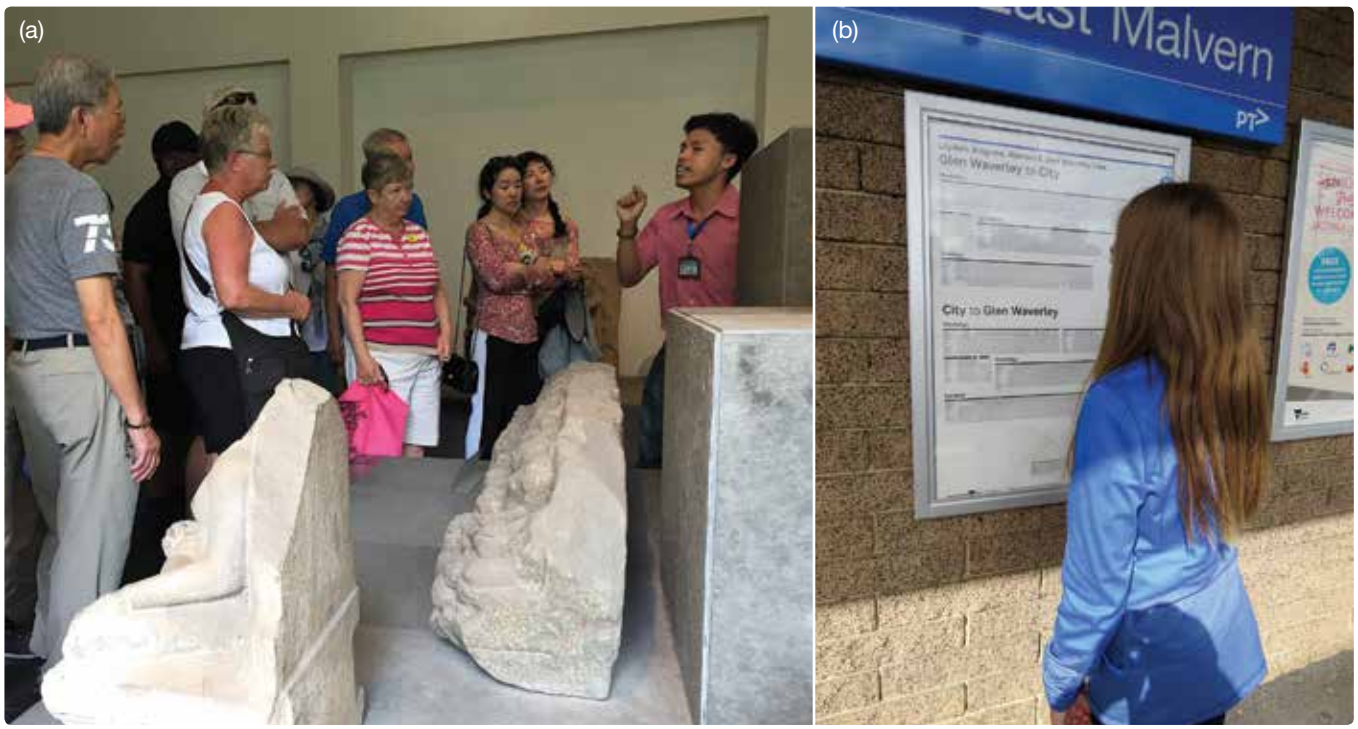

Figure 6.20 Semantic memory involves memories of facts and knowledge that we consciously retrieve and can express to others. For example, (a) this tour guide is relying on his semantic memory, as is (b) the girl recalling which of the city loop stations is closest to where she needs to go.

LEARNING ACTIVITY 6.9

Reflection

Imagine what life would be like without the ability to form new explicit memories. What are some aspects of your life that would change? For example, what would be the implications on learning at school? Playing sport? Following the plot of a movie? Navigating your way around town? Can you think of several other ways this would affect your life?

Implicit memory

Implicit memory involves memory that does not require conscious or intentional retrieval. You are not aware you are remembering, nor are you necessarily trying to remember or aware of ever having remembered something you know you know or can do. However, the remembering usually occurs effortlessly. Implicit memory is therefore commonly described as 'memory without awareness'. Examples include motor skills like brushing your teeth and riding a skateboard. Implicit memory also includes simple classically conditioned responses, such as fears and taste aversions (Schacter, Gilbert & Wegner, 2009).

The term 'implicit memory' is used because the existence of a specific memory can be 'implied' by (or inferred from) responses that can be observed. For example, your memory for knowing how to tie your shoe laces or ride a bicycle can be judged by watching you do it rather than by asking you to state how you do it. The psychologists who first described implicit memory considered adopting the term 'unconscious' or 'unaware' instead of 'implicit' but decided these

Figure 6.21 If this patient can recall unfamiliar words presented when unconscious during surgery and is unaware of when the words were learned, then she would be demonstrating implicit memory.

terms could create confusion as they are also used to describe other psychological concepts that do not necessarily involve memory (Schacter, 1987).

Implicit memories are also referred to as *non-declarative memories* because people often find it difficult to state or describe in words ('declare') what is being remembered, but the memory can be expressed through behaviour. This does not mean that we cannot describe any implicit memory. Sometimes we can and sometimes we can't. It depends on the specific type of information involved. For example, not all implicit memories are 'how to . . .' memories. We can remember words, shapes or other objects without having a conscious memory of ever having been exposed to them before or any awareness that they actually may be in our memory. When the right cue is used, however, we can retrieve and state this information (consider priming in Box 6.5 on page 353).

Different sub-types of implicit memory have been identified. Two of the most commonly described are called procedural memory and classically conditioned memory.

Procedural memory

Procedural memory is the memory of motor skills and actions that have been learned previously. It involves memories of 'how to do something'. Examples of procedural memories include how to brush your teeth, how to use chop sticks, how to play a G chord on a guitar and how to roller blade, even if you have not done so for a long time. Procedural memories are demonstrated through performance (i.e. behaviour) and include what are sometimes called *skill, motor, body* or *muscle* memories.

Procedural memories typically require little or no intentional or conscious attempt to retrieve. For example, if you have not ridden a bicycle for many years, the skills required to do so will be reactivated and brought into conscious awareness with little or no mental effort. What we remember is automatically translated into actions. All you have to do is 'will' the action and it happens, but it happens because you have an implicit memory of how to make that action happen (Schacter, Gilbert & Wegner, 2009).

Procedural memories are often particularly difficult to put into words. For example, try explaining how you balance on a bicycle without falling off when you ride down the street. Similarly, consider a more complex sequence of actions performed by an experienced hockey player. In the course of a match, the player scores a goal after taking a pass and weaving their way through several opponents while maintaining possession of the ball. If asked about the rapid series of motor activities involved in this play, the player will probably have a difficult time stating how to perform every single movement involved.

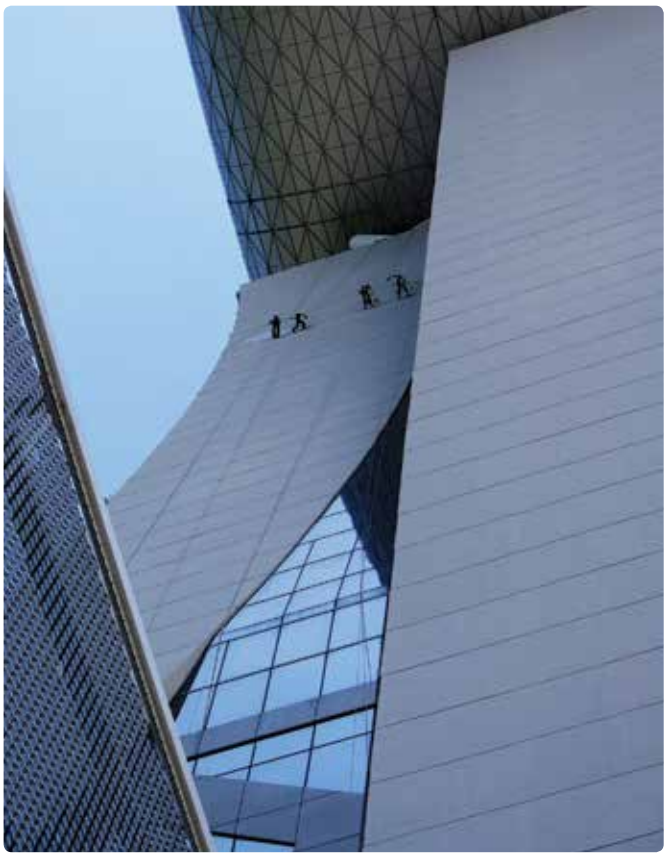

Figure 6.22 Procedural memory involves implicit memory of motor skills and actions, which is relied on by these building cleaners white-washing the walls.

Figure 6.23 Cooking a pie can involve explicit and implicit long-term memories. Procedural memory is involved in knowing how to prepare the pastry. Remembering the recipe involves semantic memory. A memory of the time and place of a previous cooking disaster with apple pie would involve episodic memory.

LEARNING ACTIVITY 6.10

Reflection

Consider the principles and actions required to ride a bicycle. Comment on whether you could verbally describe to someone who is physically able to ride a bike, but has never seen or ridden one, how to successfully do so. Assuming you could prepare a detailed list of written instructions on how to ride a bike, explain whether the person could, as an alternative, carefully read the instructions then hop on a bike and ride off.

Classically conditioned memory

Conditioned responses to conditioned stimuli acquired through classical conditioning are also considered to be a type of implicit memory, particularly those involving fear or anxiety. For example, if you immediately experience fear or anxiety at the sight of a spider or when you think about having to go to the dentist because of past associations with anxiety or pain, implicit memory is involved, whether or not you have an explicit 'declarable' recollection of a relevant past event.

Consider also a taste aversion that may be acquired involuntarily without conscious awareness through classical conditioning. Suppose, for example, that you developed a taste aversion to yoghurt after tasting or eating it and feeling nauseated. If you feel sick whenever you see or think about yoghurt, this is a type of classically conditioned response. The memory of feeling sick comes into your conscious awareness automatically, without any deliberate effort, because of the past association. This means that the memory is implicit.

There are also simple conditioned reflex responses that involve implicit memory. For example, eye blinking to a puff of air and head turning to the sound of a tone that has been acquired through classical conditioning will occur automatically without conscious awareness in response to a relevant stimulus. This also means that the memory is implicit.

Figure 6.24 If you immediately feel sick at the sight or thought of seafood because of a past association between the food and nausea, you probably have a taste aversion involving a classically conditioned implicit memory.

BOX 6.5 The implicit memory of priming

Not all implicit memories are 'how to' memories or conditioned responses. For example, we can learn and remember words, shapes or other objects without having a conscious memory of prior exposure to them or awareness that they may be in our memory. When the right cues are used, however, we can retrieve this information.

Priming is an improvement or change in the ability to remember something as the result of having prior experience with it. Essentially, prior exposure to a stimulus (the 'prime') influences a response to a later stimulus. For example, if you were to see a picture of bicycle handlebars drawn from an unusual angle, you would recognise them as part of a bike faster if you had previously seen a more conventional picture of a bike (the 'prime' or 'priming stimulus'). If you had not, you would find them more difficult to identify.

Priming is considered by many psychologists to be a type of implicit memory in the sense that it can occur independently of any conscious or explicit recollection of a previous encounter with a particular stimulus (Schacter, 1992; Stevens, Wig & Schacter, 2008).

Priming has mainly been studied in experiments using word completion tests. For example, participants may be exposed to a list of ten words that are rarely used in everyday conversation, such as assassin and sampan. They may be required to rate how much they like or dislike the words so that they do not focus on committing the words to memory. A week or so later, when given a test of explicit memory, the participants have no idea about whether any of the words were on the list. However, when given a word fragment such as a _ _ a _ _ in and s _ m _ _ n then asked to complete it with the first appropriate word that comes to mind, they are more likely to complete the words assassin and sampan than control group participants. Similarly, participants who are shown an entire word such as 'bird' or 'elephant' will respond more quickly to later presentations of these words than to words they had not previously seen, even though they do not remember having seen the words 'bird' or 'elephant' earlier.

This priming effect seems to rely on prior exposure to a stimulus even though the person is unaware of the experience. The effect, although sometimes reduced, has been observed in both people with and without amnesia, using different types of words (e.g. meaningful-non-meaningful; familiar-unfamiliar; short-long) and different types of presentations (e.g. visual-auditory; short-long exposure time) (Schacter, 1987; Schacter & Buckner, 1998).

Figure 6.25 Have you noticed how your fears are heightened during and after watching a horror film? Prior experience has primed you to more easily notice and recall related instances.

BOX 6.6 Semantic network theory on organisation of information in LTM

Before reading further, recall the names of the 12 months of the year as quickly as you can. How long did it take you? What was the order of your recall? The answer to these questions is probably 'about 5 seconds' and 'sequential order' (January, February, March …).

Now, try recalling the months in alphabetical order as quickly as you can. How long did it take you? Did you make any errors? It is likely that the first task was completed more quickly and with fewer errors than the second task.

These activities, as basic as they are, demonstrate that your memory for the months of the year has some organisation to it (Tulving, 1983). One of LTM's most distinctive features is its organisation of information. The task of retrieving information from LTM is vastly different from that of retrieving information from STM. In STM the search-and-retrieve task involves scanning only 7 ± 2 items to locate the relevant information. However, LTM stores such a vast amount of information that it needs some form of organisation to enable storage that assists the retrieval process.

(continued)

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Semantic network theory emphasises organisation of information in terms of connections ('networks') based on meaning ('semantic'). It proposes that information in LTM is organised systematically (with a hierarchical structure) in the form of overlapping networks (or 'grids') of concepts that are interconnected and interrelated by meaningful links. According to the theory, each concept, called a *node*, is linked with a number of other nodes (or concepts) in the network. When we retrieve information, cues activate the nodes and the activation of one node causes other related nodes to be activated also, thereby retrieving related information. The more nodes that are activated, the greater the likelihood that the correct information will be retrieved.

Figure 6.26 below shows how a small segment of a possible semantic network for animals might be arranged in LTM. Each concept in the network, such as *bird* or *canary*, is organised into a hierarchy in which one concept is a subcategory of another. For example, note how the concept of *animal* is broken down into *bird* and *fish*. Bird and fish are then broken down further into specific examples of each. At each node, certain characteristics of that concept are stored. For instance, the characteristics associated with fish could include fins, swimming, gills and scales.

In reality, LTM contains countless concepts, each with very many connections and links. For example, the network for animals that includes fish could overlap with the network for proteins, which could also include fish as well as nuts, cheese, meat and so on. This system of storing information in terms of meaning is not only effective for organising stored information but also enables its efficient retrieval. For example, if we locate *canary*, we not only know that canaries can sing and are small, but we also know, by moving upwards in the hierarchy, that they have wings and feathers, fly, breathe, eat, move and have skin. This helps make the information-storage system efficient because it minimises the duplication in storage of information, given that every characteristic of each animal does not need to be stored separately with that animal.

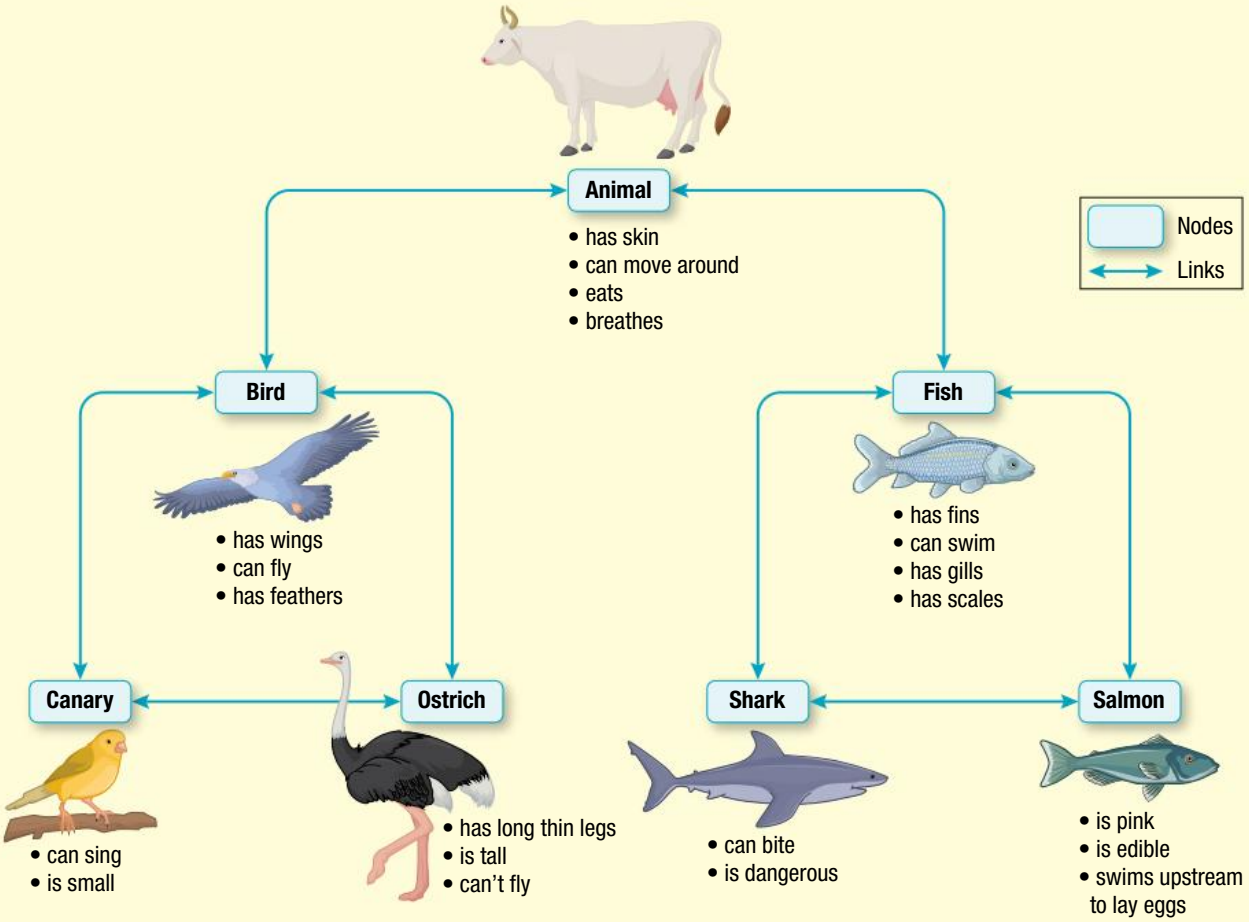

Figure 6.26 According to semantic network theory, LTM is organised into semantic networks in which concepts or nodes (such as canary, bird and animal) are interconnected by links. The shorter the link between two concepts, the stronger the association between them. The figure shows only a small segment of a possible network. Other information, such as characteristics of animals, fish, birds and so on, has been left out so that the network is kept simple.

LEARNING ACTIVITY 6.11

Review questions

1. Explain what long-term memory (LTM) is with reference to its function, storage capacity and duration.

2. (a) LTM is sometimes described as storing 'inactive' information. Explain whether this is a suitable description.
(b) Which other memory store or system could also be described as storing inactive information? Why?

3. (a) Distinguish between implicit and explicit memory with reference to two key features and relevant examples.
(b) Why are implicit and explicit memory often described as declarative or non-declarative?
(c) Give examples of when implicit and explicit memory may occur independently of each other.
(d) Give an example of an implicit memory that does not involve some kind of observable activity.
(e) Make a copy of the LTM chart in Figure 6.18 on page 348 and include information about key features and relevant examples of each subtype of implicit and explicit memory.

4. For efficient keyboarders ('typists'), keying in the phrase 'most zebras cannot be extravagant' with closed eyes is not a difficult task. However, reciting the seven letters on the bottom row of the keyboard from left to right is much more difficult. Give an explanation of this research finding with reference to implicit memory.

5. This Uber driver has just received a job call to pick up and deliver a regular customer to their usual destination. Give an example of information that may be retrieved from explicit and implicit memory systems when completing the job.

LEARNING ACTIVITY 6.12

Identifying LTM types and subtypes

For each of the following activities, name the most likely LTM type/s (explicit or implicit) and the relevant subtype/s. Briefly explain each answer.

(a) Describing your first day in Year 7
(b) Planning where to move your queen in a chess game
(c) Walking on stilts up stairs
(d) Recalling the names of Santa's reindeer
(e) Solving a crossword puzzle
(f) Texting a phone message
(g) Stating a lunch order in a fish-and-chip shop
(h) Taking a lunch order in a fish-and-chip shop
(i) Describing the plot of a novel
(j) Feeling anxious at the sight of a mouse because of a traumatic previous encounter with a mouse
(k) Playing hide and seek
(l) A knee jerk reflex CR to a CS
(m) Calculating a mean score
(n) Giving directions to the principal's office
(o) Writing up a prac. report
(p) Recalling a party you attended
(q) Recalling the name of your favourite primary school teacher
(r) Writing a computer program
(s) Playing online Scrabble
(t) Becoming extremely anxious when stuck in a lift because of a fear of having been in an enclosed place at some time in the past
(u) Playing a car-racing video game
(v) Looking up a word in a dictionary

LEARNING ACTIVITY 6.13

Visual presentation

Draw a diagram to show how procedural memory, episodic memory and semantic memory could each be involved in processing information about a competitive tennis match you played in. Include a dot point summary of each memory type.

LEARNING ACTIVITY 6.14

Reflection

To what extent is the semantic network theory described in Box 6.6 on pages 353–4 consistent with the neurological storage of memories, specifically memory storage at synapses?

BRAIN REGIONS INVOLVED IN THE STORAGE OF LONG-TERM MEMORIES

Our long-term memories are not stored in any one specific brain location. Instead, they are distributed and stored across multiple brain locations. Very simple memories may be formed, encoded and stored at specific locations. The more complex memories, however, typically comprise clusters of information that are stored throughout the brain and linked together by neural pathways. Furthermore, an entire neural pathway can be single memory, a part of multiple memories or include sections of synaptic connections that are involved in one or more other memories (Gazzaniga, Ivry & Mungun, 2014; Kolb & Whishaw, 2014).

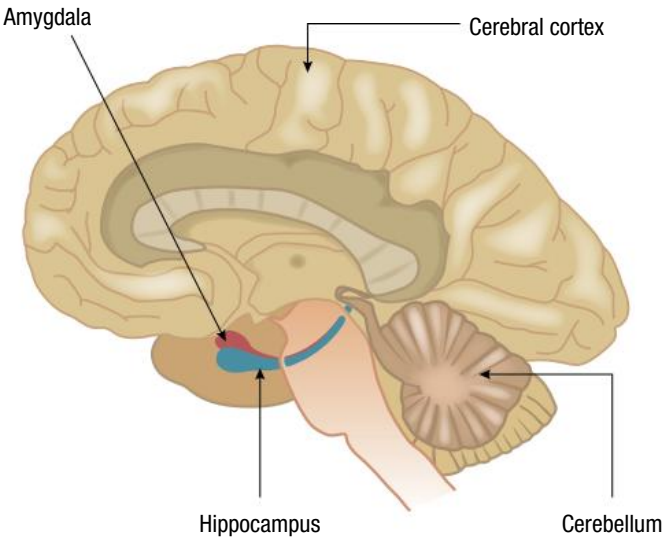

Figure 6.27 Some brain regions involved in LTM storage

There are, however, some distinguishable brain regions and structures in which different types of explicit and implicit memories are encoded and stored. This does not mean that all areas of the brain are equally involved in memory formation or storage. Different areas may become active as we encode, store and retrieve different types of information.

In this section we focus on the roles of the cerebral cortex, hippocampus, amygdala and cerebellum in the storage of implicit and explicit long-term memories. We also consider interactions between these regions, highlighting the complex yet integrated nature of brain function. In relation to long-term memory encoding, storage and retrieval, this often involves parallel processing and exchange of information within and between different brain regions.

Roles of the cerebral cortex

The cerebral cortex is the thin outer, wrinkly looking layer of neural tissue that covers the largest part of the brain (the cerebrum). Anatomically, it is divided into two hemispheres, each of which has four lobes. Unlike most structures that connect only to a limited number of brain regions, the cortex is connected to virtually all parts of the brain. This allows it to take part in almost everything we consciously think, feel and do. Basically, the cerebral cortex is what makes us who we are as human beings and distinguishes us from other animals.

Generally, long-term explicit semantic and episodic memories are widely distributed throughout the cortex. Their permanent storage tends to be in the areas where the relevant information was first processed. For example, an episodic memory of a rock concert you may attend will have different components, such as the name of the band, visual images of the various band members, the band's sounds and so on. It is therefore likely that the name of the band will be stored in a cortical area involved with language (frontal lobe), images in visual cortex (occipital lobe) and sounds in auditory cortex (temporal lobe). Furthermore, the different components are linked to ensure they do not remain a collection of separate memories.

When required, the separate parts are gathered together and reconstructed as a single, integrated memory for retrieval into our conscious awareness. This can be likened to pieces of a jigsaw coming together to create a vivid recollection. The cortex has a crucial role in this process, particularly for explicit memories (Bergland, 2015).

Through continual use of this network when recalling the concert, the groups of neurons involved in storing the different bits of information will repeatedly fire together, strengthening their connections as they become tied together as a single memory. Of course, some components of the memory may also be involved in other memories within the same network or alternative networks.

Figure 6.28 A close-up of a human brain's cerebral cortex. The protective membranes (meninges) have been peeled back to reveal the detail of the bumps and grooves.

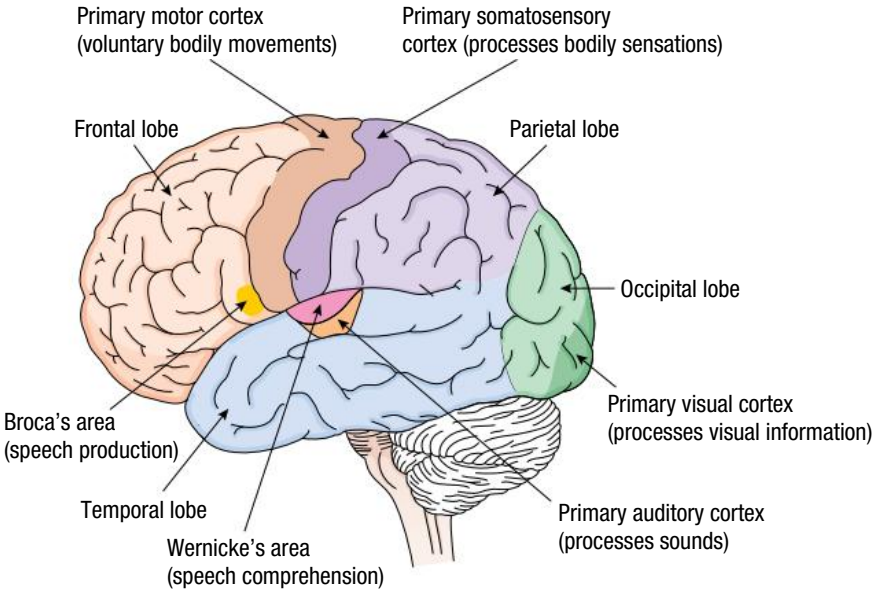

Figure 6.29 The lobes of each cerebral hemisphere and some prominent areas and roles

Given that different cortical lobes are associated with different functions and processing of specific types of information, researchers have investigated whether particular lobes are more likely to store semantic or episodic memories. Although more research remains to be done on this question, neuroimaging studies indicate that semantic memories tend to be stored throughout the cortex, most likely in both of the frontal and temporal lobes. Episodic memories tend to also be stored throughout the cortex, perhaps especially in the right frontal lobe (particularly the prefrontal cortex just behind the forehead) and the right temporal lobe. Studies of brain injured patients also implicate the frontal and temporal lobes as being more significantly involved in explicit memory processes than the other lobes (Breedlove, Watson & Rosenzweig, 2010; Gazzaniga, Ivry & Mungun, 2014).

Roles of the hippocampus

Just above each ear, deep within the brain's medial ('middle') temporal lobe area, on the edge of and just under the surface of the cerebral cortex, is the hippocampus. It is also part of the brain's limbic system involved in emotion and various other functions, together with the amygdala and other structures. The hippocampus is therefore connected to the amygdala and also has numerous connections to adjacent cortex and sub-cortical areas.

As shown in figure 6.30, the hippocampus is tubular and curved, somewhat like the shape of a seahorse (after which it is named). In humans, it is about 3.5 centimetres long and we have two of them — one in each hemisphere.

The hippocampus is the part of the brain that turns short-term memories into long-term memories. It is crucial in the consolidation of new semantic and episodic memories so that they are neurologically stable and long-lasting, but is not directly involved in the formation of implicit procedural or classically conditioned memories. For example, you could have your hippocampus surgically removed and probably still encode and store memories for motor skills and classically conditioned responses (Milner & Corkin, 2010; Ogden & Corkin, 1991; Thompson, 2000).

Although the hippocampus is a vital processing site for explicit memories, it is believed that it does not permanently store any memories itself. Instead, it transfers them to the cerebral cortex for long-term storage, most likely in the areas that initially processed the information. Links need to be established between different components of a memory to enable retrieval as a single memory. It is believed that the hippocampus plays a significant role in achieving this through interaction with the cortex and other medial temporal lobe areas before the memory is gradually transferred.

Precisely when hippocampal involvement is no longer required after a memory is transferred to the cerebral cortex remains unclear. Studies of people and animals with brain damage and experiments using neuroimaging techniques with non-brain damaged participants suggest that the hippocampus probably has a role in the retrieval of explicit memories as well.

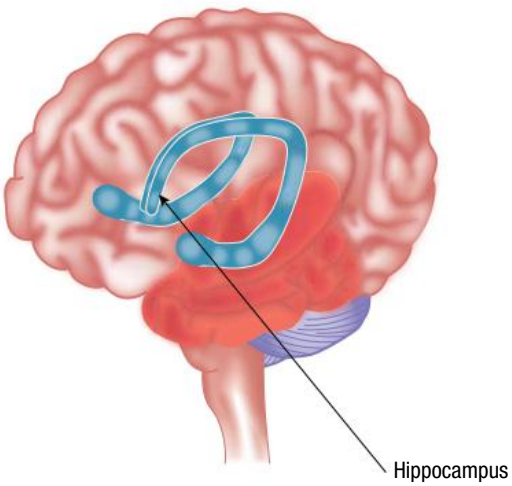

Figure 6.30 Location of the hippocampus

Through its interaction with the amygdala, the hippocampus also plays a role in the formation of emotional memories, particularly the explicit memory component of an emotional event. When emotionally aroused, we form semantic and episodic memories about the situations in which these occur and the hippocampus enables neural representations of this information as explicit memories. For example, when you have an emotionally traumatic experience, your amygdala and hippocampus encode different aspects of the emotionally arousing event for storage in your long-term memory. When you retrieve the memory from the cerebral cortex at some time in the future, the activity of the hippocampus during memory formation will enable you to remember such aspects as where the event happened, when it happened, and whom you were with at the time when you retrieve the memory. These details are *explicit* memories. Meanwhile, as your amygdala is activated during the retrieval process, you will also remember the emotional arousal content, and sympathetic nervous system reactions that have been linked to the memory may be initiated; for example, your muscles may tighten, your heart may beat faster, your stomach may feel as if it is tied up in knots, and so on. This component is *implicit* memory.

The hippocampus is also important for *spatial memory*, which is an explicit memory for the physical location of objects in space. Spatial memory is what enables us to navigate from place to place and to learn and remember locations. It is sometimes described as our brain's inner global positioning system — its GPS.

Because the hippocampus has so many connections to other regions and structures of the brain, it remains unclear as to whether some part of a spatial memory is actually stored in there. There is research evidence, however, that the hippocampus is involved to some extent in the retrieval of spatial memories. For example, neuroimaging studies with people show activation of the right hippocampus in particular when navigating in familiar locations and retrieving directions (see Box 6.7 on the next page).

Figure 6.31 The hippocampus is crucial in the consolidation of new semantic and episodic memories so that they are neurologically stable and long-lasting. This helps ensure pleasant holiday memories are stored relatively permanently.

BOX 6.7 The hippocampus of London taxi drivers

Studies of London taxi drivers have demonstrated the role of the right hippocampus in spatial learning and memory by people within large, urban environments. For example, to become a taxi driver in London, individuals had to go through a comprehensive training course for about two years and then pass a strict test of their ability to find the shortest route between any two locations. As a result of this type of training and assessment, London taxi drivers became renowned for their ability to efficiently navigate their way throughout one of the most complex and largest metropolitan areas in the world without using a street directory (or GPS).

When MRI scans of London taxi drivers (who find new routes daily) were compared with a control group who did not drive taxis, they showed that the rear part of the right hippocampus of taxi drivers were significantly larger. Studies have also found a significant relationship (positive correlation) between years of taxi-driving experience and growth of the hippocampus — the more years an individual had driven a taxi, the larger the hippocampal area, and vice versa (Maguire, et al., 2000).

The role of the hippocampus in spatial memory was first identified through research with rats. American psychologist John O'Keefe and his student Jonathan Dostrovsky (1971) found that certain neurons in the right hippocampus of a rat's brain are extremely active when a rat is in a specific place in the environment. These neurons, called *place cells*, become relatively inactive until the rat passes through that location again. It is thought that the hippocampal place cells encode spatial location information and create a kind of 'mental map' in the brain to help recognise locations. In 2003, place cells were discovered in the human hippocampus by other researchers and in 2014 O'Keefe was awarded the Nobel prize in physiology or medicine for his research findings with rats (Sanders, 2014).

Figure 6.32 London taxi drivers are renowned for their spatial navigational skills and some have been found to have a larger right hippocampus.

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Weblink
Psychology Today article: How big is your hippocampus? Does it matter? Yes and no

eGuide*plus*

Weblink
Maguire presentation on her hippocampus research and other memory features 1h 07m 12s

LEARNING ACTIVITY 6.15

Visual presentation

Make a copy of Figure 6.30 on page 357 showing the location of the hippocampus. In point form within the diagram, list the roles of the hippocampus in memory.

Roles of the amygdala

The amygdala (pronounced *uh-MIG-duh-luh*) is a small structure (about 1.5 cm long) located just above and interconnected with the hippocampus in the medial temporal lobe. Like most other brain structures, we have an amygdala in each hemisphere. The amygdala is also connected with many other brain regions and structures, thereby allowing it to participate in a wide variety of neurological activities.

The amygdala is best known for its role in processing and regulating emotional reactions, particularly emotions such as fear and anger (including aggression) that may be experienced intensely and can motivate certain types of behaviour. For example, your amygdala enables you to detect possible danger when approached by a snarling dog and to recognise fear in other people from their facial expressions before they even say a word. There is considerable research evidence that both people and animals without an amygdala cannot learn to fear things that signal danger, to express fear in appropriate situations and also lose learned fears. For example, monkeys normally feel threatened by and are afraid of snakes. But if its amygdala is damaged, a monkey loses its fear of snakes and other natural predators (Davis & Whalen, 2001; Thompson, 2000).

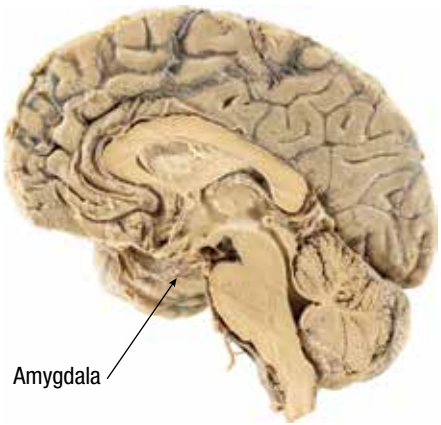

Figure 6.33 Location of the amygdala

The amygdala is also involved in the formation of a wide range of other emotional memories. A considerable amount of the research on its role has been on classically conditioned fear responses involving implicit memory.

In a typical experiment, rats are exposed to a specific stimulus such as blue light that is neutral — the light is 'meaningless' and does not produce any initial reaction by the rat. The light is then followed by an electric shock, which produces a fear response. Eventually, through pairing of the light and shock so that they occur at about the same time, the previously neutral blue light produces the fear response on its own. If one particular part of the amygdala is then damaged or removed, this interferes with the acquisition and expression of the conditioned fear response to the light alone learned during the experiment (LeDoux, 2000). As a result, these rats no longer fear the blue light. Similarly, people with damage to their amygdala are typically unable to acquire a conditioned fear response. These individuals are likely to form conscious explicit memories involving the details of the experience, but not an implicit memory that would enable them to produce or express the fear response.

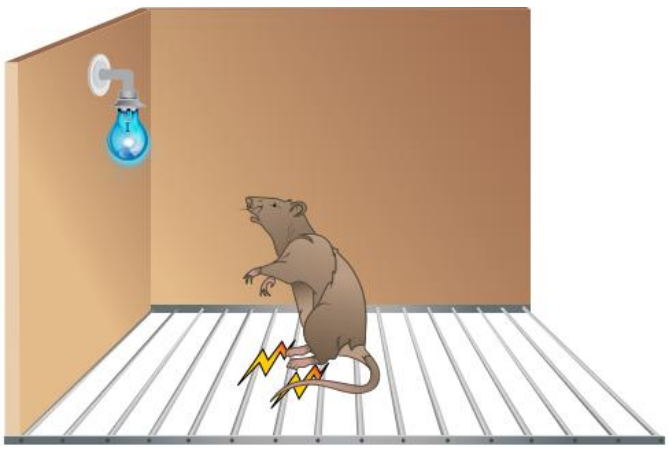

Figure 6.34 Conditioning a fear response to previously neutral blue light

Classically conditioned emotional responses involve implicit memory because they occur involuntarily in the presence of a relevant environmental stimulus. There is no intentional conscious recall and the memory can be observed through the specific reactions associated with the conditioned response. We just 'react' immediately and consciously evaluate whether there is any actual danger afterwards.

As you have probably experienced, we are more likely to remember events that produce strong emotional reactions than events that do not. It appears that the level of emotional arousal at the time of encoding influences the strength of the long-term memory formed of that event. This is believed to be partly attributable to the increased amount of the neurohormone noradrenaline in the amygdala during times of heightened emotional arousal. When released at such times, adrenaline induces the release of noradrenaline in the amygdala. The presence of noradrenaline is believed to stimulate the amygdala to attach more emotional significance to the experience and signal the hippocampus to encode and ensure long-term storage of the relevant emotional details during the memory consolidation process. Consequently, the amygdala also contributes to the formation and storage of explicit memories. This is apparent in a specific type of episodic memory known as a flashbulb memory.

A *flashbulb memory* is a vivid and highly detailed memory of the circumstances in which someone first learns of a very surprising, significant or emotionally arousing event; for example, when hearing about the unexpected death of an important person in their life or of a shocking incident that dominates the news. Many years later people can remember details about where they were, what they were doing, who they were with and what their emotional reaction was to the event (Hamann, 2009; Phelps, 2004; Richter-Levin, 2004).

Although the amygdala has a vital role in the formation of emotional memories and the expression of their emotional qualities it is believed that it does not permanently store emotional memories. This also includes emotional memories that do not involve fear, such as pleasant memories associated with reward (Gazzaniga, Ivry, Mangun, 2014; McGaugh, 2013; Paré, 2003; Thompson, 2000).

Figure 6.35 Flashbulb memories are so named because of the photographic nature of the memory of the event. Many people report flashbulb memories for the emotionally charged event of the September 11, 2001, terrorist attack on the World Trade Center in New York.

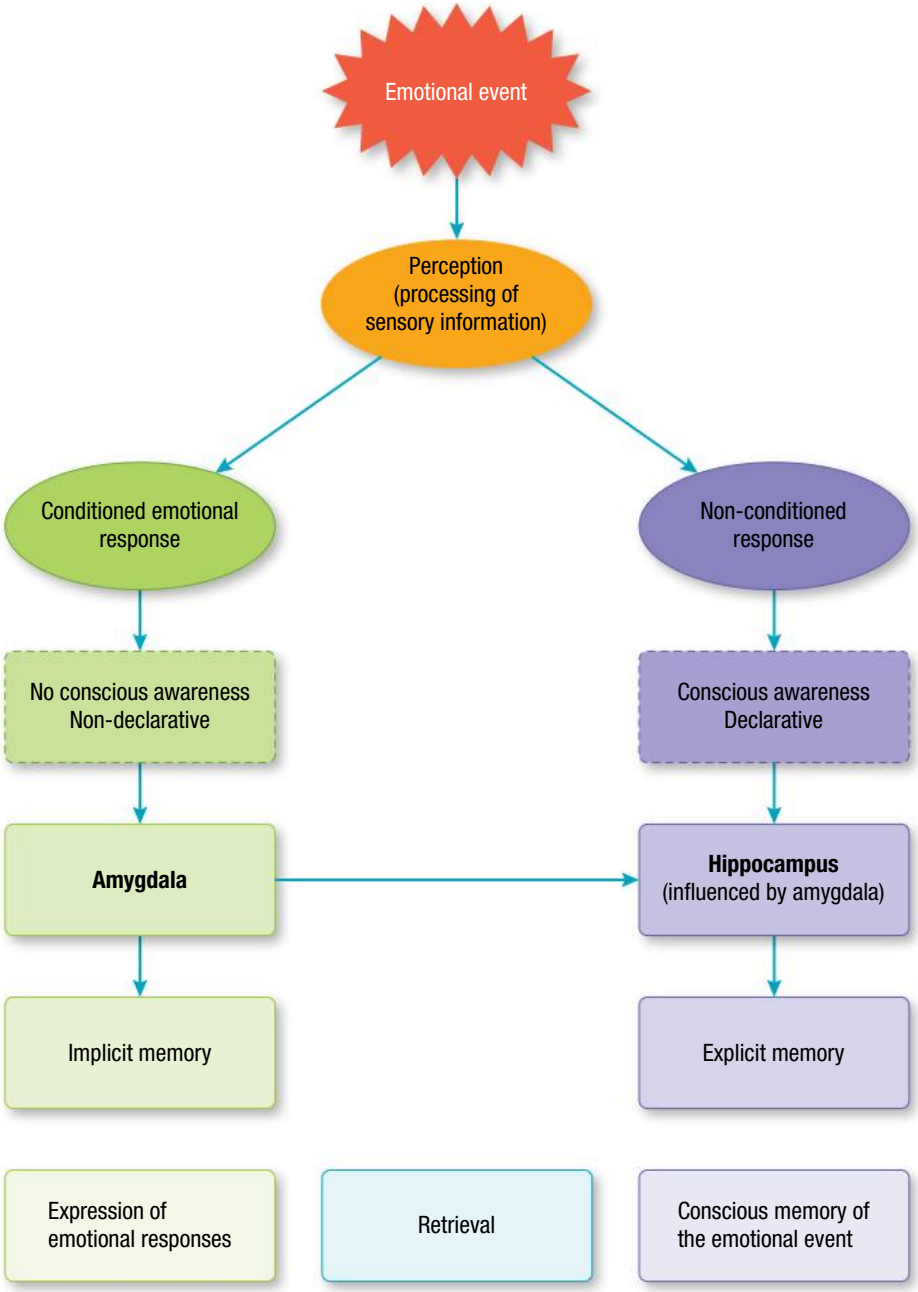

Figure 6.36 The amygdala is crucial to the formation of implicit memories involving classically conditioned fear responses, and can also contribute to explicit memories by influencing the activity of the hippocampus.

Roles of the cerebellum

Located at the base of the brain and at the rear, the cauliflower-shaped cerebellum that looks like a mini brain contains more neurons than the rest of the brain combined, even though it accounts for only 10% of the brain's total volume.

The cerebellum, like many other brain structures, has multiple roles. For example, it coordinates fine muscle movements, regulates posture and balance, and contributes to various perceptual and cognitive processes. It is probably best known for its involvement in activities requiring a skilled sequence of movements that require timing and are made with speed, ease and fluency, such as when touch-typing or playing the piano competently. However, it also plays important roles in everyday voluntary, purposeful movements, such as when reaching to pick up a cup of coffee, so that your arm and hand make one continuous movement. Consequently, damage to the cerebellum makes it difficult to time and coordinate muscle control for everyday activities like talking, reaching, walking, brushing teeth or throwing a ball.

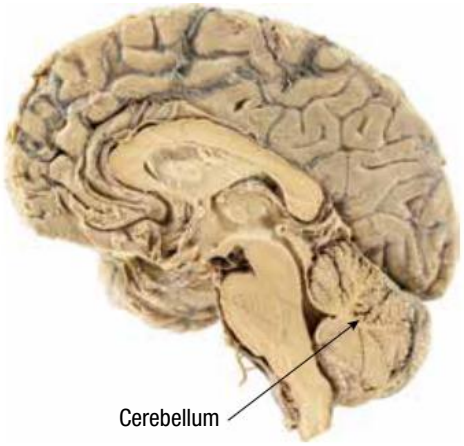

Figure 6.37 Location of the cerebellum

There is considerable research evidence that the cerebellum is directly involved in the encoding and temporary storage of implicit procedural memories for these and numerous other motor skills. It is crucial for motor learning and the execution of voluntary movements, but not their long-term storage because well-learned motor responses are believed to be stored in the cerebral cortex like many other types of memories. However, the cerebellum does form and store implicit memories of simple reflexes acquired through classical conditioning, such as associating a sound with an impending puff of air and consequently blinking in anticipation of the puff.

Although the cerebellum plays a key role in motor learning and is the permanent storage site for a range of conditioned reflexes, other brain regions and structures such as the basal ganglia and motor areas of the cerebral cortex also play crucial roles in the learning and memory of simple and complex motor skills. In addition, as shown in Figure 6.38, the cerebellum contributes to spatial learning, navigation and memory, primarily through its role in visual sensori-motor coordination (Colombel, Lalonde & Caston, 2003; Rochefort, Lefort & Rondi-Reig, 2013).

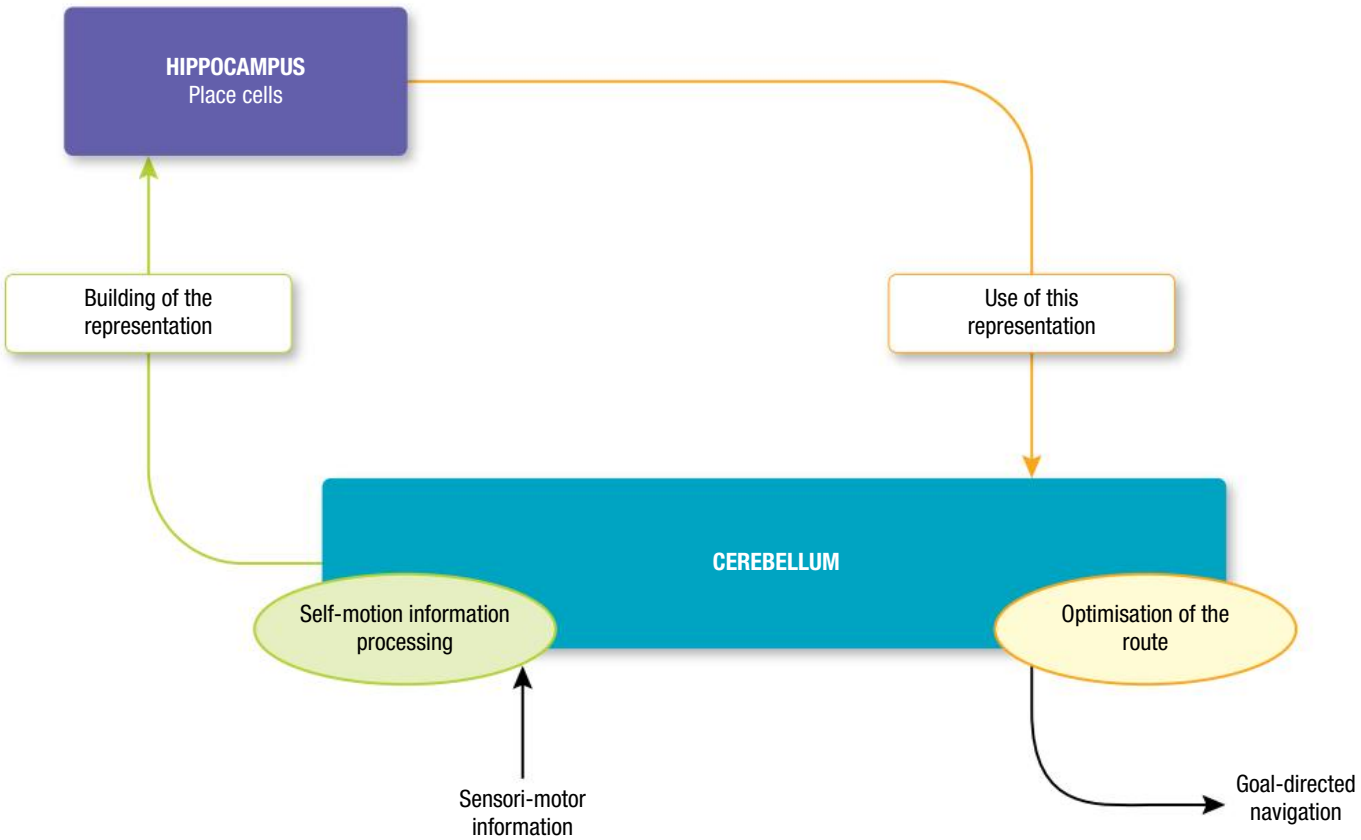

Figure 6.38 The cerebellum may contribute to spatial navigation at two levels, first in processing self-motion information to build spatial representation in the hippocampus at the level of place cells, and second in using this spatial representation to perform an optimal route toward a goal. Box 6.7 on page 359 describes the role of place cells.

Source: Rochefort, C., Lefort, J.M., & Rondi-Reig, L. (2013). The cerebellum: A new key structure in the navigation system. *Frontiers in Neural Circuits,* 7(35), 1–2.

LEARNING ACTIVITY 6.16

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Word copy of table

Summary of brain region roles in memory storage

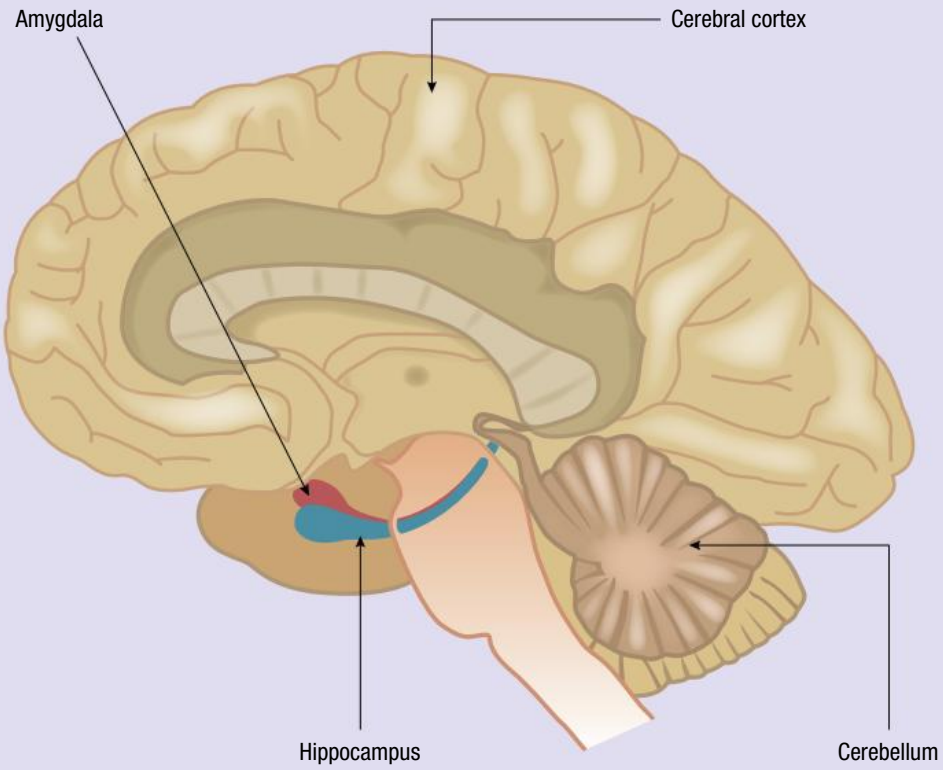
Part A

Complete the following table to summarise the roles of different brain regions in the storage of implicit and explicit memories.

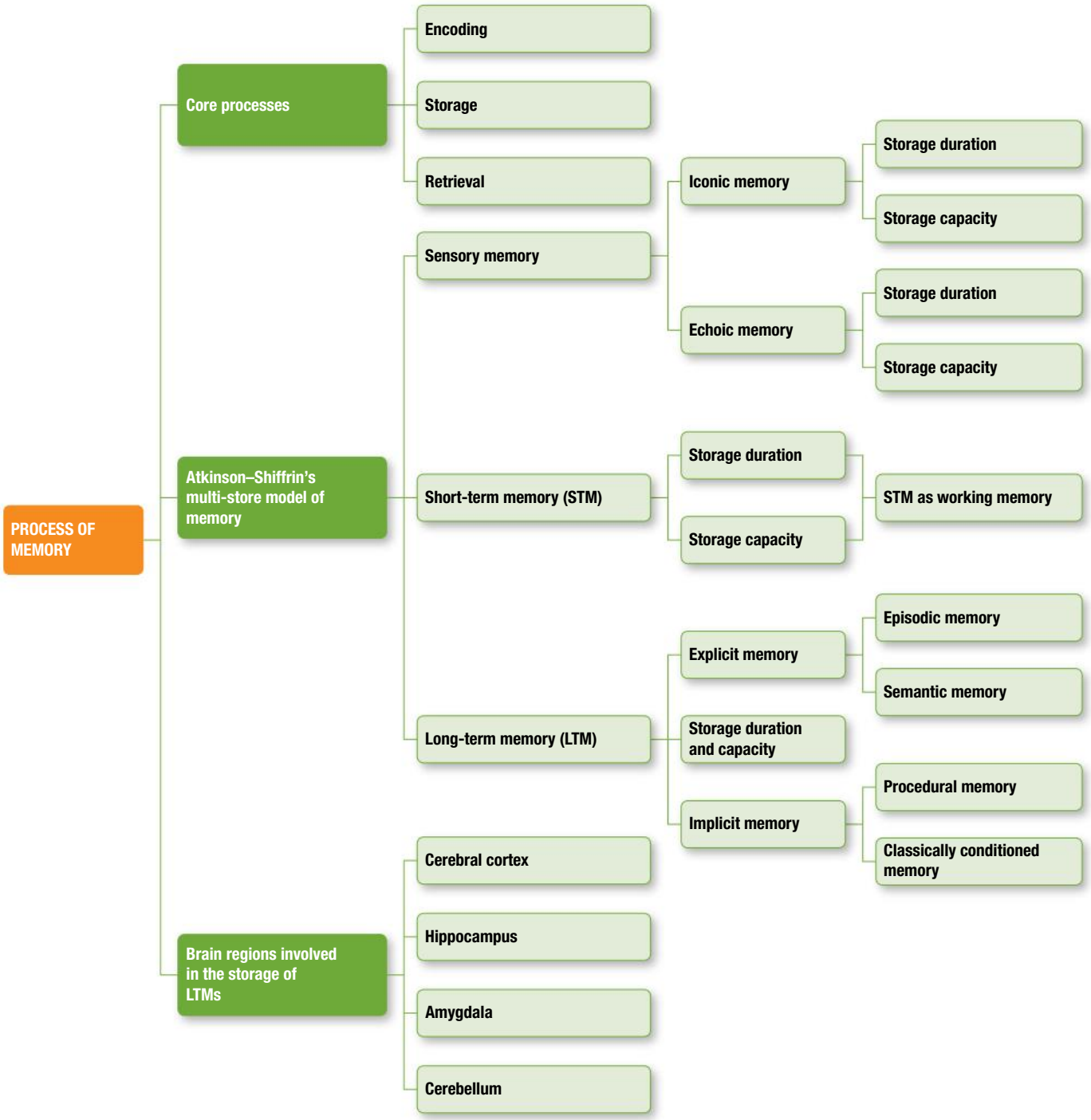
Brain region	Location of the region	Explicit memory		Implicit memory	
		Semantic	Episodic	Procedural	Classical conditioning
cerebral cortex					
hippocampus					
amygdala					
cerebellum					

Part B

Use the brain diagram below to further summarise the information in the table above.



CHAPTER SUMMARY



KEY TERMS

amygdala p. 359
Atkinson–Shiffrin multi-store model p. 333
cerebellum p. 361
cerebral cortex p. 356
classically conditioned memory p. 352
control process p. 334
echoic memory p. 340
encoding p. 332
episodic memory p. 349
explicit memory p. 348
hippocampus p. 357
iconic memory p. 336
implicit memory p. 350
long-term memory (LTM) p. 348
memory p. 332
procedural memory p. 351
rehearsal p. 334
retrieval p. 332
semantic memory p. 349
sensory memory p. 335
short-term memory (STM) p. 343
storage p. 332
storage capacity p. 333
storage duration p. 333
structural feature p. 334
working memory p. 347

LEARNING CHECKLIST

Complete the self-assessment checklist below, using ticks and crosses to indicate your understanding of this chapter's key knowledge (a) before and (b) after you attempt the chapter test. Use the 'Comments' column to add notes about your understanding.

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Word copy of checklist

Key knowledge I need to know about the process of memory	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
Memory			
encoding			
storage			
retrieval			
Atkinson–Shiffrin's multi-store model of memory			
Structural features and control processes			
Sensory memory			
• Iconic memory			
– function			
– storage duration			
– storage capacity			
• Echoic memory			
– function			
– storage duration			
– storage capacity			
Short-term memory (STM)			
• function			
• storage duration of STM			
• storage capacity of STM			
• working memory			
Long-term memory			
• function			
• storage duration			
• storage capacity			

(continued)

Key knowledge I need to know about the process of memory	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
• Explicit memory			
– episodic memory			
– semantic memory			
• Implicit memory			
– procedural memory			
– classically conditioned memory			
Brain regions involved in the storage of long-term memories			
roles of cerebral cortex			
roles of hippocampus			
roles of amygdala			
roles of cerebellum			
interactions between regions			

studyon

Unit 3 › Area of study 2 › Topic 5

Concept screens and practice questions

CHAPTER 6 TEST

SECTION A — Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Question 1

Memory is best described as

A. a unitary system through which information flows back and forth.
B. the storage and recovery of information acquired through learning.
C. a multi-store system in which all information is continually processed.
D. three independent systems called sensory memory, short-term memory and long-term memory.

Question 2

Which type of long-term memory is likely to be involved when a person recalls how to switch on an iPad after not having used one for some time?

A. working
B. semantic
C. episodic
D. procedural

Question 3

The best way of prolonging the storage duration of information well beyond its normal limit in short-term memory is through

A. encoding.
B. rehearsal.
C. recall.
D. attention.

Question 4

Which of the following statements about the hippocampus is correct?

A. The hippocampus is the permanent storage site for explicit memories.
B. The hippocampus is the permanent storage site for classically conditioned memories.
C. Procedural memories do not appear to involve the hippocampus at all.
D. The medial temporal lobe is located in the hippocampus.

Question 5

Which of the following activities involves implicit memory?

A. distinguishing between a shark and a dolphin
B. telling a friend about how the weekend was spent
C. swimming in water using the freestyle stroke
D. recalling a word for a crossword puzzle

Question 6

Which of the following long-term memories is most likely stored in the cerebellum?

A. an episodic memory of a celebration
B. any type of sensory memory
C. a classically conditioned fear response
D. a classically conditioned patellar (knee jerk) reflex

Question 7

What is required for information to be transferred from a sensory register to short-term memory?

A. attention
B. encoding
C. rehearsal
D. retrieval

Question 8

Which sub-type of long-term memory is likely to be involved when someone recalls their first day as a VCE student?

A. procedural
B. episodic
C. semantic
D. classically conditioned

Question 9

You switch off a bedside alarm clock but can still hear it ringing for a couple of seconds. This is most likely due to _____ memory.

A. episodic
B. working
C. iconic
D. echoic

Question 10

Which memory system or sub-system stores information for the shortest duration?

A. short-term memory
B. sensory memory
C. iconic memory
D. echoic memory

Question 11

In which brain region is it most likely that the long-term memory of a visual image of an artwork is stored?

A. hippocampus
B. amygdala
C. visual cortex
D. frontal lobe

Question 12

Your ability to use language efficiently in everyday conversation is an example of

A. implicit memory.
B. explicit memory.
C. retrieval by the hippocampus.
D. classical conditioning.

Question 13

Most of the information that reaches sensory memory is

A. lost from the relevant sensory register.
B. immediately transferred to short-term memory.
C. encoded before transfer to short-term memory.
D. processed in some way before transfer to short-term memory.

Question 14

Which of the following shows the most likely correct order of memory processes?

A. attention -> LTP -> encoding -> storage -> retrieval -> perception of stimuli
B. perception of stimuli -> encoding -> LTP -> storage -> retrieval
C. attention -> perception of stimuli -> LTP -> encoding -> storage -> retrieval
D. perception of stimuli -> encoding -> storage -> LTP -> retrieval

Question 15

Sara is a proficient keyboarder. For example, when creating a Word document, she can key in a complex sentence with eyes closed, very quickly and accurately. However, when asked to name the location of the seven letters on the bottom row of a keyboard, from left to right, in their correct order, she cannot do so.

Sara's keyboarding with eyes closed relies on _____ memory, whereas correctly naming the letters relies on _____ memory.

A. implicit procedural; explicit semantic
B. explicit procedural; implicit semantic
C. implicit procedural; explicit episodic
D. implicit classically conditioned; explicit semantic

SECTION B

Answer **all** questions in the spaces provided. Write using blue or black pen.

Question 1 (1 mark)

When we first experience an event, all the distinct aspects are stored in different regions of the brain, yet we are still able to remember them all later on. The brain structure called the _____ is critical to this process, associating all these different aspects so that the entire event can be retrieved as a unified memory.

Question 2 (2 marks)

Long-term semantic and episodic memories are formed in the _____ and stored in the _____.

Question 3 (2 marks)

(a) What is the main function of long-term memory? 1 mark

(b) We become consciously aware of information stored in long-term memory by retrieving it to _____ memory. 1 mark

Question 4 (2 marks)
Identify two different types of classically conditioned memories.

Question 5 (1 mark)
Explain why short-term memory may be described as 'working memory'.

Question 6 (3 marks)
You start a new job as a casual cook in a fast-food outlet where orders are called out for you to prepare.
(a) How many different items are you likely to remember in one order? 1 mark

(b) Explain your answer. 1 mark

(c) For about how long will you store all the items in short-term memory without any rehearsal? 1 mark

Question 7 (2 marks)
Explain the difference between encoding and retrieval in relation to long-term memory.

Question 8 (4 marks)
Distinguish between implicit and explicit memory with reference to an example and sub-type of each memory.

Question 9 (3 marks)
Describe the interaction between the amygdala and hippocampus in long-term memory formation and storage.

Question 10 (4 marks)

Distinguish between structural features and control processes of the Atkinson–Shiffrin multi-store model with reference to an example of each of these properties.

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The answers to the Section A multiple-choice questions are in the answer section at the end of this book and in eBookPLUS. The answers to the Section B questions are in eBookPLUS.

7 RELIABILITY OF MEMORY

KEY KNOWLEDGE

- methods to retrieve information from memory or demonstrate the existence of information in memory, including recall, recognition, relearning and reconstruction
- the effects of brain trauma on areas of the brain associated with memory and neurodegenerative diseases, including brain surgery, anterograde amnesia and Alzheimer's disease
- the factors influencing a person's ability and inability to remember information, including context and state dependent cues, maintenance and elaborative rehearsal and serial position effect
- the reconstruction of memories as evidence for the fallibility of memory, with reference to Loftus's research into the effect of leading questions on eye-witness testimonies

Source: © VCAA, VCE Psychology Study Design (June 2017 update), p. 26.

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Brain surgery 388
Alzheimer's disease 397
Factors influencing ability and inability to remember 403
Context and state dependent cues 403
Maintenance and elaborative rehearsal 409
Serial position effect 412

Suppose someone asks you to describe your thirteenth birthday party. You may accurately recollect what took place based on your direct experience of what you saw, heard and felt at the time. But you have also stored information from conversations afterwards with friends who attended your party, from shared family stories, from previous times you've described the party to others, or from reflections on photographs and videos that you have viewed afterwards. You will take these bits and pieces and build an integrated version of your thirteenth birthday from them. This account is likely to include some accurate information. However, it is also likely to include inaccurate information that fills the gaps but were not part of the original experience.

Research findings indicate that much of what we retrieve from long-term memory is not an entirely accurate reproduction of what actually happened when encoding. Instead, it tends to be a logical or plausible account of what *might* have happened, filtered and shaped by our pre-existing thoughts, attitudes and beliefs, by who we are as individuals and social beings, and by many other variables.

Although we usually retrieve accurate fragments of what we experience, human memory is prone to errors and distortions. Unlike a camera or audio recorder that captures a perfect copy of visual or auditory information, the details of human memory can change over time. Without our conscious awareness, details can be added, subtracted, exaggerated or downplayed every time we retrieve the memory. This is not an intentional distortion or manipulation of the memory. Instead, it is believed to be an adaptive process through which we assign logic and give meaning to the past, especially when our recollection of what we retrieve is unclear.

Research findings indicate that each of us has the potential to confidently and vividly remember the details of some event, yet be completely wrong. Confidence in memory is no guarantee that the memory is accurate. In fact, level of confidence has been found to be generally unrelated to the accuracy with which we retrieve information from memory. Some researchers have even found that strong confidence in the memory of minor details may actually indicate that the memory is inaccurate or even false (Reisberg, 2013).

In this chapter, we examine the reliability of memory with reference to some of the biological, psychological and social influences that can make it fallible. For example, we consider the effects of brain trauma and neurodegenerative diseases on memory (biological), how different types of rehearsal or retrieval cues can influence our ability and inability to remember information (psychological), and how memory can be manipulated by using leading questions so that it is unintentionally reconstructed in a specific way. In particular, findings of research studies on the reliability of eye-witness testimony used in courts have been a rich source of information on variables that can produce inaccuracies in what we remember (social). We start by examining methods we use to retrieve our memories or may demonstrate that information has been stored even if we don't think it is.

Figure 7.1 When we recall an event, such as our thirteenth birthday party, our personal characteristics and subsequent experiences can influence the memory of which we become consciously aware.

METHODS TO RETRIEVE INFORMATION FROM MEMORY OR DEMONSTRATE THE EXISTENCE OF INFORMATION IN MEMORY

What methods do we use to retrieve information from memory? How can you find out whether information has been retained and therefore exists in memory? If you fail to retrieve some information does that mean the information is not actually in memory? Perhaps the information exists but you failed to retrieve it by not using an appropriate retrieval method? Perhaps the information is in memory but you can only partially retrieve it?

Research findings indicate that whether or not information is retrieved from memory and the amount of information that is retrieved depends, at least partly, on the type of retrieval method that is used. Three types of retrieval methods are called recall, recognition and relearning. Each method often involves some kind of memory reconstruction during the retrieval process.

Recall

Suppose that you were asked to name the seven dwarfs in the Disney production of the Snow White fairy tale. In order to correctly complete this task, you would search through your LTM to locate the required information and reproduce it in conscious awareness.

Recall involves reproducing information stored in memory. You bring the information into conscious awareness and doing so provides evidence that something previously learned was retained. If you cannot recall targeted information, this does not necessarily mean it is not in memory. The use of a retrieval cue may enable access. Whether or not a prompt is used to assist the retrieval process, and therefore reproduction, depends on the type of recall method used. Three types of recall are free recall, serial recall and cued recall.

- **Free recall** involves reproducing as much information as possible in no particular order without the use of any specific cue. For example, you may attend a training course for a new job and afterwards remember a few important points without recalling the order in which they were presented. This recall method allows you to retrieve pieces of learnt information, 'freely' without following any specific order. You probably used free recall when retrieving the names of the seven dwarfs.

  In an experiment using free recall to assess some aspect of memory, participants might be required to learn a list of randomly selected numbers or words. Then, after a specific period of time they may be required to write, in any order, as many of the items from the list as they can. In everyday life, we tend to rely on free recall to retrieve all types of information, including 'bits' of information that represent an entire memory, and complex mixes of episodic and semantic information that form more substantial memories.
- **Serial recall** involves reproducing information in the order in which it was learned. For example, if you are telling a friend about an overseas holiday and recall the names of the cities in the order in which you visited them, then you would be using serial recall. If the memory experiment described previously used serial recall to assess memory, participants would be asked to recall the list in the order in which the numbers or words were presented.

  Serial recall is useful in everyday life as it enables us to recall events and other types of information chronologically, which can help give logic or meaning to the information in relevant situations. For example, serial recall is used in language to assemble sentences with words in a meaningful order, to tell someone about a personal experience you've just had and when recalling directions to navigate from one place to another.
- **Cued recall** involves the use of specific prompts ('cues') to aid retrieval and therefore reproduction of the required information. In the memory experiment, participants might be given the first letter of a word in each list as a cue to assist the retrieval process. The more specific the cue, the more likely we are to locate and retrieve the sought-after information from LTM. For example, a cue for the seven dwarfs question might be the first letter of each of their names: B, D, D, G, H, S and S.

  If you could not name all seven dwarfs, it doesn't necessarily mean that the information is not stored in your LTM (and therefore not available). The required information may be stored but not immediately accessible. If you used a different method of retrieval, you may have been able to access the names of all the dwarfs. For example, the recognition method is likely to be more effective.

Recognition

Long after you can't recall the names of people in your year 6 class, you may still be able to recognise them in a school photo or pick out their names from a list. This means that recognition can also indicate existence of a memory and may be more effective when the recall method fails.

Recognition involves identifying ('recognising') the original, learnt information. The presence of the correct information acts as a cue for its retrieval from memory. For example, we might scan a list of

email addresses in the hope of picking out the one we want to use or we might be called upon to identify the perpetrator of a crime from a Crime Stoppers photograph shown on TV. When the original, learnt information is in front of us and it is familiar, then we know it has been retrieved. It is like 'knowing again'. The information has been matched to a stored representation in our memory.

The essential difference between recognition and recall is that, with recall, the required information is not present for our identification whereas, with recognition, the information we seek to retrieve may be present and requires a judgment about whether it has been previously seen or experienced.

Recognition usually involves identification of the required or 'correct' information from among alternatives that include incorrect information. For example, you may be able to recognise the names of the seven dwarfs if the following question was asked: 'Which of the following are names of Walt Disney's seven dwarfs?'

- Bashful
- Pop
- Sneezy
- Happy
- Sleepy
- Doc
- Grumpy
- Dopey
- Grouchy

When the recognition method is used, if alternatives are present, they do not necessarily have to include incorrect information, but they often do. In some cases, there may be no alternatives and we are presented with a stimulus which we will either recognise or not recognise, as with a Crime Stoppers photo. In a memory experiment, participants may be presented with test items one at a time and asked to make a yes or no decision to each.

Irrespective of the kind of information presented, we are more likely to retrieve more of the required information when using the recognition method than we will with the recall method. This suggests that more information is stored in memory than can be retrieved through recall. The recognition method provides more useful cues that assist in locating and retrieving information from LTM. For example, the name of each dwarf is a more useful cue than the first letter of the name (cued recall), let alone no name (free recall).

This is why, in an exam situation, many students tend to prefer multiple-choice or true/false questions to essay or short-answer questions. Multiple-choice and true/false questions involve recognising the correct response from among a small number of alternatives (cues), whereas essay and short-answer questions require recall usually with few or no cues to assist retrieval of the correct information.

Research findings indicate that students consistently perform better on multiple-choice and true/false questions than on essay and short-answer questions when tested on the same material. However, there are exceptions, such as when incorrect alternative answers ('distracters') on multiple-choice questions are extremely similar to the correct answers, or when students expect an essay or short-answer question in an exam and use study techniques suited to that particular type of question.

Figure 7.2 An image of Disney's seven dwarves may serve as a cue for recalling their names.

Figure 7.3 Police line-ups make use of the greater sensitivity of the recognition method.

Relearning

Most people have times when they are unable to recall or recognise information that is actually stored in LTM. Even though they are unable to retrieve this information, it does not necessarily mean it is unavailable or lost from LTM. For example, in chapter 4 you learned about the role of glutamate in synaptic plasticity. Although you may now be unable to recall or recognise the specific role of glutamate, your relearning may reveal the memory.

Relearning involves learning information again that has been previously learned (and was therefore stored in LTM). If information is learned more quickly the second time, it is assumed that some information must have been retained (or 'saved') from the first learning experience, whether the individual realises it or not.

Typically, relearning something takes less effort or time than it did to learn it originally. You may have discovered this for yourself when studying for a test or exam. You may believe you have forgotten some or all of the material, yet with even a small amount of reviewing, you remember the information relatively quickly. By 'restudying', a weak link to the memory and/or a representation of the memory regains its original strength.

German psychologist Hermann Ebbinghaus (1885) is considered to be the first researcher to scientifically study relearning. Acting as his own research participant, Ebbinghaus memorised lists of three-letter 'nonsense syllables' such as *jax*, *qir* and *kuv* under various conditions of practice. When Ebbinghaus measured his memory for what he had learned, he found that, even if he could not remember a single item from the original list, he could relearn the list much more quickly a second time than he had learned it initially. He assumed therefore that some information had been retained from the initial learning.

Relearning is also called the *method of savings,* or simply *savings,* because it can be used to measure the amount of information 'saved' from previous learning. For example, suppose you were a participant in an experiment and it took you ten trials (presentations) to learn a list of 12 nonsense syllables. If in a subsequent experiment, perhaps six months later, it took you five trials to relearn the same list, then the savings would be 50% because it took you half the number of trials to relearn the information.

In this example, the savings are calculated using the formula:

$$\text{Savings} = \frac{\begin{array}{c}\text{(no. of trials for}\\ \text{original learning)}\end{array} - \begin{array}{c}\text{(no. of trials}\\ \text{for relearning)}\end{array}}{\text{(no. of trials for original learning)}} \times \frac{100}{1}$$

In the example, the savings would be calculated as:

$$\frac{10 - 5}{10} \times \frac{100}{1} = 50\%$$

A savings score can also be calculated on the basis of the *time* taken to relearn information. In this case, the formula would be:

$$\frac{\begin{array}{c}\text{(time for}\\ \text{original learning)}\end{array} - \begin{array}{c}\text{(time for}\\ \text{relearning)}\end{array}}{\text{(time for original learning)}} \times \frac{100}{1}$$

A simple expression of the formula used to determine the savings score is:

$$\text{Savings score} = \frac{T^1 - T^2}{T^1} \times \frac{100}{1}$$

Figure 7.4 This person has not spoken French since learning it at school. However, it will take less time for her to relearn it than it took to learn it originally, showing that some of the information has been 'saved' in LTM.

TABLE 7.1 Comparison of retrieval methods

Method	Description	Example
Recall	Reproducing information stored in memory	What is your name?
Free recall	Reproducing information in no particular order	Name the last three prime ministers of Australia.
Serial recall	Reproducing information in the order in which it was learned	Name the last three prime ministers of Australia in order from the most recent to the least recent.
Cued recall	Using a cue to assist the retrieval of information	Name the last three prime ministers of Australia. Their initials are MT, TA, KR.
Recognition	Identifying correct information from among a list of alternatives	Identify the last three prime ministers of Australia from the following list: Chifley, Gillard, Hawke, Abbot, Whitlam, Turnbull, Rudd, Howard, Keating, Menzies.
Relearning (method of savings)	Determining the amount of information saved when learning information again that has been previously learned	Time how long it takes to learn the last seven prime ministers of Australia. Time yourself two weeks later on the same task to test the amount of time saved in learning the information a second time compared with the first time.

BOX 7.1 The sensitivity of recall, recognition and relearning as measures of retention

Recall, recognition and relearning are commonly used as *measures of retention* to assess information stored in LTM. All differ in their relative sensitivity as measures of retention. The *sensitivity* of a measure of retention refers to its ability to assess the existence of information in memory and which is therefore available for retrieval. A very sensitive measure of retention is more likely to detect information that has been learned and stored in memory at some time in the past than would a measure that is not very sensitive. Research evidence indicates that:

- recall tends to be the least sensitive measure of retention
- relearning tends to be the most sensitive measure of retention
- recognition tends to be less sensitive than relearning but more sensitive than recall.

In one of the best-known experiments on the sensitivity of the three measures of retention, American psychologist Thomas Nelson (1978) used 102 university students as research participants. All were required to participate in the study to meet one of their psychology course requirements. The experiment consisted of three stages: the initial learning stage, a stage in which recall and recognition of the initial learning were tested, and finally a relearning stage. At the beginning of the experiment, participants were not informed about their expected involvement in the second and third stages of the experiment.

In the first stage, participants were given a series of 20 number–word pairs to learn, such as '48–party' and '95–horse'. These are called paired associates. The second stage of the experiment occurred four weeks later, when the participants were required to undertake the testing and relearning stages of the experiment. In the testing stage, participants completed two different types of tests of their memory of the paired associates; activities they had not expected. Each participant was first given a test of recall. This test involved presenting the participant with the number (the cue), such as 48, then asking them to recall the target word associated with that cue, such as 'party'. Following the test of recall, each participant was given a test of recognition. Participants were presented with a number from their original list paired with all 20 of the target words. This was something like a multiple-choice question with 20 possible correct answers. Following the test of recognition, participants were given a distraction task for 10 minutes.

The third stage of the experiment involved relearning 10 of the previously learned paired associates that had been incorrectly recalled during the test of recall, as well as ten new paired associates. Participants were then given a test of recall on both the relearned information and the new information. They were then debriefed about the experiment and allowed to leave.

The results showed that a mean score of 48% of the target words were correctly recalled and 69% were correctly recognised in the testing stage (second stage) of the experiment. Furthermore, the percentage of target words correctly recalled during the relearning stage was significantly higher for old items (88%) than for new items. These findings further demonstrate that relearning is more sensitive than recognition as a measure of retention.

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Practical activity
Comparing sensitivity of recall and recognition

Reconstruction

Imagine yourself going to a fancy restaurant for dinner. You are seated at a table with a nice white table cloth. You study the menu. You tell the waiter you want the chargrilled barramundi, with deep-fried potato chunks and the salad with mayo dressing. You also order a lemonade from the drinks list. A few minutes later, the waiter arrives with your salad and drink. Later, the rest of your meal arrives. You enjoy it all, except the potatoes were a bit underdone.

If asked about your dining experience, you can probably retrieve a considerable amount of detail. For example, without looking back, answer the following questions:

- What kind of salad dressing did you order?
- Was the table cloth red-checked?
- What did you order to drink?
- Did the waiter give you a menu?

You were probably able to recall everything you ordered, and maybe even the colour of the table cloth. But did the waiter give you a menu? Not in the paragraph above, but many people answer 'yes' because that is a logical inference based on what they already know about restaurants through prior experience. What we retrieve is not always a perfect reproduction of what happened at the time of encoding. We reconstruct our memories during retrieval. During reconstruction, if the memory has gaps or is not clear, we tend to add information that helps ensure the retrieved memory is complete and 'makes sense'. When doing so, we may draw on past and current knowledge to infer the way things 'must have been' (Myers, 2007).

Memory **reconstruction** generally involves combining stored information with other available information to form what is believed to be a more coherent, complete or accurate memory. It is an active process and is influenced by many factors such as our pre-existing knowledge, personal experiences, values, psychological state, cues in the environment, motivations, expectations and assumptions about what might have happened. *Reconstructive memory*, as it is commonly called, is most evident when we retrieve an episodic memory of a specific event for which we can't recall or are uncertain about some of the details.

Memory reconstructions are often accurate, but may also contain errors and distortions. Since

Figure 7.5 Is your memory of a deb ball or some other significant event in your life identical every time it is retrieved?

the early 1900s, researchers have investigated memory processes in numerous experiments and found that reconstruction occurs regardless of whether memories are retrieved after short or long periods. Reconstructive errors in retrieval have also been found to occur in both semantic memories (e.g. words, prose, pictures) and episodic memories (e.g., scenarios, events) (Roediger & DeSoto, 2015).

How do errors and distortions creep into memories? When we form a long-term memory, we actively encode and organise the elements and details of the experience throughout different areas of the brain. These are linked together within neural networks or pathways. When we later attempt to access the memory, we do not retrieve a simple 'readout' of the entire memory. Instead, we retrieve the encoded elements and actively reconstruct the memory. In the process of doing so, various factors can contribute to errors and distortions — or more precisely, what we think we remember. With repeated retrieval, the memory is subject to further distortion and it becomes harder to distinguish the details of what actually happened in the original encodings from what was added later (Roediger & DeSoto, 2015).

A well-known experiment reported by British psychologist Frederick Bartlett in 1932 first drew attention to the reconstructive nature of human memory. Bartlett believed that Ebbinghaus studied human memory in an artificial way. For example, he suggested that by using nonsense material in order to control the influence of past knowledge, Ebbinghaus also excluded important variables that impact on everyday human memory in real life, such as the influence of our prior experiences, attitudes and expectations. Therefore, instead of using nonsense syllables, Bartlett had participants read prose (a story or essay) or look at a picture. He then asked them on several later occasions to recall and describe the prose passage or draw the picture.

Each time, the participants 'remembered' the original stimulus material it was reproduced a little differently. If the original story had contained unusual or unexpected events, the participants tended to describe it in a more logical or 'sensible' way, as if they had revised their memories to make the information more closely match their personal beliefs of what was likely to be true. Bartlett concluded that we tend to remember only a few key details of an experience, and that during recall we reconstruct the memory, drawing on our personal values, beliefs and expectations to make up and add missing bits in ways that complete the memory in a logical or plausible way. This is usually done without conscious awareness of it happening.

Many subsequent studies have confirmed Bartlett's conclusions and extended his findings about the reconstructive nature of human memory. The best-known research has focused on the fallibility of eye-witness testimony through manipulation of the reconstruction process.

LEARNING ACTIVITY 7.1

Review questions

1. Name and describe three different methods for retrieving information from memory or demonstrating the existence of information in memory. For each method, refer to an example not used in the text.

2. Explain a key difference between recall and recognition in relation to the presence or absence of sought after information.

3. In what way is cued recall like and unlike recognition?

4. Choose one concept you have studied this semester and write a question requiring the recall method and a question requiring the recognition method.

5. In what way does the relearning method suggest that information that cannot be retrieved by recall or recognition may still exist in LTM?

6. (a) Describe two ways of measuring retention of information in LTM using relearning (the method of savings).
(b) Why did Ebbinghaus use nonsense syllables rather than words in his study of relearning?
(c) Ahmed took 30 minutes to learn a list of ten Spanish words when they were first given to him. When he had to relearn them before a test the following week, it took him 5 minutes.
(i) Using a savings formula, calculate the amount of retention of information from the first learning session to the second learning session.
(ii) Explain what this figure means in terms of Ahmed's retention of Spanish words.

7. Refer to Box 7.1 (page 376) on the sensitivity of the three retrieval methods. Read Nelson's (1978) research and answer the following questions:
(a) Name the experimental design.
(b) (i) What is an advantage of using this design for this particular experiment?
(ii) What is a limitation of using this design for this particular experiment?
(c) Name the sampling procedure.
(d) What question about the ethical value of justice could be raised in relation to the study?
(e) What do the results obtained indicate about the relative sensitivity or effectiveness of the three retrieval methods?

8. List the three retrieval methods in order of effectiveness for accessing and recovering information in LTM.
9. Define the meaning of reconstruction in relation to memory.
10. (a) Explain *how* and *why* memory construction or reconstruction is believed to occur.
    (b) If human memory is vulnerable to manipulation during reconstruction, what implication does this have for people recalling details of a crime scene?

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Practical activity
Testing reconstructive memory

Figure 7.6 Crime scene

LEARNING ACTIVITY 7.2

Identifying retrieval methods

For each of the following examples, identify one or more retrieval methods that is most likely being used: free recall (FR), serial recall (SR), cued recall (CR), recognition (RG) or relearning (RL).

- remembering a friend's mobile phone number with no cues
- playing hangman
- using photos from a trip to describe your experiences
- identifying a friend who appears in a news report
- remembering the directions to a friend's house
- writing out the words of a song from memory
- reading back over your course notes before an exam
- writing out the words of a song with the music of the song playing in the background

LEARNING ACTIVITY 7.3

Reflection

Without reading further, suggest a way in which the reconstructive nature of memory may be intentionally manipulated to create a false memory, either for a positive or a negative purpose.

FALLIBILITY OF MEMORY RECONSTRUCTION

Reconstruction of memories provides evidence for the fallibility of memory. This has been demonstrated by numerous research studies conducted by American psychologist Elizabeth Loftus and various colleagues on eye-witness testimony.

Eye-witness testimony is any firsthand account given by an individual of an event they have seen. It is best known for its use by police to acquire details about a crime and even to identify a perpetrator. Eye-witness testimony is used often in court and juries tend to view it as a reliable source of information.

Loftus has found that eye-witness testimony is not always accurate because eye-witnesses reconstruct their memories and their reconstructed memories can be manipulated by leading questions that contain misleading information. Many of her studies typically involve showing participants a short video or set of slides on an event such as a car accident. Participants are then asked specific questions about the scene they 'witnessed'. Sometimes, information that was not present in the actual scene or which contradicts the scene is introduced. At other times, leading questions are asked.

Loftus's research makes it clear that leading questions can be used to manipulate memory reconstruction and therefore information that is reported by eye-witnesses. A **leading question** has content or is phrased in such a way as to suggest what answer is desired or to lead to the desired answer. For example, suppose that you witness a car accident and are later asked, 'How fast was the car going when it ran the stop sign?' According to Loftus (1975), this is a leading question because it contains a *presupposition* — information that should or must be true in order for the question to make sense. The question presupposes, or 'assumes', that there was a stop sign. But what if there was no stop sign? You might answer the question anyway because it was a question about

how fast the car was going and not a question about the presence of a stop sign or whether the car ran a stop sign. Loftus proposes, however, that because of the way the question was worded, you might add the new false information about the stop sign to your memory of the event. Then you will be more likely to recall it as a part of your reconstructed memory when answering a question about it, such as 'Did you see the stop sign?', at a later time.

Research by Loftus

One of the most influential of Loftus's research studies on memory reconstruction was conducted with her student John Palmer (1974). The study consisted of two laboratory experiments that investigated the influence of question wording on memory reconstruction, particularly how information supplied *after* an event can distort a witness's memory for that event.

In the first experiment, 45 volunteer students from the university where Loftus worked were each shown seven short videos of car accidents. These videos ranged from 5 to 30 seconds in duration. After viewing each video, the participants ('eye-witnesses') were asked to write a description of the accident they had just seen. They were also asked to answer some specific questions about the accident, including a critical 'leading' question that required them to estimate the speed of the cars involved in each collision.

There were five conditions in the experiment, with nine participants randomly allocated to each condition. In each condition, a different word (verb) was used to complete the critical question, so different groups of participants were given different versions of the question. The question asked, 'About how fast were the cars going when they _____ each other?' It was completed with each of the following words: *smashed*, *collided*, *bumped*, *hit* and *contacted*. For example, in condition 1, the critical question was 'About how fast were the cars going when they smashed into each other?' In condition 2, the critical question was 'About how fast were the cars going when they collided with each other?', and so on. In order to control the potential influence of the order in which the videos were viewed, the videos were presented in a different order to each group of participants.

As shown in Table 7.2, the wording of the question influenced the speed estimates given by the participants, with the most 'intense' verb (*smashed*) bringing about the highest speed estimates (a mean of 40.5 miles per hour) and the least 'intense' verb (*contacted*) bringing about the lowest speed estimates (a mean of 31.8 miles per hour). The differences in speed estimates were found to be statistically significant, which means that chance factors could not account for the results.

Figure 7.7 American psychologist Elizabeth Loftus has conducted more than 200 experiments involving more than 20 000 participants over the past 40 years. She has found that memory reconstruction by eye-witnesses can be manipulated through the use of leading questions that contain misleading information. Loftus is shown here testifying in court as an 'expert witness'.

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Weblinks

- TEDTalk: Loftus presentation on the reliability of memory 17m 36s
- Outlines of Loftus and Palmer experiments 8m 54s

Loftus and Palmer suggested that the results could be due to participants' memories being distorted by the verbal label used to describe the intensity of the car crash. However, they also recognised that the results could have been influenced by an uncontrolled extraneous variable called *response bias*; that is, participants were uncertain about the exact speed of the cars and may therefore have adjusted their estimates to fit in with the expectations of the researcher.

TABLE 7.2 Speed estimates for each verb used

Verb	Mean estimate of speed (mph)
Smashed	40.5
Collided	39.3
Bumped	38.1
Hit	34.0
Contacted	31.8

Source: Loftus, E.F., & Palmer, J.C. (1974). Reconstruction of automobile destruction: An example of the interaction between language and memory. *Journal of Verbal Learning and Verbal Behavior, 13*, 586.

In the second experiment, a procedure similar to that for the first experiment was used. This time, 150 different university students who volunteered for the experiment were randomly allocated to one of three groups (conditions) and viewed a 1-minute video that included a 4-second scene of a multiple car crash. The participants were then questioned about the accident. Group 1 was asked 'About how fast were the cars going when they smashed into each other?' Group 2 was asked 'About how fast were the cars going when they hit each other?' Group 3 was not asked a question about the speed of the cars. The results obtained showed that the mean speed estimate for the question with *smashed* into was 10.46 miles per hour and the mean speed estimate for the question with *hit* was 8.00 miles per hour. The difference in the mean scores was found to be statistically significant (and therefore attributable to the IV, not chance factors).

One week later, the participants returned for the second part of the experiment. Without viewing the video again, they were required to answer a series of 11 questions about the car crash. This time, the critical question was 'Did you see any broken glass?' This question was 'hidden' among the other questions that served as 'distracters'. It was also placed in a random position on each participant's question paper. There was, in fact, no broken glass at the accident scene.

As shown in Table 7.3, the wording of the original question in the first part of the experiment influenced whether or not participants reported seeing broken glass. Although most participants accurately reported not seeing any broken glass, more participants who had been given the question with the word *smashed* into (16) reported seeing broken glass than did those who had been given the question with the word *hit* (7). These results were also found to be statistically significant.

TABLE 7.3 Distribution of responses to the question 'Did you see any broken glass?'

Response	Verb condition		
	Smashed	Hit	Control
Yes	16	7	6
No	34	43	44

Source: Loftus, E.F., & Palmer, J.C. (1974). Reconstruction of automobile destruction: An example of the interaction between language and memory. *Journal of Verbal Learning and Verbal Behavior, 13*, 587.

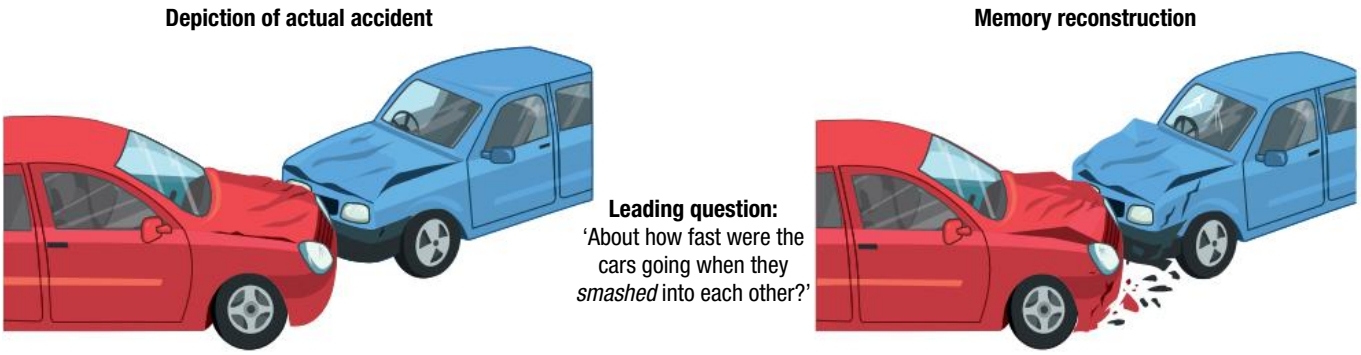

Figure 7.8 Loftus found that the wording of a question influenced the participants' memory reconstruction of the accident they had viewed. The more intense verbs brought about the highest speed estimates.

In explaining the results, Loftus and Palmer suggested that in the first part of the experiment, participants formed a memory of the car crash they witnessed on viewing the video. Integrated with this memory was the additional piece of 'new' false information supplied *after* the event about the cars having either 'smashed' into or 'hit' each other.

This information was included as a presupposition in the critical question on the speed of the cars. When asked one week later whether they saw any broken glass at the accident scene, participants remembered broken glass that wasn't really there.

Over time, information from the two different sources (events witnessed when viewing the video and the presupposition in the leading 'critical' question asked afterwards) had been integrated in the reconstruction of a new distorted memory. Participants were unable to tell that key information in their memory had now come from different sources. This has been described as source confusion. *Source confusion* arises when the true source of the memory is forgotten or when a memory is attributed to the wrong source. In Loftus's studies, 'misinformation' provided in leading questions *after* the event become confused with the details of the original memory.

Numerous other research studies by Loftus as well as other researchers have confirmed that the memories of eye-witnesses are reconstructions, not exact replicas of the events witnessed. They have also confirmed Loftus's original findings that eye-witness memories can be altered by post-event exposure to inaccurate information introduced during questioning. For example, people have incorrectly recalled stop signs as give-way signs, green stop lights as shining red, non-existent barns along empty country roads, non-existent mothers with prams, a blue car used in a crime scene as white and even Minnie Mouse when they really saw Mickey Mouse (Loftus, 1993).

It is possible, however, that eye-witnesses in a laboratory setting may think, feel and behave differently when observing a crime compared to eye-witnesses in a real-world setting. For example, what is viewed in a laboratory may not have the same emotional impact as witnessing a real-life event. Furthermore, eye-witnesses in a laboratory will usually get ready to see and remember something, and they may pay more attention to an event and its finer details because they believe they are expected to. In addition, the use of students in a sample for a road accident study may not reflect a wider population that may comprise older, more experienced drivers who are more confident in their ability to estimate speeds and perhaps also less likely to be influenced by a verb in a question.

Nonetheless, Loftus's research clearly demonstrates that eye-witness testimony cannot be regarded as infallible, even when the witness is making every possible effort to be truthful. Among many other variables, eye-witness testimony can be distorted by leading questions that contain 'misleading' information. This is the main reason why leading questions by prosecutors and barristers are disallowed in courtroom proceedings.

Loftus has proposed that any model of memory should include the process of reconstruction that occurs when new information is integrated into the original memory of an event. Figure 7.9 below shows a traditional model of recall from LTM compared with Loftus's model, which includes an extra step of integrating new information. New information acquired after the original experience is integrated with information in the original memory, resulting in recall of a reconstructed or altered version of the original memory. Later, if you are asked a question about the original experience, your recall will not be of the actual original experience, but of your reconstruction of the experience.

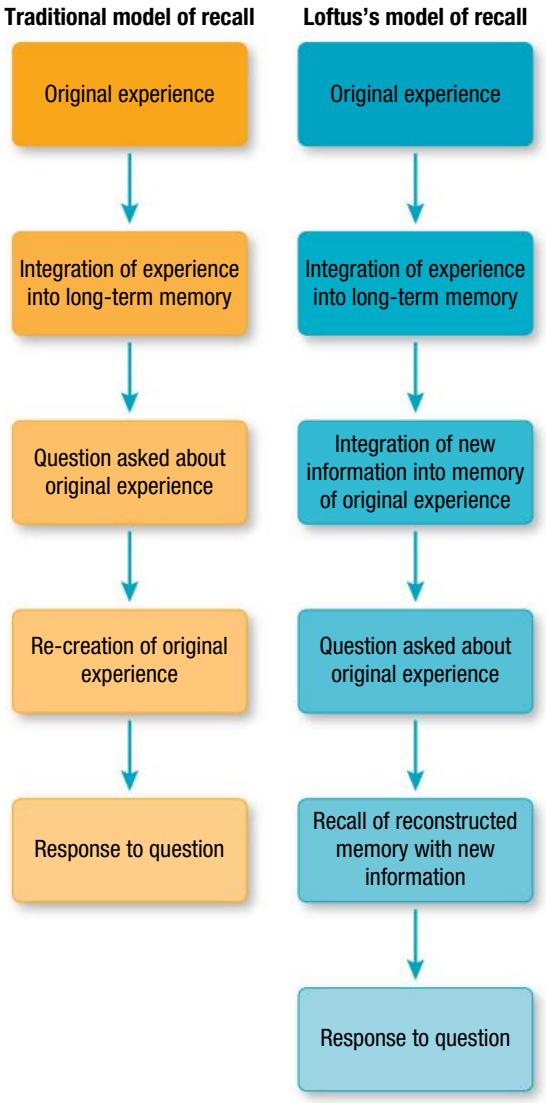

Figure 7.9 A comparison of Loftus's model of recall from LTM with the traditional model. Loftus's model includes an extra step of integrating new information acquired after the original experience, which may be used in a reconstructed memory that does not accurately reflect the original experience.

BOX 7.2 Planting false memories

Elizabeth Loftus has also extensively researched and written about *false memories*. These are memories of events that are distorted or made up and that an individual believes to have experienced but that never actually took place. Following is an extract from one of Loftus's articles on false memories.

> It is one thing to change a stop sign into a yield sign, to turn Mickey into Minnie, or to add a detail to a memory report for something that actually did happen. But could one create an entire memory for an event that never happened? My first attempt to do this used a procedure whereby participants were given short narrative descriptions of childhood events and encouraged to try to remember those events. While participants believed that all of the descriptions were true and had been provided by family members, one was actually a pseudoevent that had not occurred. In this study, approximately 25% of participants were led to believe, wholly or partially, that at age 5 or 6 they had been lost in a shopping mall for an extended time, were highly upset, and were ultimately rescued by an elderly person and reunited with their family. Many added embellishing details to their accounts.
>
> The method of using family members to help plant false memories can simply be called the *lost-in-the-mall* technique. Many investigators have used the lost-in-the-mall technique to plant false memories of events that would have been far more unusual, bizarre, painful or even traumatic had they actually occurred. Participants have been led to believe that they had been hospitalised overnight or that they had an accident at a family wedding. They have been convinced that they had nearly drowned and had to be rescued by a lifeguard. They have been persuaded by the suggestion that they were once the victims of a vicious animal attack.
>
> Most studies find that a significant minority of participants will develop partial or complete false memories. In one set of studies reviewed by a team of psychologists, the average false memory rate was 31% (but in individual studies, the data can vary). Sometimes people have been resistant to suggestions, as they were when investigators tried to plant false memories of having received a rectal enema. Conversely, sometimes false memories have been planted in the minds of more than 50% of exposed individuals, as they were when investigators tried to plant false memories of having gone up in a hot-air balloon ride. Particularly striking are the complete false memories, or what might be termed *rich false memories*, which are experiences about which a person can feel confident, provide details, and even express emotion about made-up events that never happened.

Source: Loftus, E.F. (2003). Make-believe memories. *American Psychologist, 58*(11), 867–873.

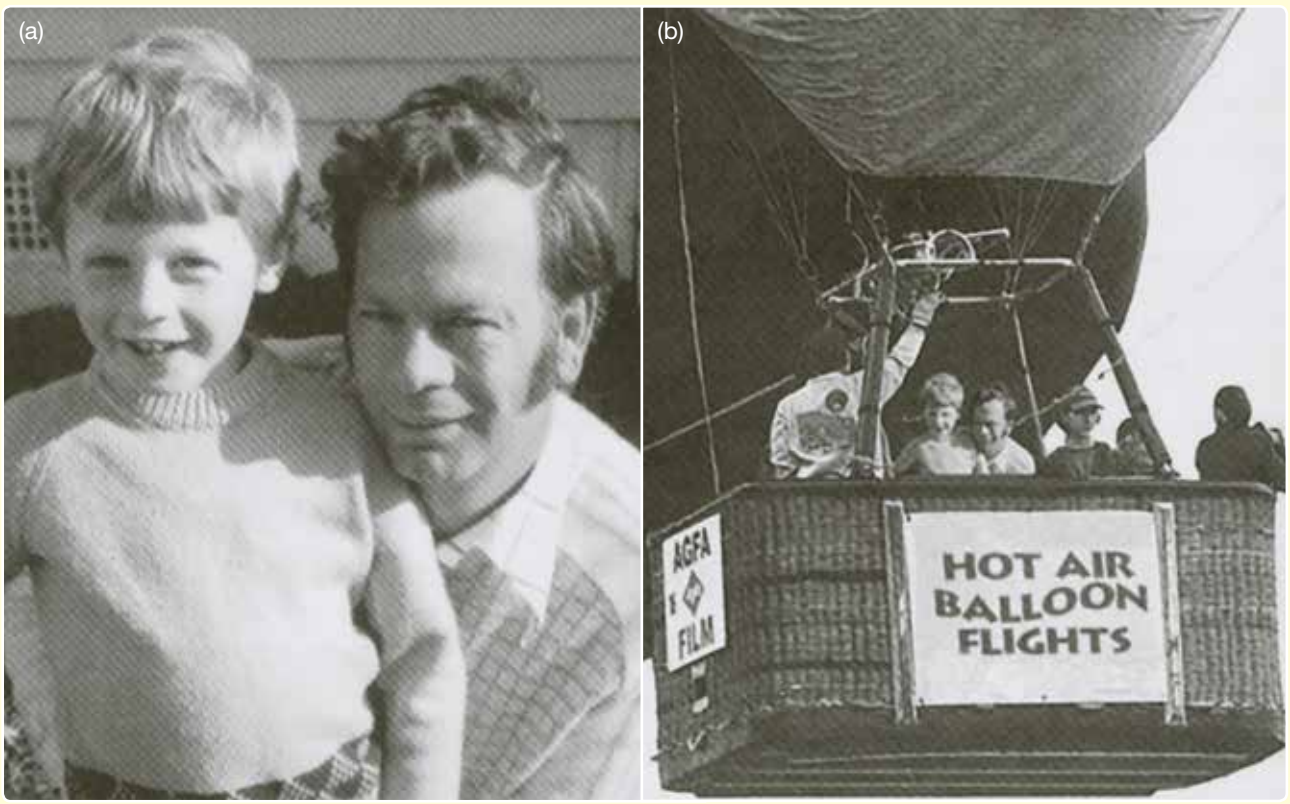

Figure 7.10 When researchers pasted childhood photos (a) into a photo of a hot-air balloon ride (b), about half the participants could remember the event, even though none had ever been in a hot-air balloon.

LEARNING ACTIVITY 7.4

Review questions

1. What is eye-witness testimony?
2. (a) Explain what a leading question is with reference to the use of a presupposition.
(b) Give an example of a leading question with a presupposition, other than one given in the text.
3. (a) Explain, with reference to research evidence, how a leading question can be used to manipulate memory reconstruction by eye-witnesses.
(b) What does this evidence suggest about the fallibility or reliability of eye-witness testimony?
4. Explain whether Loftus's research findings on the reconstructive nature of memory are relevant to long-term memories other than episodic memories.
5. When deciding whether or not a particular event occurred just as it was described to you by the sole eye-witness, what are three factors that should be considered?

LEARNING ACTIVITY 7.5

Reflection

Memory provides the means of recording our life experiences and developing our self-concept or personal identity. Comment on whether your knowledge that memory is fallible should influence your confidence in what you know about your past and your sense of self.

LEARNING ACTIVITY 7.6

Analysis of data

1. (a) Graph the results in Table 7.2 on page 381.
(b) Describe and explain the results in the graph with reference to the experimental procedures used by Loftus and Palmer (1974).
2. Explain whether or not conclusions drawn from Table 7.2 are influenced by the lack of a control group in the experiment.
3. (a) Graph the results in Table 7.3 on page 381.
(b) Explain why 16 participants in the 'smashed' verb condition reported seeing broken glass.
(c) Suggest an explanation for six control group participants reporting that they saw broken glass.
(d) What do the data in Table 7.3 indicate about participant attrition?

LEARNING ACTIVITY 7.7

Evaluation of research by Loftus and Palmer (1974) on memory reconstruction

Evaluate the research study conducted by Loftus and Palmer (1974). You may present your evaluation of the two experiments as an annotated diagram such as a flowchart. You are required to:

- formulate a research hypothesis that could have been tested by the procedures used in each experiment
- identify the sample in each experiment and the population from which these were drawn
- identify the participant selection and allocation procedures
- identify the operationalised variables in each experiment
- identify the conditions of each experiment
- identify the type of experimental design used
- briefly state the results obtained
- briefly state a conclusion based on the results obtained
- briefly state what the conclusion suggests about the accuracy of eye-witness testimony
- briefly state the researchers' explanation of the results
- identify a potential extraneous or confounding variable that could impact on the results obtained if uncontrolled and explain how it was controlled
- comment on the extent to which the results can be generalised.

EFFECTS OF BRAIN TRAUMA ON MEMORY

Many causes of memory failure or loss have a neurological basis, which results from some sort of injury or damage to the brain, usually in a specific area associated with memory. The term **brain trauma** is an 'umbrella' term that refers to a brain injury that is acquired after birth and impairs the normal functioning of the brain. The effect can be mild or severe, temporary or permanent. Some brain injuries may be congenital (inherited), but most are acquired at some time after birth through an event such as impact to the head that jolts the brain, a stroke, infection, lack of oxygen, a drug use episode, prolonged alcohol or substance abuse, a tumour, or by a neurodegenerative disease (Brain Injury Australia, 2018).

A **neurodegenerative disease** is a disorder characterised by the progressive decline in the structure, activity and function of brain tissue. Essentially, neurons within the brain tissue ('neuro') gradually become damaged or deteriorate ('degenerate') and lose their function, hence the term 'neurodegenerative'. With neurodegenerative diseases, the gradual deterioration is usually age-related. For example, Alzheimer's disease is an age-related neurodegenerative disease linked to damaged neurons, resulting in progressive memory failure and loss as well as a range of other problems. It is age-related because it is more common in older people and the problems usually worsen with age.

The term **amnesia** is used to refer to loss of memory that is inconsistent with ordinary forgetting. Memory loss may be either partial or complete, temporary or permanent. Brain trauma commonly results in some kind of amnesia. The nature, location and severity of the injury determine the specific characteristics of the amnesia.

There are many different kinds of amnesia, each of which has a different pattern of symptoms. Generally, someone with amnesia may be unable to access information from LTM or have difficulties forming new memories. Often there are difficulties with certain types of information, for example, loss of explicit memories but not implicit memories. Case studies have been reported of people who become amnesic for the meaning of nouns, but not verbs, and vice versa. There are other case studies of people who become amnesic for animals, but not people, or who become amnesic for human faces but not for other objects. Though having no sense of who you are is often depicted in movies, it is rare for amnesia to cause a sudden loss of self-identity.

One type of amnesia with a specific kind of memory loss is called anterograde amnesia. In this section, we examine anterograde amnesia with reference to brain trauma and neurodegenerative diseases. We then examine the effects of brain trauma on areas associated with memory, focussing on damage due to brain surgery or Alzheimer's disease, which is the most common type of neurodegenerative disease.

studyon

Figure 7.11 Brain trauma can cause amnesia — loss of memory that is inconsistent with ordinary forgetting. The memory loss may be partial or complete, temporary or permanent.

Anterograde amnesia

If brain trauma causes loss of memory for information or events *after* the trauma occurs, it is called **anterograde amnesia** (*antero* means forward — in this case, forward in time). People with anterograde amnesia lose the ability to form or store new long-term memories. They typically have little difficulty retrieving memories stored before their brain injury, but they cannot remember what has happened since. They usually don't remember new information for more than a very short period and their problem becomes clear when interrupted for some reason. For example, they may read a newspaper article and, if distracted, read the article again as if it were new because they are absolutely unable to remember what they have just read. In some cases they may forget what they have done in the instant before. They may meet a person, have a conversation, go into another room for a moment and on returning will have no recollection of having already met and spoken with that person. New experiences seem to leave no enduring record, as though nothing new can get from STM to LTM.

Anterograde amnesia is often found to be associated with damage to the medial temporal lobe area, particularly the hippocampus and connections linking the medial temporal lobe with the frontal lobes. A common cause among younger people is a traumatic brain injury caused by a blow to the head or by the head being forced to move rapidly forward or backward, usually with some loss of consciousness. When the head is struck hard, the brain slams against the inside of the skull. As a result of this blow or rapid movement, brain tissue may tear, twist or bleed.

Among older people, anterograde amnesia is a common symptom of Alzheimer's disease. It is also common among people with another type of neurodegenerative disease called Korsakoff's syndrome. This disease primarily damages an area within the middle of the brain where the thalamus is located as well as large areas of the frontal lobes. *Korsakoff's syndrome* occurs mainly in people who are chronic alcoholics and is linked to the prolonged loss of thiamine (vitamin B)

from their diets. Alcoholics who obtain most of their calories from alcohol and neglect their diet most often have this thiamine deficiency. Although Korsakoff's syndrome is considered to be a neurodegenerative disease, the symptoms may appear suddenly within the space of days (Kolb & Whishaw, 2014).

People with anterograde amnesia do not necessarily have a problem forming new implicit memories, providing evidence of the independence of explicit and implicit memories. In many tests of implicit memory, the results of patients with anterograde amnesia are indistinguishable from those of ordinary individuals. For example, they can satisfactorily learn new procedural motor skills and acquire conditioned responses.

Figure 7.12 The 2000 American movie *Memento* with Australian actor Guy Pearce in the lead role portrays anterograde amnesia. Anterograde amnesia involves loss of memory for information or events experienced after the brain trauma event.

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Weblinks
- *Memento* official movie trailer 2m 22s
- Review of amnesia depiction in movies

Among the earliest evidence is a report based on classical conditioning. In 1901, Swiss psychologist Édouard Claparède secretly positioned a pin in his hand before shaking hands with a female patient who had anterograde amnesia due to Korsakoff's syndrome. The patient received a pinprick and the following day was reluctant to shake hands when Claparède reached out to do so. She gave no indication that she recognised Claparède or of having remembered anything about the previous encounter when questioned about it. However, the refusal behaviour indicated she had actually remembered something about the previous day's event. More conventional experiments have confirmed that these types of conditioned responses are indeed preserved in amnesic patients (Baddeley, 1999; Reisberg, 2013).

Anterograde amnesia is believed to result from a failure of memory encoding and storage because of disruption to consolidation. New information is processed, but almost immediately forgotten, never making it into the cortical regions where long-term memories are stored. Regardless of its specific cause, STM tends to remain intact (Andreasen & Black, 1996).

Anterograde amnesia can be contrasted with *retrograde amnesia* for which there is loss of memory for information or events experienced *before* the trauma occurs. The memory loss may extend back a few moments, days, weeks or sometimes years. Older memories may be accessible, whereas more recent memories are not. Memory failure due to retrograde amnesia is often caused by a blow to the head which jolts the brain too, such as one received in a car accident, a boxing match or a sporting accident. It is also commonly experienced by people with severe depression who have been treated by electroshock therapy (ECT) involving administration of brief jolts of electricity to the brain.

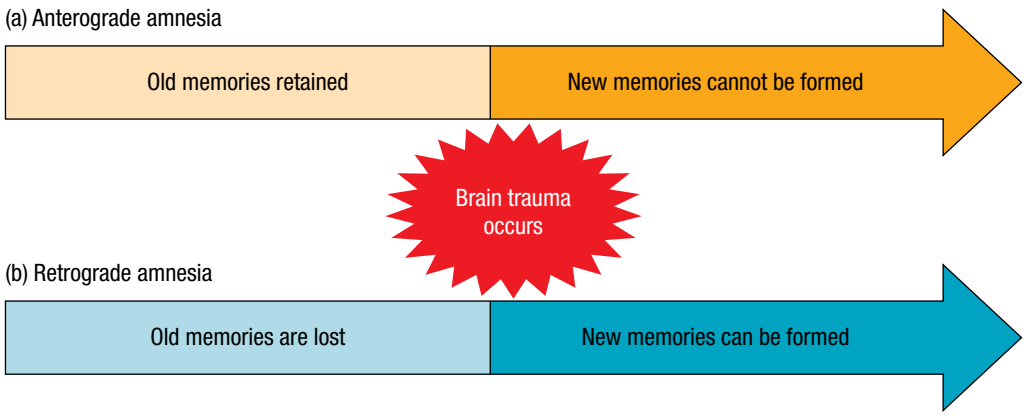

Figure 7.13 (a) With anterograde amnesia, the person cannot form new memories that occur after the brain trauma (but not necessarily for all types of information). (b) In contrast, retrograde amnesia involves loss of some or all memories formed before the brain trauma occurred.

BOX 7.3 Retrograde amnesia

If brain trauma affects memory for information or events experienced *before* the trauma occurs, it is called *retrograde amnesia* (*retro* means backwards — in this case, backwards in time).

A very detailed case study of retrograde amnesia was reported by English neurologist Ritchie Russell (cited in Baddeley, 1999). The case involved a 22-year-old greenkeeper who was thrown from his motorcycle in August 1933. There was a bruise in the left frontal lobe area and slight bleeding from the left ear, but no fracture was seen on X-ray examination. A week after the accident he was able to converse sensibly, and the nursing staff considered that he had fully recovered consciousness. When questioned, however, he said that the date was February 1922 and that he was a schoolboy. He had no recollection of five years spent in Australia, two of which were spent working on a golf course.

Two weeks after the injury Russell remembered the five years spent in Australia, and remembered returning to England, but the previous two years were a complete blank. Three weeks after the injury he returned to the village where he had been working for two years. Everything looked strange, and he had no recollection of ever having been there before. He lost his way on more than one occasion. Still feeling a stranger to the district, he returned to work. He was able to do his work satisfactorily, but he had difficulty in remembering what he had actually done during the day. About ten weeks after the accident, the events of the past two years gradually returned and finally he was able to remember everything up to within a few minutes of the accident.

Typically, people who experience retrograde amnesia find that their inability to remember information and events leading up to the brain trauma gradually disappears. The period for which the memory is lost shrinks as the person gradually recovers their memory. However, people who have experienced retrograde amnesia typically find that their memory for the period immediately before the accident is never recovered.

In addition, episodic memory tends to be more severely affected than semantic memory, so that the person may remember words and general knowledge (such as who their country's leader is, how everyday objects work, colours, and so on) but not specific events in their lives. Procedural memories are typically not affected at all.

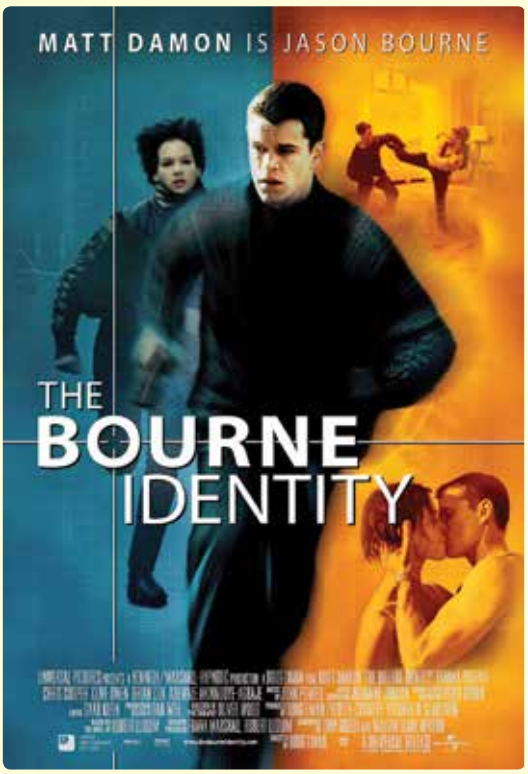

Figure 7.14 The 2002 movie *The Bourne Identity* with Matt Damon in the lead role portrays retrograde amnesia. Retrograde amnesia involves a loss of memory for information or events experienced before the brain trauma event.

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Weblink
The Bourne Identity official movie trailer 2m 09s

LEARNING ACTIVITY 7.8

Review questions

1. What is amnesia?
2. Explain the meaning of the phrase 'amnesia resulting from brain trauma and neurodegenerative disease'.
3. Why is Alzheimer's disease considered to be a neurodegenerative disease?
4. What distinguishes a neurodegenerative disease from other types of brain trauma?
5. (a) Explain the meaning of anterograde amnesia, with reference to explicit and implicit memories.
   (b) How does anterograde amnesia impact on learning?
   (c) In what way do learning and memory problems typically associated with anterograde amnesia provide evidence of the independence of explicit and implicit memory?
   (d) Explain why anterograde amnesia may be attributable to a disruption to the consolidation process.
6. Voula was involved in a car accident as a passenger. She was not wearing a seatbelt and hit her head on the front windscreen when the two cars collided. She was unconscious for a short time. Brain scans showed there was no permanent brain damage, however, Voula experienced memory problems for some time after the accident.

   If Voula suffered anterograde amnesia, what memory problems is she likely to experience?

LEARNING ACTIVITY 7.9

Media analysis/response on anterograde amnesia

The movie *Memento* referred to in Figure 7.12 on page 386 is widely described in the popular media as accurately depiciting amensia and memory processes.

Comment on how accurately the movie depicts anterograde amnesia and other aspects of memory, with particular reference to each of the following.

1. The likelihood of the lead character Shelby acquiring anterograde amensia from the reported cause.
2. Whether it is possible for Shelby to have a vivid memory of the cause of his amnesia.
3. The movie's depiction of symptoms involving explicit memory.
4. The movie's depiction of symptoms involving implicit memory.
5. Whether the myth that amnesia is marked by a loss of identity is perpetuated.
6. Whether Shelby, as he states, actually has 'no short-term memory' and whether it is possible for him to have no STM.

Brain surgery

In 1957, the publication of a now widely cited case study drew the attention of psychologists to the importance of the medial temporal lobe area in memory and provided compelling evidence for the separation of explicit and implicit memories. The case study documented memory problems experienced by American patient H.M. who had undergone brain surgery. The patient, whose real name was Henry Molaison, subsequently participated in hundreds of research studies on memory until he died in 2008 at age 82. However, until his death, he was known only by the initials H.M. to protect his privacy.

In 1953, when Molaison was 27 years old, he agreed to brain surgery to treat the severe epilepsy from which he had been suffering since the age of ten. Molaison's epilepsy was unresponsive to anti-convulsant medications and other treatments. It was also extremely debilitating and he had difficulty holding even a simple job. At the time, doctors knew that, in many patients with epilepsy, seizures started in either the right or left hemisphere, usually in the medial temporal lobe (Scoville & Milner, 1957).

Because Molaison's seizures were so severe, and because their precise origin could not be determined, his neurosurgeon decided to remove the medial temporal lobe area from each hemisphere. Altogether, over 5 centimetres of tissue was 'sucked out' from each lobe. This included about two-thirds of each hippocampus, most of each amygdala, and adjacent cerebral cortex from around the hippocampus and amygdala. Although some of the hippocampus and amygdala remained in each lobe, these structures and surrounding neural tissue were so damaged ('lesioned') that what was left was believed to be useless (Milner & Corkin, 2010).

Medically, the surgery was successful in terms of its goals. Molaison's seizures declined in their frequency and severity, and could also be controlled with medication. His personality was basically unchanged and almost all cognitive functions remained unaffected. Molaison could conduct a conversation as normally as most people, as long as he was not distracted. He had a good vocabulary, normal language skills and slightly above-average intelligence. However, there was a huge cost. The surgery left him with serious memory problems.

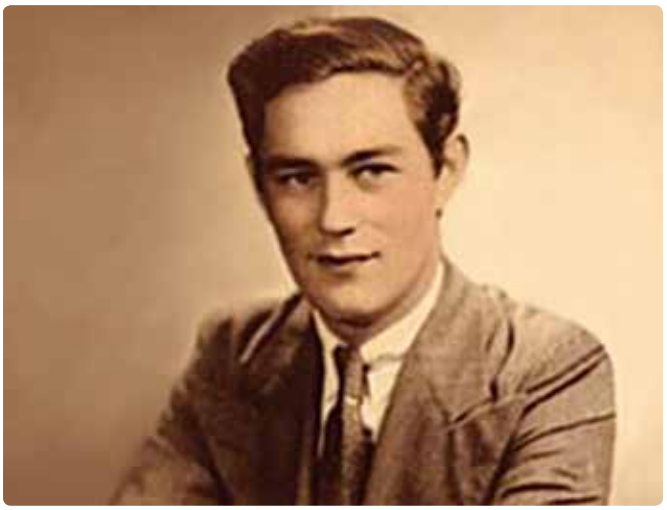

Figure 7.15 This photo of Henry Molaison, or H.M. (1926–2008), was taken shortly before he underwent his surgery that left him with serious memory problems.

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Weblinks

- BBC radio report on H.M. that includes interviews with H.M. and commentaries by his psychologists 29m 00s
- NOVA scienceNOW print interview with neuropsychologist Suzanne Corkin who studied H.M.

Molaison could not remember things that happened in the period leading up to his operation. This memory loss was virtually 'total' for about 2 years pre-surgery and 'partial' back to about 10 years pre-surgery. Overall, in relation to episodic memories, he could not remember any event that happened at a specific time and place but he had retained the gist of personal experiences. He could describe in a general way his life up until his operation. He could talk about experiences, but could not report specific details.

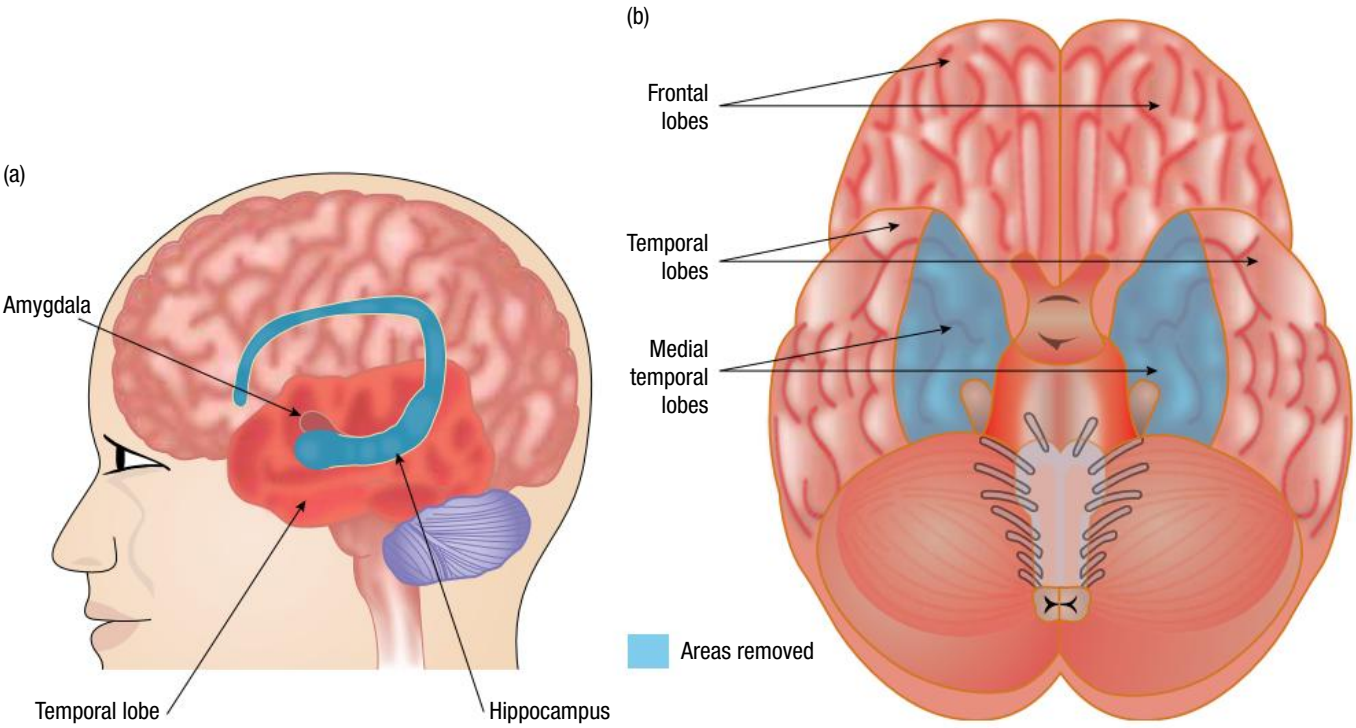

Figure 7.16 (a) Location of the hippocampus and amygdala in the medial temporal lobe area. (b) Molaison had the hippocampus, amygdala and surrounding cortex in the medial temporal lobe area of each hemisphere surgically removed to treat his epileptic seizures. As a result, he lost certain past episodic memories and was incapable of forming new long-term explicit memories — both episodic and semantic memories.

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Weblink
Suzanne Corkin explains MRI scans of H.M.'s brain lesions 6m 01s

More significantly, Molaison had anterograde amnesia and was therefore incapable of forming new episodic or semantic memories. For example, Molaison could no longer remember what he had eaten for breakfast when asked shortly afterward, or why he was in hospital. He had to be reintroduced to his doctors every time he visited them, including Brenda Milner, his neuropsychologist who tested him regularly for some 50 years. Molaison had almost no knowledge of current events because he forgot the news almost as soon as he had seen or heard something. He had no idea of what time of day it was unless he had just looked at a clock, and each time he was told his uncle died he reacted with surprise but could never actually experience sadness.

However, Molaison's short-term 'working' memory was relatively normal. For example, he could amuse himself doing crossword puzzles. And, if given a series of numbers to learn during psychological testing, he could recall about seven numbers like most people. As long as he paid attention to a task and thought about or actively repeated it aloud, he could retain information in short-term memory (and therefore conscious awareness) for as long as required. However, as soon as he was distracted and his attention was consequently diverted to something else, he immediately forgot about it. The information vanished without a trace and could not be recalled thereafter (Ogden & Corkin, 1991).

Furthermore, Molaison could also learn and retain new motor skills, so formation of these types of procedural memories was also relatively normal. For example, he learned a new motor skill involving 'mirror drawing' for which he had to trace around a shape such as a star that could only be seen in a mirror (see Figure 7.17). He progressively improved with practice on this and other motor learning tasks over a period of three days. However, he could never recall having seen and therefore been exposed to the test materials or engaging in practice on the task at any previous time.

Molaison's case and studies of other people with amnesia following brain surgery provide similar evidence for the crucial roles of various brain structures and regions in memory processes, in particular, the roles of the hippocampus, cerebral cortex, amygdala and cerebellum which we will examine in the next section. When considering their roles, it should be kept in mind that they are all anatomically interconnected and interact with each other in memory processes together with other structures and regions. They are all part of an integrated learning and memory system that extends throughout the brain. However, each structure has distinguishable roles that can be isolated and studied.

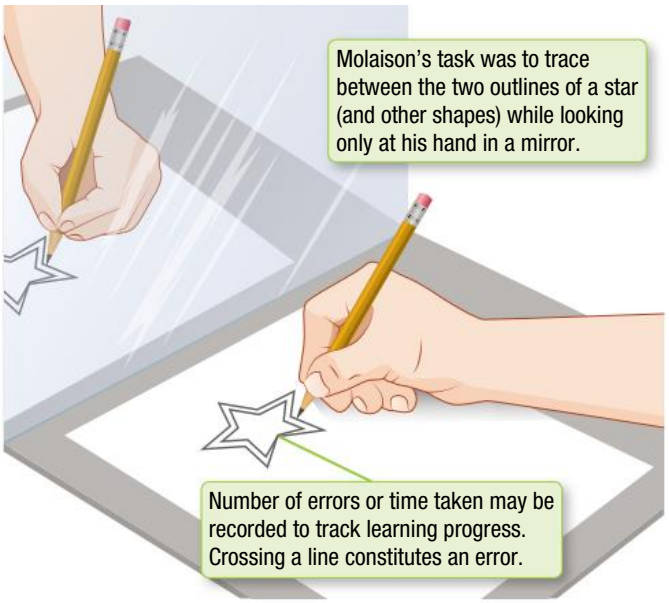

Figure 7.17 Despite surgical removal of the hippocampus in each hemisphere, Molaison could learn mirror drawing and improve with each training session (so procedural memory for motor skills was intact). However, he could never recall ever having seen the materials (so formation of new explicit memories was impaired).

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Weblink
Video explaining H.M.'s tracing task 1m 06s

Hippocampus

Molaison's case illustrates that removal of (or damage to) the hippocampus in each hemisphere disrupts identifiable memory processes. It does not seem to affect the formation, storage or retrieval of procedural memories, but the formation of semantic and episodic memories and their transfer to the cerebral cortex for storage may be affected. For example, a person can still learn how to serve in tennis or use an elevator, but will not remember any aspect of the learning experience such as when, where or how the learning occurred.

Removal of H.M.'s hippcampi is likely to have impaired the consolidation process, which probably accounts for why Molaison was incapable of forming new long-term episodic or semantic memories. Consolidation was unable to occur due to the lack of structures that undertake the process, not only through the loss of most of the hippocampus in each hemisphere, but also other medial temporal lobe areas and synaptic connections that may be involved in the formation and transfer of explicit memories.

Other studies have also provided evidence that supports this. For example, monkeys and people who lose both hippocampi to surgery or disease also lose most of their explicit memories of whatever they learned during the preceding month, though their older memories tend to remain intact. This includes the explicit content of emotional memories formed when highly aroused (but not the expression of the emotional qualities or reactions, such as an elevated heart rate if fearful). The longer both hippocampi and their pathways to the cortex are left intact after learning, the smaller the memory loss, most likely because of the time available for consolidation and transfer to cortex. Removal of one hippocampus — either one — does not seem to cause much memory impairment. It is only when both are removed or severely damaged that profound difficulties are experienced in forming new memories. The greater the loss or damage, the greater the impairment (Di Gennaro et al., 2006; Gluck, Mercado & Myers, 2008; Schacter, Gilbert & Wegner, 2009).

The fact that H.M. was able to learn the hand–eye coordination skills required for mirror drawing, despite having absolutely no memory of having practised the task before, also provides evidence of the existence of explicit and implicit memories and that they are distinctively different. In addition, H.M. had retained a good deal of previously stored long-term memories suggesting that the hippocampus is not entirely responsible for their retrieval.

Although H.M. was unable to remember anything that left STM, his STM was still functional. Given that hippocampal removal did not affect H.M.'s STM in any significant way, this provides evidence that STM is different from LTM and that the hippocampus is not involved in STM encoding, storage or functioning, other than possibly the transfer of information about facts and events from STM to LTM.

Loss of or damage to the left or right hippocampus seems to produce different results. People (and animals) without the right hippocampus tend to have difficulties learning and remembering the location of objects or places. This provides evidence for the crucial role of the right hippocampus in spatial learning and memory. Studies have also found that people without the left hippocampus tend to experience difficulty remembering verbal information (e.g. words), but they have little or no difficulty recalling visual designs (or locations). This provides evidence for the crucial role of the left hippocampus in verbal learning and memory. The reverse applies to those without the right hippocampus (Schacter, 1996).

Destruction or absence of either or both hippocampi appears to have little or no effect on the acquisition or retention of conditioned eye-blinks and other simple reflexive responses through conventional classical conditioning procedures. Therefore, it seems that the hippocampus is not required for classical conditioning or storage of these simple motor responses (Breedlove, Watson, & Rosenzweig, 2010).

Although surgery to remove both medial temporal lobes is no longer performed as a treatment for epilepsy, case studies of patients with injury or disease to hippocampi in both lobes indicate that they experience similar difficulties to those of H.M., although often not as severe. Removal of the hippocampus in the temporal lobes of other mammals such as rats, rabbits and monkeys also results in the same types of memory problems (Gluck, Mercado & Myers, 2008; Zola-Morgan & Squire, 1993).

BOX 7.4 The hippocampus, spatial learning and spatial memory

The earliest evidence that the hippocampus is involved in spatial learning and memory comes from studies with animals. In one of the best-known studies, British psychologist Richard Morris and his colleagues (1982) conducted an experiment with rats in what they called a water 'maze', which is an unusual choice of terms because the task is performed in an open wading pool and not in a labyrinth-like series of pathways.

The researchers set up a circular tank about two metres in diameter filled with opaque, milky water that obscured a platform submerged just below the surface. The water temperature was sufficiently stressful to motivate the animals to escape, but not so stressful as to inhibit learning. The platform provided a means of escape from the water. This apparatus was used to compare the performance of three groups of rats in swimming through the water maze to the platform.

Group 1 comprised rats with a cerebral cortex that had been surgically damaged in the upper area of the frontal lobe. Group 2 comprised rats with a surgically damaged hippocampus. Group 3 comprised rats with no surgically damaged brain region or structure.

When a Group 3 'normal' rat was placed in the tank, it would swim around until it found the platform and then pull itself up. Each time it was placed in the tank, it located the platform more quickly, eventually working out the most direct route and thereby demonstrating spatial learning and memory. When a Group 1 rat (with cortical damage) was placed in the tank, it performed about as well as a Group 3 'normal' rat. After several trials, it would learn a direct route through the maze to the platform. However, whenever a Group 2 rat (with hippocampal damage) was placed in the tank, it showed little evidence of learning or memory.

As shown in Figure 7.19 below, these rats failed to learn a direct path to the platform, performing in each trial as if it was the first trial. The results of this study indicate that the hippocampus is important in spatial learning and memory. It also suggests that LTP is important in learning because LTP, which is known to occur in the hippocampus, was prevented by the hippocampal damage.

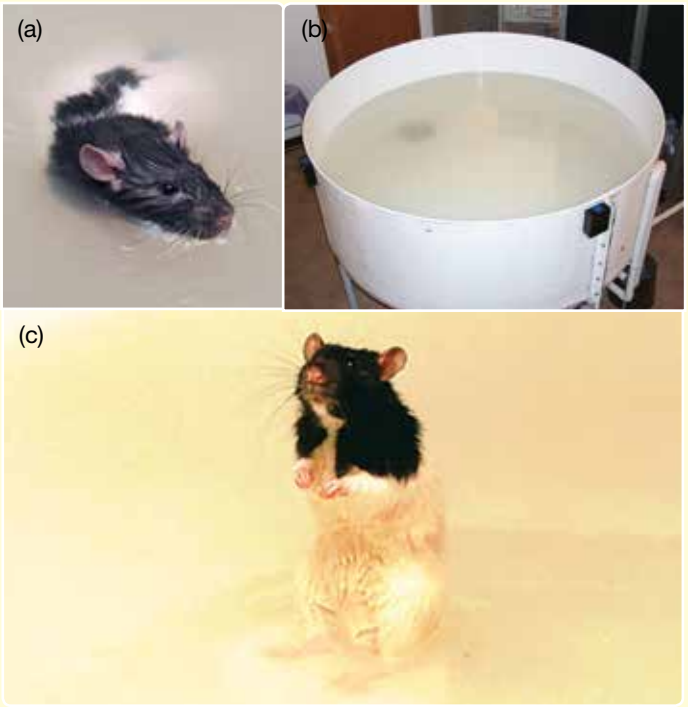

Figure 7.18 (a) A rat in a Morris water maze test swimming to find the submerged platform. (b) Circular tank filled with opaque water. (c) A rat stands on the submerged platform.

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Video on Morris water maze testing 4m 45s

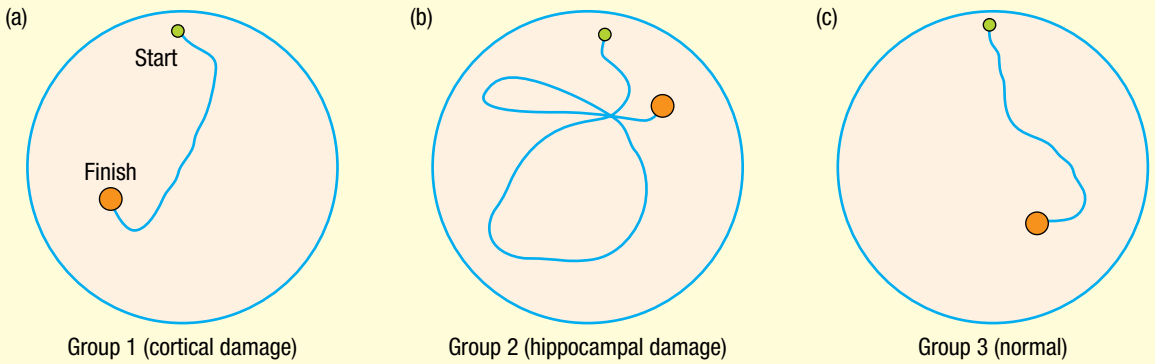


Figure 7.19 Typical swimming paths shown by rats within a water maze. Normal rats (c) rapidly acquire a direct path, as do rats with cortical damage (a), whereas hippocampal damage results in a failure to learn (b).

Source: Morris, et al., (1982). Place navigation impaired in rats with hippocampal lesions. *Nature, 297*, 681–683.

LEARNING ACTIVITY 7.10

Review questions

1. Who was Henry Molaison and why is he well known to memory researchers?
2. List the STM and LTM memory impairments experienced by H.M. after his surgery and what these indicate about the roles played and not played by the hippocampus in explicit and implicit memories.
3. What does the H.M. case study suggest about where LTMs are stored in the brain? Explain with reference to the case study.

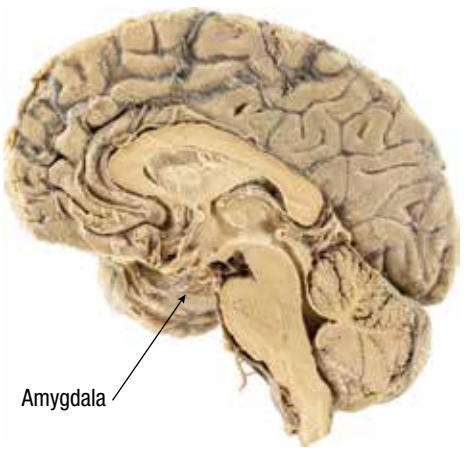
LEARNING ACTIVITY 7.11

Evaluation of research by Morris et al. (1982) on the role of hippocampus in spatial learning and memory

Consider the experiment by Morris et al. (1982) with rats in a water maze summarised in Box 7.4 on page 391 and answer the following questions.

1. Identify the experimental and control groups.
2. Identify the operationalised independent and dependent variables for the experiment.
3. Formulate a research hypothesis that would be supported by the results obtained for the experiment.
4. Why are the results considered to be evidence of the role of the hippocampus in
   (a) spatial learning and memory?
   (b) LTP?
5. Which of the two hippocampi would have most likely been damaged by the researchers?
6. What variable other than hippocampal damage or spatial learning and memory may be a possible explanation of the results?
7. What conclusion can be drawn from the results?
8. To what extent can the results be generalised to humans?

Amygdala



Studies of people who have had either or both amygdalae surgically removed indicate that their loss tends not to result in STM, procedural or many explicit memory problems. The separate roles of the left and right amygdala, however, are still not yet fully understood (Feinstein, et al., 2013; McGaugh, 2013; Young, et al., 2018).

Given the crucial role of the amygdala in the formation of emotional memories, problems are usually experienced with aspects of these types of memories when it is damaged. For example, an individual without an amygdala may remember the semantic and episodic details of a traumatic or joyful event stored in long-term memory, but not the emotional qualities of that event. Nor are emotionally arousing events that trigger the release of adrenaline likely to be well-remembered given the critical role played by the amygdala in enhancing storage of these memories. There may also be an impaired ability to recognise facial expressions of emotions, especially fear. Loss of the right amygdala tends to more severely impact on this type of facial recognition.

Problems with emotional memories are more likely when both amygdalae are lost, but not necessarily all types of emotions. Impairments in facial recognition of emotions after amygdala damage may be highly variable across different individuals and across different types of emotion. If either or both amygdalae are damaged, the degree of impairment will depend on the site, extent and nature of the damage (Cristinzio, Sander & Vuilleumier, 2007; Feinstein, et al., 2013).

Acquisition of conditioned fear responses appears to critically involve the amygdala. People (and other mammals) without an amygdala or severe damage to both are typically unable to acquire a conditioned fear response. These individuals can usually form conscious explicit memories of the details of the experience, but not implicit classically conditioned memories that would enable them to express fear, such as fight, flight or other fear reactions. Removal of the amygdalae may also abolish all signs of fear to an unlearned or previously learned stimulus. For example, a rat typically reacts with an unlearned fight–flight–freeze response to a cat. But without a fully functional amygdala, as observed in one study, the rat may climb on a cat and try to bite it (Thompson, 2000).

Figure 7.20 A rat typically reacts with an unlearned fight–flight–freeze response to a cat. But without a fully functional amygdala, the rat may show no signs of fear of an aggressive cat.

BOX 7.5 Research on the role of the amygdala in the acquisition of a classically conditioned fear response

One of the best-known studies with human participants on the role of the amygdala in implicit classically conditioned memories involving fear responses was conducted by American psychologist Antoine Bechara and his colleagues (1995). The study involved three participants, each with significant brain damage:

- S.M., who had a damaged amygdala in each temporal lobe (called *bilateral amygdala damage*) but no damage to either hippocampus
- W.C., who had a damaged hippocampus in each temporal lobe (*bilateral hippocampal damage*) but no damage to either amygdala
- R.H., who had damage to each amygdala and each hippocampus (*bilateral amygdala and hippocampal damage*).

All three participants were shown a series of coloured lights and each time a blue light was presented a loud, startling boat horn was sounded. After several presentations (i.e. trials), the blue light was presented alone and each participant's 'skin conductance response' was measured as an indicator of their level of conditioned fear.

The results are shown in Table 7.4 below. When all participants were asked to report contextual information about what had happened during the experiment, only participant S.M., with amygdala damage, could accurately report details such as 'A light comes on, followed by the horn'. However, S.M. failed to show a conditioned fear response when the blue light was presented alone, indicating that he had not acquired this type of response. In contrast, participant W.C., with hippocampal damage, showed a conditioned fear response to the blue light but could not remember and therefore report any details of the experiment. Finally, participant R.H., with both amygdala and hippocampal damage, showed neither a conditioned fear response nor any recollection of the trials.

These results indicate that damage to the amygdala interferes with the acquisition of a conditioned fear response, providing evidence for the crucial role of the amygdala (but not the hippocampus) in acquiring and expressing a conditioned fear response (LeDoux, 2007).

TABLE 7.4 Results of experiment on conditioned fear response and recollection in participants with brain damage

Participant	Conditioned fear response (implicit memory)	Conscious recollection of experiment (explicit memory)
S.M. (bilateral amygdala damage)	–	+
W.C. (bilateral hippocampal damage)	+	–
R.H. (bilateral amygdala and hippocampal damage)	–	–

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Le Doux video — the amygdala in 5 minutes 5m 37s

LEARNING ACTIVITY 7.12

Evaluation of research by Bechara et al. (1995) on the role of the amygdala in classically conditioned fear responses

Consider the experiment by Bechara et al. (1995) summarised in Box 7.5 on page 393 and answer the following questions.

1. (a) Identify the experimental research design.
   (b) Why was this design most likely used rather than another type?
2. Name the type of sample used.
3. Identify the operationalised independent and dependent variables for the experiment.
4. Formulate a research hypothesis that would be supported by the results obtained for the experiment.
5. Explain whether sample size for this experiment enables valid generalisations to be made from the results.
6. Identify the NS, UCS, CS, UCR and CR.
7. Callie was terrified by her neighbour's dog yesterday. Describe what is likely to happen if Callie saw the dog today under each of the following conditions:
   (a) no amygdala or hippocampal damage
   (b) bilateral amygdala damage
   (c) bilateral hippocampal damage.

Cerebral cortex

Surgical removal of one or more cortical areas can result in serious memory impairments. The fact that Molaison could still recall information and events experienced long before his surgery means that these memories must have been stored somewhere other than the medial temporal lobe area. His cerebral cortex was left relatively intact and this helps explain why he could retrieve old memories. The memories were located in the cortex and had already been formed and stored with well-established neural connections linking the components.

Although explicit memories are stored throughout the cortex, some areas seem to specialise in different memory processes and/or storing different kinds of information. For example, studies of people with damage to the frontal lobes indicate these are primarily involved in memory processes rather than storage. Differences have been observed between hemispheres as well as at more specific areas within the different lobes. For example, greater injury in the left hemisphere is often worse for recall of verbal material (such as a name or phone number) than non-verbal 'visual' material (such as a face or spatial location). At the same time, damage to a cortical area that originally processed information for a memory and has become its storage site can disrupt its storage and retrieval. Surgical removal is likely to result in loss of the information stored there because this area has to be reactivated as part of the memory reconstruction process during retrieval (Gazzaniga, Ivry & Mangun, 2014; Thompson, 2000).

Molaison's ability to retrieve old memories suggests a crucial role of the cortex in the retrieval process, most likely independent of the hippocampus and amygdala if consolidation has already occurred. This has been confirmed by studies of other patients with amnesia following brain surgery and also by studies that have used neuroimaging techniques.

Frontal lobe loss in particular tends to disrupt the *retrieval* process. For example, memories of events themselves are likely to be remembered, but problems tend to be experienced recalling where and when they were experienced or who said something. In addition, difficulties can be experienced making judgments about the contents of their memory. Different lobes are more or less involved in different memory processes. For example, neuroimaging studies indicate the right frontal lobe is activated when retrieving an episodic memory moreso than the left lobe, and that the left frontal lobe is more involved in the encoding of an episodic memory (Kolb & Whishaw, 2014; Suss & Alexander, 2005).

If a specific area of prefrontal cortex just behind the forehead is surgically removed, then individuals are greatly impaired in remembering the sequence of events, regardless of whether a recall or recognition

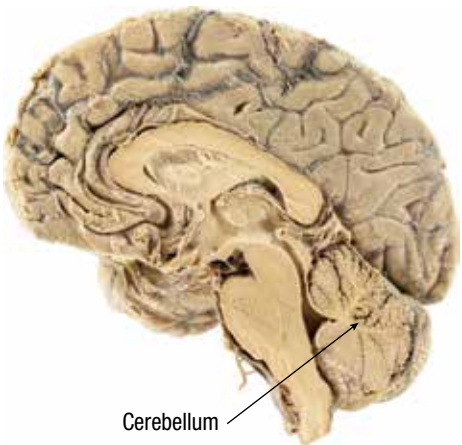
method is used to test them. For example, a patient may be shown a series of paintings, one at a time, and at some point the patient is shown two paintings and then asked which was seen *first*. Patients with prefrontal damage tend to be significantly impaired on this task (which is usually easy for non-impaired people) although they tend to remember perfectly well having seen both paintings earlier (Thompson, 2000).

It seems that damage to the frontal lobes, particularly the prefrontal cortex, also interferes with the *efficiency* of other memory processes, such as attention that is required for transfer of information from sensory memory to STM, and organising and activating information for efficient retrieval from LTM, including coordination and manipulation of information for transfer from cortical storage areas into STM to enable conscious awareness.

The parietal lobe is also involved in attention, so damage to cortical areas within this lobe may also massively impair STM, but not necessarily our ability to maintain information in STM. However, surgical removal of temporal lobe areas can impair explicit memory retrieval and aspects of spatial memory such as spatial awareness and navigation. There may also be differences between the left and right parietal lobes. For example, damage to the right parietal lobe is more likely to impair spatial memory and awareness. And damage to a particular part of the left parietal cortex is likely to massively impair STM of verbal materials and likewise the right parietal cortex for STM of non-verbal materials (Suss & Alexander, 2005; Thompson, 2000).

In sum, it should be kept in mind that the cortex is part of a larger interconnected learning and memory system. Removal of any cortical area may also disable connectivity with another part of that system and its functionality, making it difficult to isolate the actual source of a memory impairment.

Cerebellum



Classically conditioned motor responses involving simple reflexes such as an eye blink, leg movement or head turn in response to a conditioned stimulus are stored in specific locations within the cerebellum. This was first discovered by American psychologist Richard Thompson when investigating the roles of the cerebellum. Thompson conditioned rabbits to blink in response to a beep that had been associated with a puff of air. When the relevant area of the cerebellum was surgically removed, the rabbit's memory of the learned response disappeared. It no longer blinked when the beep was sounded (the CS). But when the puff of air was re-introduced, the rabbit blinked, indicating the rabbit could still blink normally so this reflex had not been destroyed. However, the conditioned response could not be learned again (Thompson, 2000).

Further research by Thompson and others confirmed the results and obtained evidence that classically conditioned learning and memory of very specific reflexive movements critically involves the cerebellum. These findings are also believed to apply to people too because individuals with damage to that very same area of the cerebellum have been found to be unable to store a long-term memory of a conditioned eye blink and other simple conditioned reflexes. All components of the conditioned response to the CS are abolished but there is no effect on the reflex itself (Thompson, 2000).

There are rare cases of people who have been born without a cerebellum and a small number of cases who have had it surgically removed because of a malignant tumour or some other life-threatening disorder. These individuals cannot acquire a classically conditioned reflex response such as the eye blink response, but do remember the experiences of hearing sounds and feeling puffs of air to the eye during the conditioning procedure (Boyd, 2009; Silveri & Misciagna, 2000; Thompson, 2000).

A spatial function of the cerebellum has also been clearly demonstrated in a variety of experiments with small mammals, such as rats and mice in the Morris water maze task shown in Box 7.4 (on page 391). The cerebellum has two hemispheres and surgical removal of either of these results in severely impaired spatial learning and memory. However, the exact role of the cerebellum in spatial functions remains unclear, especially its role in relation to the hippocampus. Its role is believed to be more related to the ability to organise and execute complex and effective exploration behaviours (the implicit procedural component of navigation) than to an inability to develop an internal map of the environment (the explicit semantic component of navigation) (Passot et al., 2012; Rochefort, Lefort & Rondi-Reig, 2013).

The few documented case studies of people born without a cerebellum report only minor to moderate problems with spatial abilities. Although all symptoms are highly variable, most of these individuals are described as having lived relatively normal lives despite motor impairments and were not discovered as not having a cerebellum until post-mortem examination after their death. It is likely that neural plasticity after birth eventually resulted in the hippocampus and other brain regions compensating for the lack of cerebellar tissue.

Problems ordinarily expected of people without a cerebellum, especially coordination and timing of voluntary movements for a range of motor activities, are common during infancy and childhood, but many seem to eventually develop normal or near-normal motor skills as well as most other abilities involving the cerebellum. Loss of the cerebellum during adulthood is far more debilitating. Significant motor impairments are evident and recovery of function through neural plasticity tends to not be as extensive as that which may occur among individuals born without a cerebellum (Glickstein, 1994; Lemon & Edgley, 2010; Poretti, Boltshauser & Schmahmann, 2012).

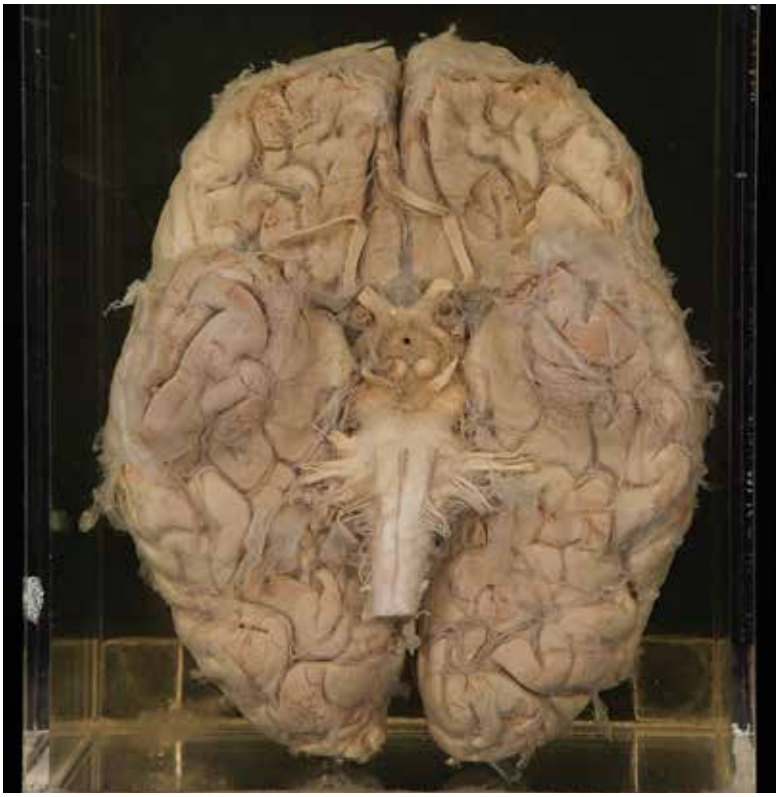


Figure 7.21 A human brain without a cerebellum. Case studies of people born without some or all of their cerebellum, a condition called cerebellar agenesis, provide valuable insights on the role of the cerebellum.

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Online article: Doctors discover a woman with no cerebellum

LEARNING ACTIVITY 7.13

eBook*plus*
Word copy of table

Summarising effects of brain surgery on memory processes

Part A
Make a copy of the table below to summarise the effects of brain surgery on memory processes associated with different brain regions.

Brain region	STM	Explicit memory		Implicit memory	
		semantic	episodic	procedural	classical conditioning
hippocampus					
amygdala					
cerebral cortex					
cerebellum					

Part B
Refer to the table you completed for Learning Activity 6.16 on page 363 to summarise the roles of different brain regions in the storage of implicit and explicit memories.

Construct a table that combines the information in the table above with the table in Learning Activity 6.16 to provide a single summary of the roles of all four brain regions in long-term storage and other memory processes.

Alzheimer's disease

Alzheimer's disease is a type of *dementia* characterised by the gradual widespread degeneration of brain neurons, progressively causing memory decline, deterioration of cognitive and social skills, and personality changes. As brain cells die the brain shrinks. The outer part of the brain is usually the area affected first by the disease. Short-term memory loss is therefore one of the first symptoms of Alzheimer's disease. As the disease progresses to deeper parts of the brain, long-term memory is increasingly impaired. Explicit memories are primarily affected. Implicit memories tend to remain intact or are less severely affected, although this depends on the brain regions that have been damaged and the extent of the damage. As a physical brain disease, Alzheimer's disease also affects other brain functions and consequently, many other aspects of behaviour are also disturbed (Dementia Australia, 2018a; Fleischman, et al., 2005; Machado, et al., 2009).

Alzheimer's disease is the most common type of dementia, affecting up to 70% of all people with dementia. The biggest risk factor for having Alzheimer's disease is increasing age. Although it occurs relatively frequently in older people, regardless of family history, it is not a natural part of ageing. It is estimated that more than 100 000 Australians suffer from Alzheimer's disease. The disease is most common among older people with dementia, moreso among women.

There is currently no single or simple diagnostic test for Alzheimer's disease (or any other dementia). An entirely accurate diagnosis can only be made after death when an autopsy involving microscopic examination of brain tissue is conducted. Because physical signs are not readily detectable in the living patient, a person's memory, general knowledge, intellectual and personal skills and overall functional capacity are assessed. The assessment process often includes input from others such as family members, carers and service providers. However, no one symptom is reliable, making diagnosis difficult (Dementia Australia, 2018a).

The rate of progression of Alzheimer's disease varies greatly from person to person, as can the symptoms. However, the symptoms will get worse and the disease does eventually lead to complete dependence and finally death. The average time a person lives with Alzheimer's disease is 7 to 10 years, but that too is variable.

The disease typically starts slowly and in the early stages, the symptoms can be very subtle. However, as the disease progresses, symptoms become more noticeable and interfere with daily life. In the initial stage, deficits are evident in a number of areas but the person can still function with minimal assistance. Moderate memory loss, especially for recent events, confusion, unusual irritability, impaired decision-making, reduced interest in hobbies and social activities, and needing to be prompted about personal care tasks are often early symptoms of the disease. These continue to feature prominently as the disease progresses.

As well as experiencing a general decline in cognitive abilities, a person in the latter stages of the disease may be unable to recognise their own family members or regular carers, or may even forget their own identity. Severe personality changes are also associated with Alzheimer's disease. For example, someone who was formerly quiet and polite may become obnoxious, swear a lot and continually make insulting sexual comments to friends and strangers alike. Alternatively, someone who was caring and outgoing may become apathetic and socially withdrawn (Dementia Australia, 2018a).

Figure 7.22 People with Alzheimer's disease eventually suffer severe memory impairments, so they may benefit from a 'structured environment'. For example, strategically placed labels are used to help this person to locate his personal belongings.

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Weblink
Dementia Australia videos on AD and other dementias

Both the loss of past explicit memories (retrograde amnesia) and difficulties in retaining newly learned information (anterograde amnesia) distinguish Alzheimer's disease from many other disorders involving amnesia. Overall, memory gradually erodes as the disease progresses. Memory loss in the latter stages may include:

- *events* — forgetting part or all of a significant event such as a wedding and career
- *words or names* — forgetting words and names of well-known people and objects
- *directions* — inability to remember and follow written or verbal directions
- *narratives* — inability to follow a story on television, in a movie or a book
- *stored knowledge* — forgetting known information such as historical or political information
- *everyday skills* — inability to perform tasks such as dressing, cooking, cleaning, using the toilet and taking medication.

Brain damage associated with Alzheimer's disease

Post-mortems of people who died with Alzheimer's disease expose a brain with cortical and sub-cortical areas that look shrivelled and shrunken due to the widespread death of neurons. The area of the brain that appears most affected is the medial temporal lobe, particularly the hippocampus. Autopsies have revealed that up to three-quarters of the neurons in this area may be lost in Alzheimer's patients, and the remaining neurons are often damaged. This makes shrinkage in the hippocampal area especially severe.

Microscopic examination of neural tissue in a brain with Alzheimer's disease usually reveals high levels of abnormal structures that interfere with neural communication within and between neurons, and therefore impair normal brain function. These abnormalities involve plaques and tangles.

The *plaques* are fragments of the protein called beta amyloid that the body produces normally. In a healthy brain, these are broken down and eliminated from the brain naturally. In a brain with Alzheimer's disease, the fragments accumulate over time to form clumps of hard, insoluble plaques outside and around the neurons, thereby impairing synapses and inhibiting communication between neurons.

Within the neurons, another protein called *tau* also accumulates in an insoluble form. Gradually, the tau deposits form another type of abnormal structure called *neurofibrillary tangles*. These look like twisted fibres and inhibit transport of essential substances throughout the neuron. This failure of the transport system is believed to eventually kill the neurons.

Both amyloid plaques and neurofibrillary tangles can occur as part of the normal ageing process of the brain, but they are much more abundant in individuals with symptoms of Alzheimer's disease. It remains unclear whether the build up of plaques and tangles cause Alzheimer's disease or result from the disease process (Dementia Australia, 2018a).

The brains of people with Alzheimer's disease also have greatly reduced levels of the neurotransmitter acetylcholine (ACh). The amount of ACh in the brain decreases naturally as we age. With Alzheimer's disease, however, it decreases much faster than normal. It is believed that the build-up of amyloid and tau may contribute to this by destroying ACh-transmitting neurons (Hampel, et al., 2018).

The risk of Alzheimer's disease and other dementias increases after a moderate or severe traumatic brain injury, such as a blow to the head or injury of the skull that causes amnesia or loss of consciousness for more than 30 minutes. Individuals who sustain repeated brain injuries, such as footballers, boxers and those in combat, are also at a higher risk of developing dementia and impairment of cognitive functions.

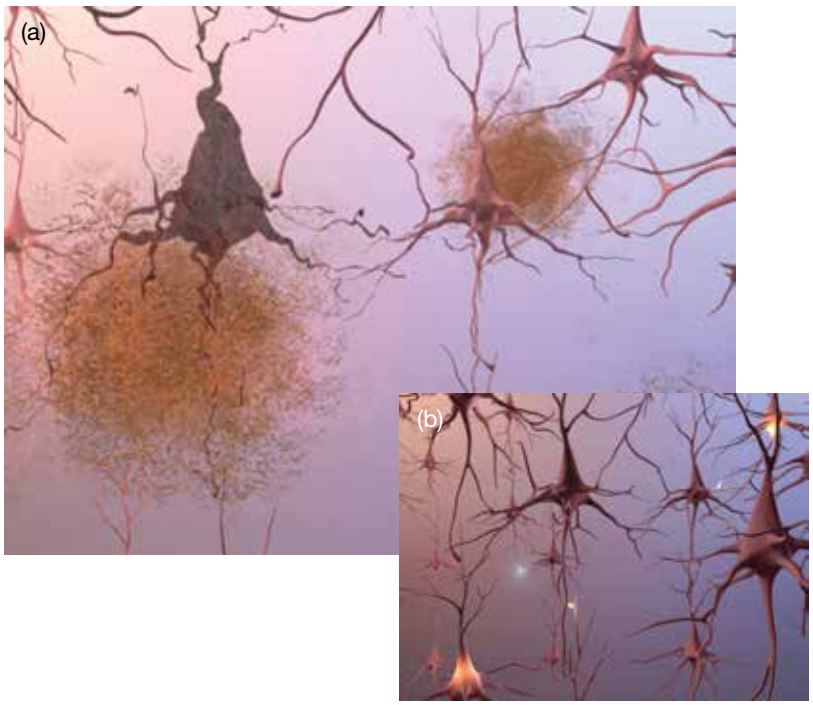

Figure 7.23 Amyloid plaques and neurofibrillary tangles associated with Alzheimer's disease that interfere with neural communication within and between neurons. (a) Neural tissue in an Alzheimer's-affected brain contains fewer neurons and synapses than (b) neural tissue in a healthy brain.

There is no cure for Alzheimer's disease. However, the use of medications that boost the level of ACh in the brain in the early or middle stages of the disease can slow the rate of development of 'primary' symptoms. These drugs improve the efficiency of damaged neurons. Medications can also ease some of the 'secondary' symptoms of Alzheimer's disease, such as depression.

Neuroimaging techniques such as CAT, MRI and PET can be used to identify the extent of brain damage resulting from Alzheimer's disease. The resulting scans make it possible to identify the parts of the brain that have deteriorated.

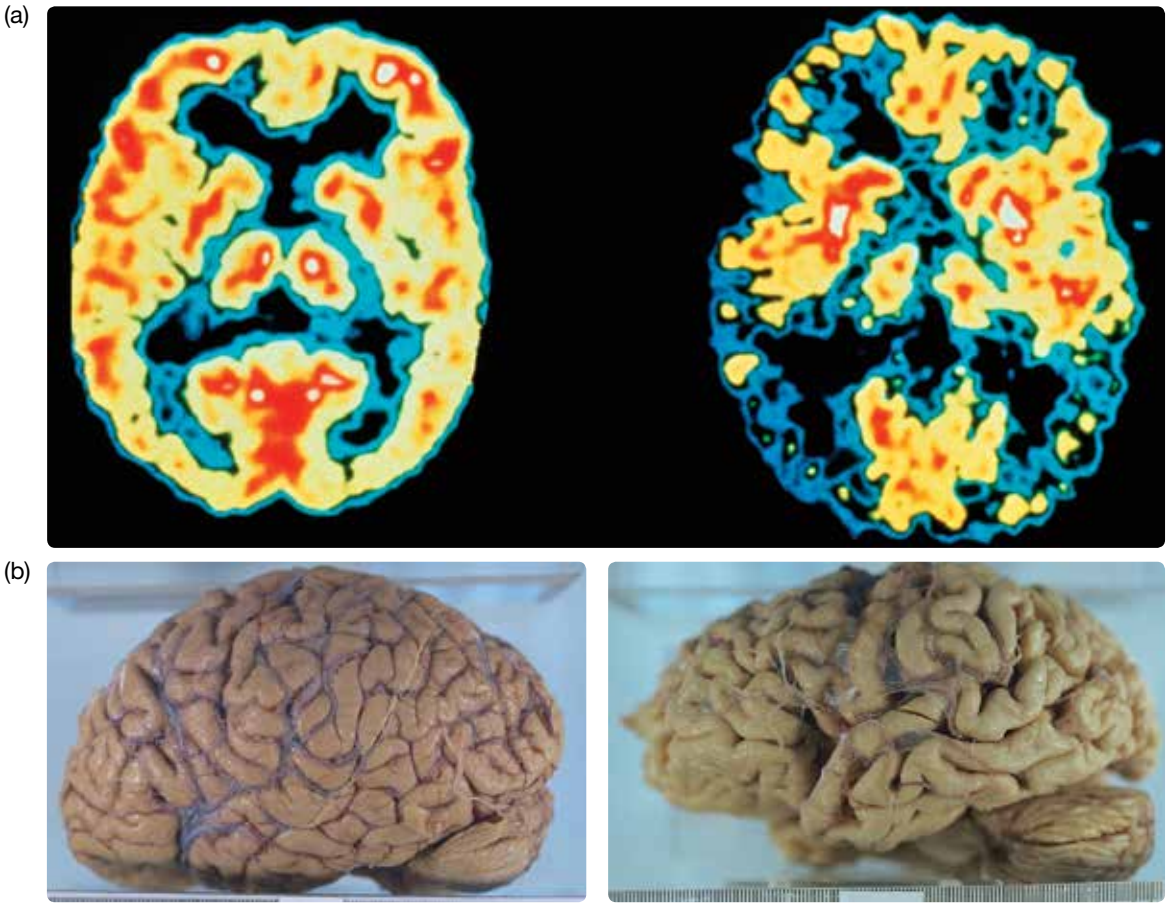

Figure 7.24 (a) A PET scan of a normal brain is shown on the left. High levels of brain activity are indicated by the red and yellow areas. The PET scan on the right shows a brain with Alzheimer's disease. Note the reduced areas of activity through neuronal loss compared to the scan of the normal brain. The lack of activity is most significant in the temporal and parietal lobes. (b) The brain on the left is a healthy one. Compare it to the brain on the right, which is affected by Alzheimer's disease. Note the gaps and shrinkage.

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Weblink
CSIRO video on the neurobiology of AD 3m 50s

BOX 7.6 Dementia

Dementia is not a specific disease. *Dementia* is an umbrella term used to describe a syndrome — a collection of symptoms associated with more than 100 different neurodegenerative diseases and other disorders that are characterised by progressive decline in a person's functioning. It affects thinking behaviour and the ability to perform everyday tasks. Brain function is affected enough to interfere with the person's normal social or working life (Dementia Australia, 2018b).

Dementia is often diagnosed if two or more cognitive functions are found to be significantly impaired. The cognitive functions can include memory, language skills, understanding information, spatial skills, judgment and attention (Dementia Australia, 2017c).

(continued)

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Memory loss is one of the main symptoms of dementia. We all forget things from time to time, but dementia is different. For example, normal forgetfulness may include misplacing your sunglasses, but a person with dementia may lose their sunglasses and then forget what they're used for. Other common symptoms evident in everyday functioning include a decline in mental abilities such as reasoning, problem-solving and decision making, as well as behaviour and personality changes such as becoming more assertive, more withdrawn or less flexible, losing interest in things that have mattered previously, becoming absent-minded or repeating the same story or question. However, every individual experiences dementia in a different way and their experience depends on the type or cause of their dementia.

Dementia is often described as progressing in stages, with memory loss typically being one of the first signs of its onset. Memory decline is persistent rather than occasional and worsens as the dementia progresses.

It may affect a person's ability to continue to work or carry out familiar tasks. It may mean they have difficulty finding the way home. Eventually it may mean forgetting how to dress or how to bathe. With advanced dementia in the final stage, a person will become dependent on their carer(s) in most, if not all, areas of daily living.

Dementia mostly affects people over the age of 65 years, but it can have a younger onset and affect people in their 50s, 40s or even their 30s. The term 'younger onset dementia' is used to describe any form of dementia diagnosed in someone under the age of 65.

Dementia usually develops over a number of years, gradually worsening. However, it is not a normal part of the ageing process. Most people who age do not develop dementia. Numerous known diseases, many of which are neurodegenerative, can cause dementia symptoms. When caused by neurodegenerative factors, the onset of the disease and its symptoms cannot be reversed. In 2018, dementia was the leading cause of disability and the second leading cause of death in Australia. Twice as many females died from dementia — 5.4% of all deaths in males and 10.6% of all deaths in females. In 2016 it surpassed heart disease as the leading cause of death among Australian females (Dementia Australia, 2017b).

More than 425 000 Australians were living with dementia in January 2018. About 1 in 10 were aged 65 and over, and 3 in 10 were aged 85 and over. About 250 people each day are joining the population with dementia (Dementia Australia, 2018c).

There are many different types of dementia, each with different causes and overlapping symptoms. The most common types are described below.

TABLE 7.5 The most common types of dementia

Type of dementia	Description
Alzheimer's disease	• Damage and changes to brain neurons caused by the build-up of deposits called amyloid plaques and neurofibrillary tangles which affect communication within and between neurons and ultimately kill the cells • The most common type of dementia • Accounts for about 70% of all dementia cases worldwide
Vascular dementia or multi-infarct dementia	• Caused by problems of blood supply to the brain being cut off due to clotting or blood vessels bursting in the brain (aneurism) destroying surrounding tissue and triggering strokes • The second-most common type of dementia • Classified as a non-degenerative dementia • Accounts for about 20% to 30% of cases
Frontotemporal dementia including Pick disease	• A group of dementias whereby there is degeneration in one or both of the frontal or temporal lobes of the brain • Accounts for about 5% to 10% of cases
Dementia with Lewy bodies	• A build-up of Lewy bodies — accumulated bits of alpha-synuclein protein — throughout the brain (including the hippocampus) • Dementia symptoms are characterised by pronounced fluctuations in mood with periods of confusion, followed by greater lucidity and disturbed visual experiences. These symptoms make it different from Alzheimer's disease. • Accounts for up to 5% of cases
Dementia due to Parkinson's disease	• A degenerative disease with motor and non-motor symptoms due to depletion of dopamine-producing neurons in the brain • Some people with Parkinson's disease may develop dementia in the latter stages of the disease.
Dementia due to Korsakoff's syndrome (alcohol-related dementia)	• A dementia caused by long-term alcohol abuse, especially combined with a poor diet low in vitamin B (thiamine) • Classified as a non-degenerative dementia
Dementia due to Huntington's disease	• An inherited, degenerative brain disease caused by a defective gene • Usually appears between the ages of 30 and 50, and is characterised by intellectual decline and irregular involuntary movements. Other symptoms include memory disturbance, personality change, slurred speech and impaired judgment. Dementia occurs in the majority of cases.

Sources: Australian Institute of Health and Welfare (2016). *About dementia*. Canberra: Australian Institute of Health and Welfare; Dementia Australia (2018d). Kaufer, D.I. & DeKosky, S.T. (1999); Diagnostic classifications: Relationship to the neurobiology of dementia. In D.S. Charney, E.J. Nestler & B.S. Bunney (Eds), *The Neurobiology of Mental Illness* (p. 642). New York: Oxford University Press.

BOX 7.7 How good is your memory?

The self-rating questionnaire below was developed by British psychologist and prominent memory researcher Alan Baddeley. He uses questionnaires such as this to determine memory lapses in everyday life and in people experiencing memory problems from head injuries. The questionnaire lists some of the memory lapses that we can experience from time to time. How often do they happen to you? In order to complete the questionnaire, refer to the response key and then rate yourself by writing the appropriate number in the box beside each item.

Response key

1. Not at all in the last six months
2. About once in the last six months
3. More than once in the last six months but less than once a month
4. About once a month
5. More than once a month but less than once a week
6. About once a week
7. More than once a week but less than once a day
8. About once a day
9. More than once a day

Items	Response
1 Forgetting where you have put something; losing things around the house.	
2 Failing to recognise places that you are told you have often been to before.	
3 Finding a television program difficult to follow.	
4 Not remembering a change in your daily routine, such as a change in the place where something is kept, or a change in the time something happens. Following your old routine by mistake.	
5 Having to go back to check whether you have done something that you meant to do.	
6 Forgetting when something happened; for example, forgetting whether something happened yesterday or last week.	
7 Completely forgetting to take things with you, or leaving things behind and having to go back and get them.	
8 Forgetting that you were told something yesterday or a few days ago, and maybe having to be reminded about it.	
9 Starting to read something (a book or an article in a newspaper or magazine) without realising you have read it before.	
10 Letting yourself ramble on about unimportant or irrelevant things.	
11 Failing to recognise by sight close relatives or friends whom you meet frequently.	
12 Having difficulty picking up a new skill; for example, learning a new game or working some new gadget after you have practised once or twice.	
13 Finding that a word is on the tip of your tongue — you know what it is but cannot quite find it.	
14 Completely forgetting to do things you said you would do, and things you planned to do.	
15 Forgetting important details of what you did or what happened to you the day before.	
16 When talking to someone, forgetting what you have just said — maybe saying: 'What was I talking about?'	
17 When reading a newspaper or magazine, being unable to follow the thread of the story; losing track of what it is about.	
18 Forgetting to tell somebody something important; perhaps forgetting to pass on a message or remind someone of something.	
19 Forgetting important details about yourself; for example, your birthday or where you live.	
20 Getting the details of what someone has told you mixed up.	
21 Telling someone a story or joke that you have told them already.	
22 Forgetting details of things you do regularly, whether at home or at work; for example, forgetting details of what to do, or forgetting at what time to do it.	
23 Finding that the faces of famous people seen on television or in photographs look unfamiliar.	

(continued)

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Items	Response
24 Forgetting where things are normally kept or looking for them in the wrong place.	
25 (a) Getting lost or turning in the wrong direction on a journey, during a walk or in a building where you have often been before. (b) Getting lost or turning in the wrong direction on a journey, during a walk or in a building where you have only been once or twice before.	
26 Doing some routine thing twice by mistake; for example, putting two lots of tea in the teapot, or going to brush or comb your hair when you have just done so.	
27 Repeating to someone what you have just told them or asking them the same question twice.	
Total	

To score the questionnaire, add up the numbers you wrote in the response column. According to Baddeley, a total score of 27–58 means that your memory is generally good, 58–116 means it is average and 116–252 means it is 'below average'. He suggests, however, that you 'should not be alarmed if your score is below average'. In his view, this may simply mean that you lead a very busy life that puts considerable demands on your memory. Statistically, the greater the number of situations in which memory lapses are possible, the greater the number of lapses you will report overall.

Source: Adapted from Baddeley, A.D. (1997). *Human memory: Theory and practice*. Hove: Psychology Press.

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Word copy of Baddeley's questionnaire

LEARNING ACTIVITY 7.14

Review questions

1. What is Alzheimer's disease?
2. Why is Alzheimer's disease irreversible?
3. Explain why Alzheimer's disease may be attributable to neurological factors, with reference to plaques and tangles.
4. Consider the list on page 398 outlining memory impairments that can be experienced in the latter stages of Alzheimer's disease. For each item in the list, identify:
   (a) the general and specific type of LTM involved
   (b) whether anterograde amnesia is involved.
5. Consider the following extract from a blog posted on a site for caregivers of people with Alzheimer's disease.

   By understanding how a person's memory is being affected, we can adjust our approaches in ways that better help our loved one.

   Every time we perform a task for our loved one without allowing them time to try to do it him or herself, we are actually harming his or her memory and abilities. It is important for us to allow our loved one time to try and complete tasks on their own. Rather than spoon feeding a person with dementia, we should try finger foods, put the food in his or her hand and provide guidance. Rather than buttoning up his or her shirt, we should carefully explain how to button or demonstrate how to button and encourage him or her to try.

   Explain the potential benefits of allowing persons with procedural memory impairments to practice actions such as using a spoon, eating finger foods and self-buttoning, even if such actions are only partially completed. Ensure you refer to both a neurological and a psychological benefit.

LEARNING ACTIVITY 7.15

Reflection

An American neuropsychologist and international dementia expert is challenging the use of the term memory loss and how our beliefs about memory problems can affect people living with dementia, especially those with Alzheimer's disease.

The expert is calling on carers, health professionals and the community to stop using the phrase 'memory loss' as a defining experience of people living with dementia because people with a diagnosis can still make new memories and learn new things.

'It is really memory dysfunction rather than loss and therefore what we do around people living dementia, how we treat them, can enable them to function, can support them and build, rather than erode, their confidence', he said.

What do you think?

Source: Dementia Australia (2017, September 11). *US dementia expert sets the challenge to forget about 'memory loss'* (Media release). Retrieved from https://www.dementia.org.au/media-releases/2017/us-dementia-expert-sets-the-challenge-to-forget-about-'memory-loss'

FACTORS INFLUENCING ABILITY AND INABILITY TO REMEMBER

Have you ever forgotten when someone's birthday was, the location of a place you've been to before or the time you were supposed to meet a friend? Have you ever sat for an exam and been unable to remember something that you know you know? Why is some information unable to be retrieved when we need it? Is this information completely lost from memory or is it that we cannot access it at a specific point in time? What causes us to forget? You know that brain trauma is one explanation of why some people forget. However, there are also psychological factors that can explain forgetting from LTM when there is no brain trauma.

Forgetting refers to the inability to access or recover information previously stored in memory. When you forget something, it means that it is inaccessible to you at the time you are trying to remember it. The information may still be stored in your memory and therefore available, but for some reason you cannot access it when you want to.

When describing forgetting, psychologists primarily refer to LTM and often distinguish between accessibility and availability of information previously stored there. If information is stored there then it is said to be *available*. If information can be recovered from memory and brought into conscious awareness at a specific time and/or place, then it is said to be *accessible*. If information is not available, then it cannot be accessed.

Although forgetting results in the loss of information and skills, if you did not forget, your mind would become cluttered with so much information that you would have great difficulty locating and retrieving the information you needed. Remembering might take hours instead of seconds! If you think about it, would you really like to be able to remember *everything*? With a perfect memory you could retrieve not only what you wanted to, but also life experiences that are perhaps best forgotten. Like remembering, forgetting has an adaptive purpose and contributes to our survival and our sanity (Squire & Kandel, 1999).

There are various psychological explanations of why we forget and how we can minimise forgetting. For instance, forgetting may occur because an appropriate retrieval cue is not used. In addition, psychologists have identified conditions under which we are more likely to retrieve information. We start with an examination of different types of retrieval cues.

Context and state dependent cues

If you have ever experienced a 'mental blank' for a question in an exam, only to recall the exact information you needed when discussing the question with a friend after the exam, then you have had firsthand experience of retrieval failure.

Most of the time, we can retrieve information from LTM with relative ease. For example, for the next 5 seconds, think of as many different types of animals as you can. Next, recall five words that rhyme with 'mum', then three things you did yesterday, three things that are round and four types of food that you like. In completing these tasks, you were able to retrieve information from LTM using a retrieval cue that assisted you to locate relevant information.

A **retrieval cue** is any stimulus that assists the process of locating and recovering information stored in memory. A retrieval cue acts as a prompt or hint that guides the search and recovery process within LTM. Being asked a question is an example of a cue. A question focuses your search for information in specific areas of LTM, much like the call number on a library book or a URL for a website. For example, a question such as 'Who was at the party last Saturday night?' focuses on the specific information among all the information associated with the party. Other cues are less direct and might not even be recognised as memory prompts. For example, the smell of a particular perfume or aftershave, the look of someone's face, a photograph, an emotional state or a particular situation or place may each act as a cue that can unintentionally trigger a specific memory or related group of memories.

According to *retrieval failure theory* we sometimes forget because we lack or fail to use the right cues to retrieve information stored in LTM. For example, you might have forgotten where the summer Olympic Games were held in 2016, but if you went through the letters of the alphabet, the letter *R* might be a cue for the retrieval of the name *Rio*. Additionally, *Rio* would serve as a cue for *Rio de Janeiro*. This explanation of forgetting suggests that memories stored in LTM are available and not actually forgotten. However, the memories are temporarily inaccessible because of an inappropriate or faulty cue.

An effective way of enhancing retrieval from LTM is to re-create the conditions under which the required information was originally learned. This approach is based on the *encoding specificity principle* (Tulving & Thomson, 1973).

The principle involves a general 'rule' that the more closely a retrieval cue matches the original learning conditions, the more likely it is that the information will be retrieved. More specifically, the principle states that memory is improved when information available at encoding is also available at retrieval. Therefore, re-creating the external environment (*context*) in which the original learning occurred, or the learner's internal environment (*state*), has been found to provide valuable cues that aid the retrieval process.

Context dependent cues

Why is it that police investigating a crime take an eye-witness back to the crime scene, particularly if the witness is having trouble recalling some details of what they saw that are crucial to the investigation? The answer to this question is based on research findings that cues in the environment may be important in helping to locate and retrieve related memories.

Context dependent cues are environmental cues in the specific situation ('context') where a memory was formed that act as retrieval cues to help access the memories formed in that context. These cues may include the sights, sounds and smells within the specific situation.

The context dependency of certain memories was demonstrated in a well-known experiment undertaken to investigate the effect of contextual cues on recall in a natural 'real-life' environment (rather than a laboratory environment). The sample consisted of 18 participants (13 males and 5 females) from a university diving club. British psychologists Godden and Baddeley (1975) presented the divers with a list of 36 unrelated words in one of two settings: on the beach or under about 5 metres of water. After they had heard the words, the divers were tested for recall of the words, in the same environment where the learning took place and in the alternate one over a period of four days. As shown in Figure 7.26, the divers recalled up to 20% more words when the words were learned *and* retrieved in the same context.

The context dependency of certain memories helps explain why an eye-witness may recall apparently forgotten information about a crime when they return to the crime scene. When they return to the scene (the context where the memory was originally formed), the environmental cues act as additional retrieval cues that assist the recall of additional information.

Figure 7.25 Using the right cue may prompt retrieval of a memory, indicating that information has not actually been forgotten.

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Weblink
Demonstrating retrieval cues

A number of research studies have tested whether students perform better if their final exams are taken in the same room where they learned or studied the test material. Typically, the results suggest that any differences are sufficiently small so as to not be of concern for students (Saufley, Otaka & Baveresco, 1985). However, these results have been consistently obtained only when the learning environment and the testing environment are similar; for example, if the learning and recalling occurred in different rooms in the same school. But if the testing environment is substantially different from the learning environment, the differences in performance are likely to be more noticeable (Baddeley, 1999).

The best-known study on this research question of considerable interest to most students was conducted over 20 years ago by a team of American psychologists. Forty participants were required to read a previously unseen article in either silent or noisy conditions. Their reading comprehension of this 'meaningful information' was then assessed with both short-answer (recall) and multiple-choice (recognition) tests under either silent or noisy conditions. The results showed context-dependency effects for both tests. The participants whose noise level matched during studying and testing conditions remembered significantly more information than those whose noise level was mismatched. More specifically, performance was better in the matching conditions (silent study/silent test and noisy study/noisy test) than in the mismatching conditions (silent study/noisy test and noisy study/silent test). The researchers concluded that context cues appear to be important in the retrieval of newly-learned, meaningful information. On the basis of their results, they also recommended that students may perform better on both recall and recognition tasks in exams in general by studying in silence (Grant et al., 1998).

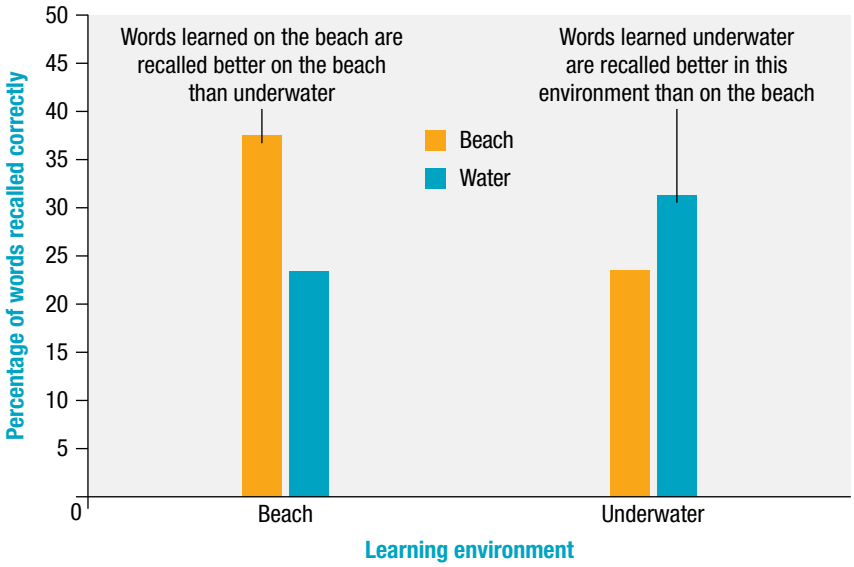

Figure 7.26 The influence of context was evident in a study in which participants learned lists of words either while on the beach or while submerged under 5 metres of water. These results show that when the conditions of learning and retrieval matched, participants were able to recall more words (Godden & Baddeley, 1975).

Figure 7.27 Research findings show that when studying for a test (or exam) that uses recall and/or recognition questions, it is best to match the studying context as best as possible to the test context. In particular, studying under silent conditions, just like the test conditions, is best.

BOX 7.8 Context dependent retrieval cues in Aboriginal storytelling

When Margaret Mead (1901–1978), an eminent American anthropologist, lived with Aboriginal people in South Australia, she learned that some important aspects of the culture are transmitted through storytelling. Stories of significant events are memorised so that the next generation can learn about the cultural past. These stories are sometimes long and contain many important details.

Mead observed that in order to be able to tell a long story accurately, the storytellers had to walk through the places involved in the story. Thus, features of the environment were context dependent cues that triggered the storytellers' memories. If the storytellers were tested in a laboratory setting without the retrieval cues of their physical environment, their memories probably would not be so remarkable.

Figure 7.28 Aboriginal storytellers often use specific cues in the environment to help them recall details of their stories.

LEARNING ACTIVITY 7.16

Evaluation of research by Godden and Baddeley (1975) on context dependency of memories

Evaluate the experiment conducted by Godden and Baddeley (1975). You may present the evaluation as an annotated diagram, such as a flow chart. You are required to:

- identify the aim of the experiment
- formulate a research hypothesis that could have been tested by the procedures used in the experiment
- identify the operationalised independent and dependent variables
- identify the different conditions of the experiment
- identify the type of experimental design used
- name and describe an appropriate participant allocation procedure
- briefly state the results obtained
- briefly state a conclusion in relation to context-dependent memory based on the results obtained
- comment on the generalisability of the results.

State dependent cues

Internal cues that are related to a specific experience may also trigger the retrieval of associated memories. These are called state dependent cues. **State dependent cues** are associated with an individual's internal physiological and/or psychological state at the time the memory was formed, and act as retrieval cues to help access those memories. For example, if you learn information when you are happy, sad, intoxicated, sober, calm or aroused, that information is more likely to be retrieved when you are in the same 'state' (Bower, 1981; Eich, McCaulay & Ryan, 1994).

In a pioneering research study on state dependent cues, American psychiatrist Donald Goodwin and his colleagues (1969) conducted a repeated measures experiment on the effects of alcohol on memory. They were interested in why many of their patients who were heavy drinkers and who hid alcohol or money when intoxicated were often unable to remember where it was hidden once they were sober. On becoming intoxicated again they tended to remember where the items were hidden. So they asked male volunteers to perform various memory tasks that involved learning and recalling words while either sober or under the effect of alcohol (well in excess of BAC 0.05). They found that participants who were intoxicated when learning and during recall performed almost as well as participants who had been sober on both occasions. Their results led them to conclude that 'learning which the subject acquires while he is intoxicated may be more available to him while he is intoxicated than when he is sober'.

The findings led to a variety of follow-up studies by other researchers. Many found that the effect of alcohol on memory could be generalised to other physiological states. For example, research studies have found that when participants learn information while under the influence of other substances or drugs such as caffeine, nicotine or marijuana, they tend to recall the information *better* when they are again under the influence of the same substance than when they are not under its influence (Baddeley, 1990; Roediger, 1992).

It seems that consuming certain substances can produce an internal state with unique psychological and physiological characteristics, aspects of which may become encoded with new memories. At a later point, the same internal state can provide additional retrieval cues that assist recovery of information from memory.

Thus *state dependent retrieval* involves better recall of information when the physiological and/or psychological states of learning and retrieval match. Does this mean that substances or drugs such as alcohol and marijuana *improve* memory? Absolutely not — they actually impair memory, as they interfere with encoding. For instance, Goodwin also found that participants who were intoxicated when learning and sober at recall performed the worst.

Your mood also provides state dependent retrieval cues. Mood is an emotional state and we seem to associate good or bad events with their accompanying emotional state. Thus, the emotional state becomes a retrieval cue when we feel good or bad again because it can trigger memories that are consistent with the mood. More specifically, some memories of events can become mood dependent when associated with particular moods, particularly moods involving strong emotions. In such cases, details of the events will tend to be retrieved more quickly and remembered better at a later date when we are in the same or a similar mood (Bower, 1981; Eich, 1995).

Retrieval failure involving context- or state-dependent cues is a widely described and comprehensive theory of forgetting based on substantial research evidence, but it does not account for all forgetting and therefore has limitations. For example, retrieval failure does not explain forgetting that may be due to:

- failure to access certain anxiety-laden memories (e.g., these experiences may be repressed and 'unconsciously' blocked from entering conscious awareness because of the upset or distress they cause)
- disrupted or lost memories as a consequence of brain trauma (e.g. brain injury) or a neurodegenerative disease (e.g. Alzheimer's disease)
- memories interfering with one another due to the similarity of information being retrieved.

It is also suggested that a limitation of retrieval theory is that it does not account for forgetting due to ineffective encoding during memory formation. However, in such cases, the information is never stored in LTM in the first place so it is not available to be forgotten.

Figure 7.29 What is learned in one state (such as when very sad) may be more easily retrieved when in the same state.

BOX 7.9 Tip-of-the-tongue phenomenon

You have probably experienced the feeling of trying to recall a person's name, or the name of a place or an object, that you're sure you know. You are certain you are just on the verge of remembering but can't quite recall the information right then. You know that you know the answer and can almost, but not quite, bring it forth. Psychologists refer to this as a tip-of-the-tongue event.

Tip-of-the-tongue (*TOT*) is a state, or 'feeling', that occurs when you are aware of knowing something, and confident you will eventually remember it, but you are not able to retrieve it from memory at that time. When the sought-after information is eventually remembered, it tends to occur suddenly, seeming to 'pop' out of a memory, often when you are not consciously thinking about it.

When we experience TOT, we can usually remember certain features of the sought-after item in memory, but not all the features. For example, when trying to recall a specific word, we seem to have some information about the word we are searching for even though we cannot actually state it. Sometimes we can tell how many syllables it has, the beginning and ending letters, or what it rhymes with. But we cannot say the entire word. We can often confidently eliminate words that are incorrect because they don't have the proper sound or length. These observations suggest that TOT involves a *partial retrieval process* in which bits of information can act as retrieval cues for the required information, helping to 'home in' on this information.

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One of the earliest investigations of the TOT state was conducted by American psychologists Roger Brown and David McNeil (1966). They used a simple technique for producing the TOT state in their research participants. The technique was to give participants dictionary definitions of uncommon objects and ask for the name of the defined object, such as:

> *a small boat used in shallow water in the Orient that is rowed from behind using a single oar.*

Attempts to recall this name will produce a TOT state in many people. Brown and McNeil were not interested in people who knew and could immediately recall the correct answer. Neither were they interested in cases in which the participant had no idea of the correct name. Their interest was to re-create the TOT state and analyse attempts by participants to recall the name during TOT.

The participants experiencing TOT were usually able to recall some information about the name ('It starts with s' or 'It sounds like Siam'), or recall a word related to the name ('It looks like a junk'), even though they usually knew a related word was not the one they were trying to retrieve. And then moments later, for some participants, the word would 'pop' into memory, indicating that it was there all the time but could just not be retrieved at that moment.

It is possible that all information stored in LTM is still there, but just cannot be retrieved until the right cue is used to call it out of storage. For instance, both phonetic (the sound of the word) and semantic (the meaning of the word) features of a word can assist its retrieval. Through remembering such features, you will probably recall the word that has caused you so much frustration (Lahey, 1992). Interestingly, it has been found that people are often able to tell beforehand if they are likely to remember something (Nelson, 1987).

The occurrence of TOT has also been explained in biological terms, taking account of how memory is stored in the brain. For example, the storage of a specific memory can involve a number of different locations, and for the complete memory to be retrieved, each of these locations must be accessed. Therefore, it has been proposed that retrieval failure occurs because we have accessed only one or two of the locations, resulting in retrieval of only part of the entire memory.

Figure 7.30 The boat to be named in the Brown and McNeil (1966) experiment was a *sampan.*

LEARNING ACTIVITY 7.17

Review questions

1. (a) Define the meaning of forgetting.
   (b) Explain whether sensory memory and STM are subject to forgetting.
2. Define the meaning of retrieval cue with reference to an example of one you have recently used.
3. What is retrieval failure theory?
4. Explain the difference between context dependent and state dependent retrieval cues with reference to relevant examples.
5. Which type of retrieval cue best explains the greater ease of recalling happy rather than sad prior experiences when feeling happy?
6. Jasmine can't remember where she left her sunglasses. She systematically retraces where she has been in the time up to when she lost them to determine all the possible places where her sunglasses might be located. Which type of retrieval cue is Jasmine reliant on?
7. A rat learns the shortest route through a maze when under the influence of an anti-anxiety drug. When tested the next day without the drug, it is apparent that the rat has forgotten the shortest route. However, when given the drug again the next day, the rat immediately uses the shortest route when placed in the maze. The rat demonstrated _____ dependent retrieval.
8. Give an example of an everyday life situation involving the use of both context and state dependent cues to retrieve a memory.
9. Explain how context and state dependent cues can improve or enhance retrieval of explicit and implicit memories. For each type of cue, give two relevant examples linked to memory improvement.
10. What are two limitations of retrieval failure theory as an explanation of forgetting?

Maintenance and elaborative rehearsal

Information can be kept in STM (or 'working memory') for longer than the usual maximum of about 18 to 20 seconds if it is rehearsed in some way. In the study of memory, **rehearsal** is the process of consciously manipulating information to keep it in STM, to transfer it to LTM or to aid storage and retrieval. The two main types of rehearsal are called maintenance rehearsal and elaborative rehearsal.

Maintenance rehearsal

Maintenance rehearsal involves repeating the information being remembered over and over again so that it can be retained (or 'maintained') in STM. When you hear something for the first time and simply 'go over and over it' so that you don't forget it, you are using maintenance rehearsal.

Maintenance rehearsal not only involves simple *repetition* of words or auditory information such as the sounds of words, but it can also involve visual or spatial information such as images or 'mental maps'. When the information involves words and sounds, maintenance rehearsal can occur *vocally*, by repeating the information aloud over and over again, or *sub-vocally*, by silently repeating the words or a tune 'in your head'.

When the information is visual and/or spatial, maintenance rehearsal involves using something like an 'inner eye' to maintain the image of the object or scene in STM for a period after you first see it. Whether maintenance rehearsal involves words or auditory, visual or spatial information, provided it is not interrupted, the information can be retained indefinitely in STM.

Although maintenance rehearsal can be very effective for retaining information in STM, it does not always lead to long-term retention. In one experiment, participants were asked to memorise pairs of numbers; for example, 295–417, 381–620, 749–836. After the presentation of each pair, participants were told to repeat one word per second, out loud, to prevent rehearsal of the numbers. However, unexpectedly for the participants, the memory test given at the end of the paired number presentations involved recalling the words they thought were distractions, and not the numbers. The results showed that merely repeating the words did not guarantee retention. Furthermore, the number of times a person rehearsed a word — four, eight or 12 times — had no effect on the ability to recall that word (Rundas, 1977).

Nonetheless, maintenance rehearsal is a useful technique for coping with the limited duration of STM. A limitation of maintenance rehearsal, however, is that when information is continually renewed and therefore retained in STM through the rehearsal process, the amount of new information that can enter is restricted because of the limited storage capacity of STM.

To transfer information to LTM, where it may be stored indefinitely, it is more effective to use elaborative rehearsal as the information will be more 'deeply' processed (and encoded).

Figure 7.31 When a teacher gives verbal feedback on coursework during a lesson, maintenance rehearsal can be used to keep the information in STM until the advice can be written down or implemented.

Elaborative rehearsal

Unlike maintenance rehearsal, elaborative rehearsal involves focusing on the meaning of the information. More specifically, **elaborative rehearsal** is the process of linking new information in a meaningful way with other new information or information already stored in LTM to aid in its storage and future retrieval from LTM. For example, rather than 'memorising' a definition of memory for the end-of-year exam by repeating the definition aloud or writing it down over and over again, your ability to recall an appropriate definition will be more enhanced if you link it to learning and think about the nature of its relationship to learning, biologically and psychologically. You might note that learning comes before memory (as does the *l* in learning and the *m* for memory), or that memory is an expression of learning. You might also think about key processes of memory such as encoding, storage and retrieval. You might analyse a personal example of when you successfully and unsuccessfully stored and retrieved information that was important. The more you elaborate, or 'flesh out', the various features of the concept and link it to your own experience, the more likely you are to remember it.

When we relate new information to personal experiences and our personal situation in some way, we are more likely to remember it. This is called the *self-reference effect.* For example, if the word 'win' is on a list of words to remember, you might link it to the last time you won something, or if the word 'cook' appears, you might link it to the last time you cooked a meal (Matlin, 2002; Rogers, Kniper & Kirker, 1977).

Elaborative rehearsal is a more active and effortful process than maintenance rehearsal. It is also more effective than maintenance rehearsal for remembering new information because it helps to ensure that information is encoded well. Consequently, it is much better to process material that you want to store for long periods in a meaningful way, rather than memorise it in a meaningless, repetitive, rote way. Why is elaborative rehearsal a more effective way of encoding new information than maintenance rehearsal?

The most common explanation emphasises that elaborative rehearsal involves a deeper level of information-processing that enhances encoding and consolidation for long-term storage. Depending on the strategy used, it may also help enhance organisation of information in LTM in a way that aids retrieval. For example, memory aids ('mnemonics') and ways of minimising forgetting described in Box 7.11 on page 415 typically involve some kind of elaborative rehearsal that simplifies organisation, reduces memory load and/or provides retrieval cues, all of which can aid retrieval.

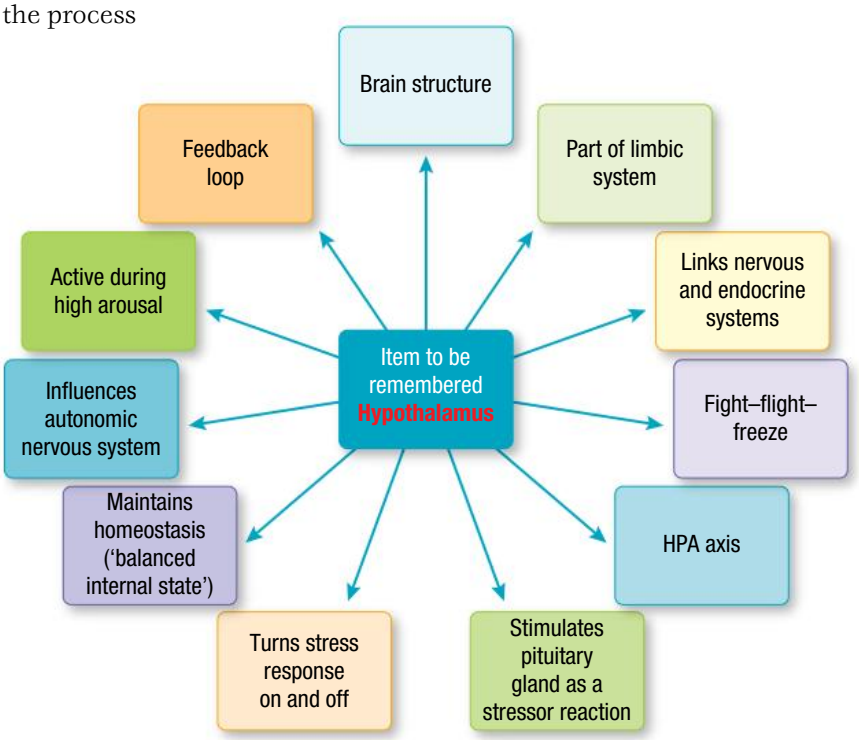

Figure 7.32 Elaborative rehearsal enables more effective encoding, thereby enhancing LTM storage and retrieval. The more associations (and therefore neural connections or activation of connections) made between new information and information already in memory, the more likely the new information will be retained and accessed.

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Practical activities
- Self-referencing effect
- Meaningfulness and memory

BOX 7.10 Is cramming effective when studying?

Some students believe that if they cram (doing the majority of their revision the night before a test or exam) the information will be available to them when they need it the next day.

Some believe that one or two extended study sessions over a very short time (called *massed rehearsal*) is more effective than spacing out the study sessions over an extended period (called *spaced* or *distributed rehearsal*).

However, research findings suggest that if long-term retention of information is required, spaced rehearsal tends to be a more effective strategy.

In one study, researchers tested the long-term effects of spaced rehearsal on the retention of 300 foreign-language words. They compared the retention of information in three different conditions, when study sessions were spaced at intervals of 14 days, 28 days and 56 days. Participants were tested on retention of information subsequently each year for five years.

The results indicated that longer intervals between rehearsal sessions resulted in greater retention of the learned information one, two, three and five years after the last training session (Bahrick et al., 1993). These findings have generally been replicated by other studies that used different material and memory tasks (Benjamin & Tullis, 2010; Toppino & Schneider, 1999).

The results have important implications for students, especially those who want or need to retain information learned for a longer time.

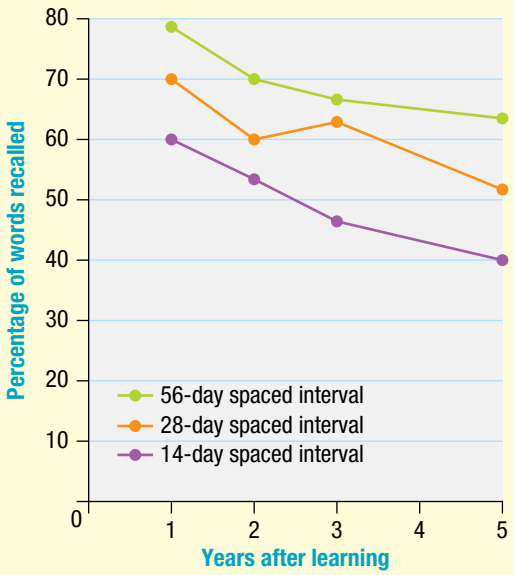

Figure 7.33 Results from the Bahrick et al. (1993) study on the impact of spaced learning on retention over five years. Longer intervals between rehearsal sessions resulted in greater retention of the learned information one, two, three and five years after the last training session.

Source: Adapted from Bahrick, et al., (1993). Maintenance of foreign language vocabulary and the spacing effect. *Psychological Science, 4*(5), 316–321.

LEARNING ACTIVITY 7.18

Review questions

1. Describe two key roles of rehearsal in memory.
2. (a) Define the terms maintenance rehearsal and elaborative rehearsal.
   (b) Identify two important characteristics that distinguish these two forms of rehearsal.
3. Explain why elaborative rehearsal is more effective than maintenance rehearsal in enhancing retention of information in LTM.
4. Describe three different ways to elaborate information.
5. Apply your understanding of maintenance and elaborative rehearsal to respond to the following question a teacher was asked by a student: 'Is it best to read my notes over and over again, or is there something else I could do to study for the exam?' Give two reasons for your answer, ensuring you refer to advantages and limitations of each type of rehearsal.

LEARNING ACTIVITY 7.19

Using elaborative rehearsal for deep processing

Choose one of the concepts below and draw a diagram to show how it could be processed deeply using elaborative rehearsal so that it is more likely to be retained in LTM. Figure 7.32 on page 410 may be used as a model. Alternatively, complete the task for a brain region or structure involved in memory, such as the hippocampus or amygdala.

- independent variable
- sensory memory
- dependent variable
- iconic memory
- extraneous variable
- confounding variable
- echoic memory
- reconstruction
- research hypothesis
- encoding
- maintenance rehearsal
- elaborative rehearsal
- short-term memory

Serial position effect

Considerable research evidence supports the view that memory has at least two distinguishable storage components or systems, most commonly referred to as long-term memory and short-term memory (or working memory). Some of this evidence comes from studies of patients with amnesia or brain damage and some from observations of the serial position effect.

To test whether STM is a component of memory that is distinguishable and possibly separate from LTM, psychologists have conducted experiments on memory for lists of words, numbers, images and various other types of information. Typically, participants are presented with a list of about 15 words for a short time such as 30 seconds. Then, participants are required to recall as many words as possible in any order using *free recall* rather than *serial recall* (the order the words were presented in).

These types of studies usually obtain similar results. The words in the list that are more likely to be recalled seem to depend on their serial position; that is, where they are located in the list. This finding is called the serial position effect.

The **serial position effect** is a research finding that free recall is better for items at the end and beginning of the list than for items in the middle of the list. More specifically, the recall of items tends to be best for items at the end, and then the beginning, and worst for items around the middle. When retention of all the items is plotted on a graph, the result is a U-shaped curve, like that shown in Figure 7.34 below.

The **primacy effect** describes superior recall of items at the *beginning* of a list. The **recency effect** describes superior recall of items at the *end* of a list. Together with the relatively low recall of items from the middle of the list, this pattern makes up the serial position effect.

Experiments testing the serial position effect with different kinds of information, such as numbers or even sketches of objects, have consistently found a similar U-shaped curve with a strong recency effect (Buchner, Irmen & Erdfelder, 1996; Page & Norris, 1998; Tremblay & Jones, 1998).

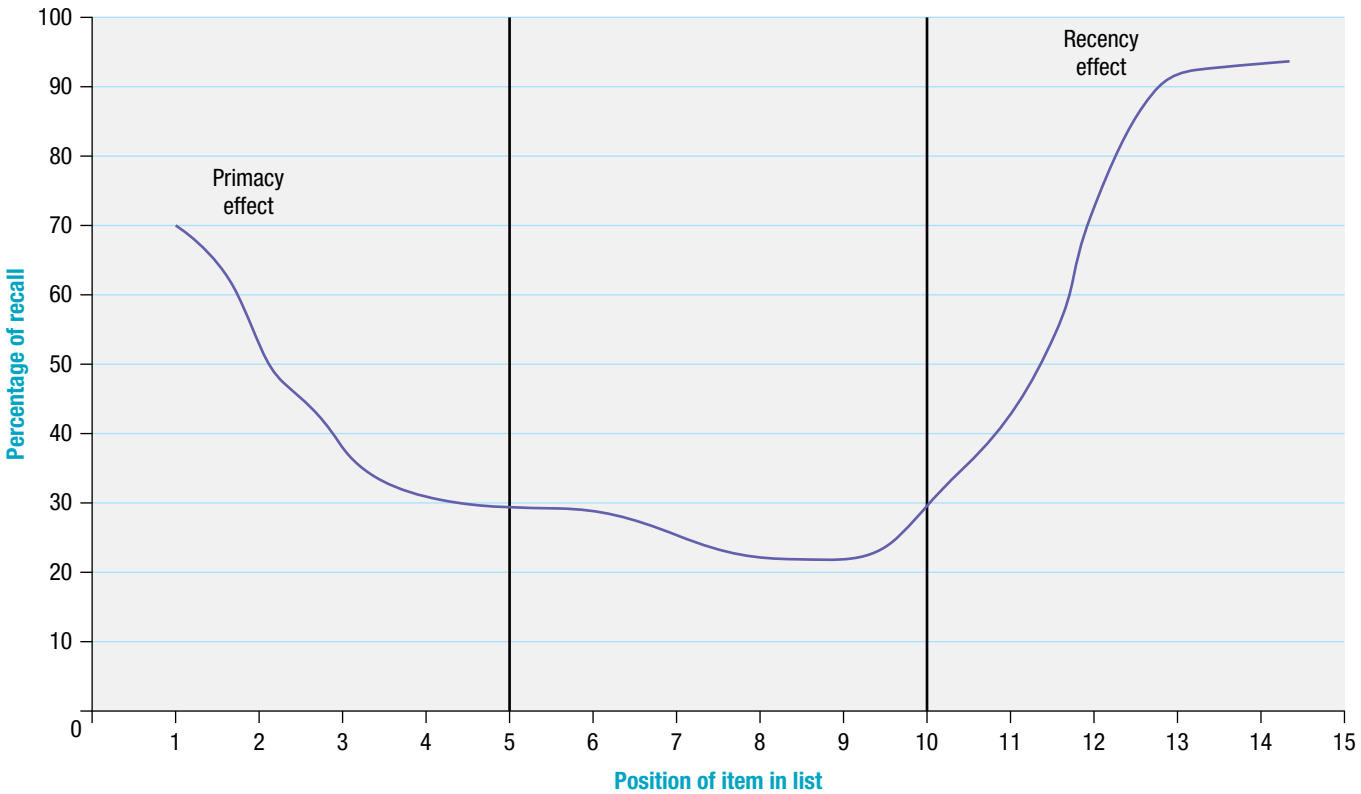

Figure 7.34 The serial position effect shows that free recall is better for items presented at the end and the beginning of a list than for items in the middle of the list. Items from the end of the list are *most* likely to be recalled, and those from the middle of the list are *least* likely to be recalled.

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Practical activity
Serial position effect

Figure 7.35 Prince Harry is more likely to remember the names of the people he has just met (recency effect) and those of the people he first met (primacy effect) than those in between.

What causes the serial position effect? A widely accepted explanation is in terms of differences between STM and LTM. Many researchers have argued that, if recall occurs *immediately* after the list is learned, the last few items are remembered best because they are still in STM. The first few items in a list are remembered well probably because they received more attention and rehearsal than other items and are therefore transferred into LTM. Items around the middle of a list are presented too late to be adequately rehearsed and transferred into LTM and too early to be held in STM without rehearsal, so they are more likely to be forgotten (unless they are distinctive in some way). Many experimental investigations provide evidence in support of an explanation that distinguishes between STM and LTM.

One of the best-known studies was reported by American psychologists Murray Glanzer and Anita Cunitz in 1966. They conducted an experiment in which participants were asked to memorise a list of 15 words. As shown in Figure 7.36, the serial position effect was clearly found when the participants were asked to recall the list immediately after learning it. Recall was better for items at both the beginning and the end of the list. But when the participants were asked to recall the list after a delay of 30 seconds — beyond the limits of STM — the serial position effect was not entirely observed.

According to Glanzer and Cunitz (1966), recall was better at the beginning of the list, probably because those items were rehearsed more and were therefore more likely to have been stored in LTM. However, as for words at the end of the list, where no recency effect was evident, recall was not as good, probably because the participants could not hold the last items in STM long enough.

The findings of numerous research studies on the serial position effect have not only enabled psychologists to more confidently identify LTM and STM (or working memory) as *different* components, systems or sub-systems when referring to the *structure* of memory, but also to describe LTM and STM as *interacting* when referring to their functions in memory.

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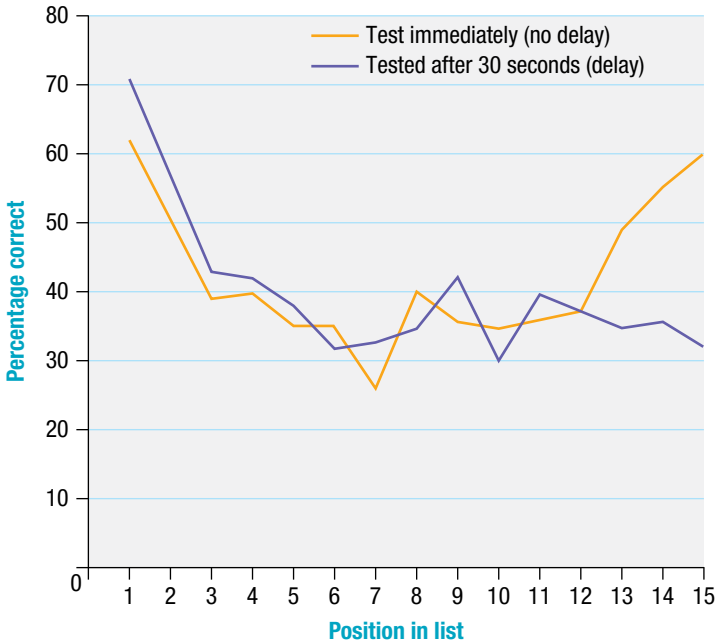


Figure 7.36 The serial position effect is clearly evident when testing recall immediately after learning a list of items (i.e. with no time delay). However, when recall is delayed for 30 seconds, participants tend to forget the latter items and no recency effect is evident.

LEARNING ACTIVITY 7.20

Review questions

1. (a) Describe the serial position effect.
(b) What are the primacy and recency effects? Why do they occur?
(c) Why are items in the middle of a serial list recalled least?

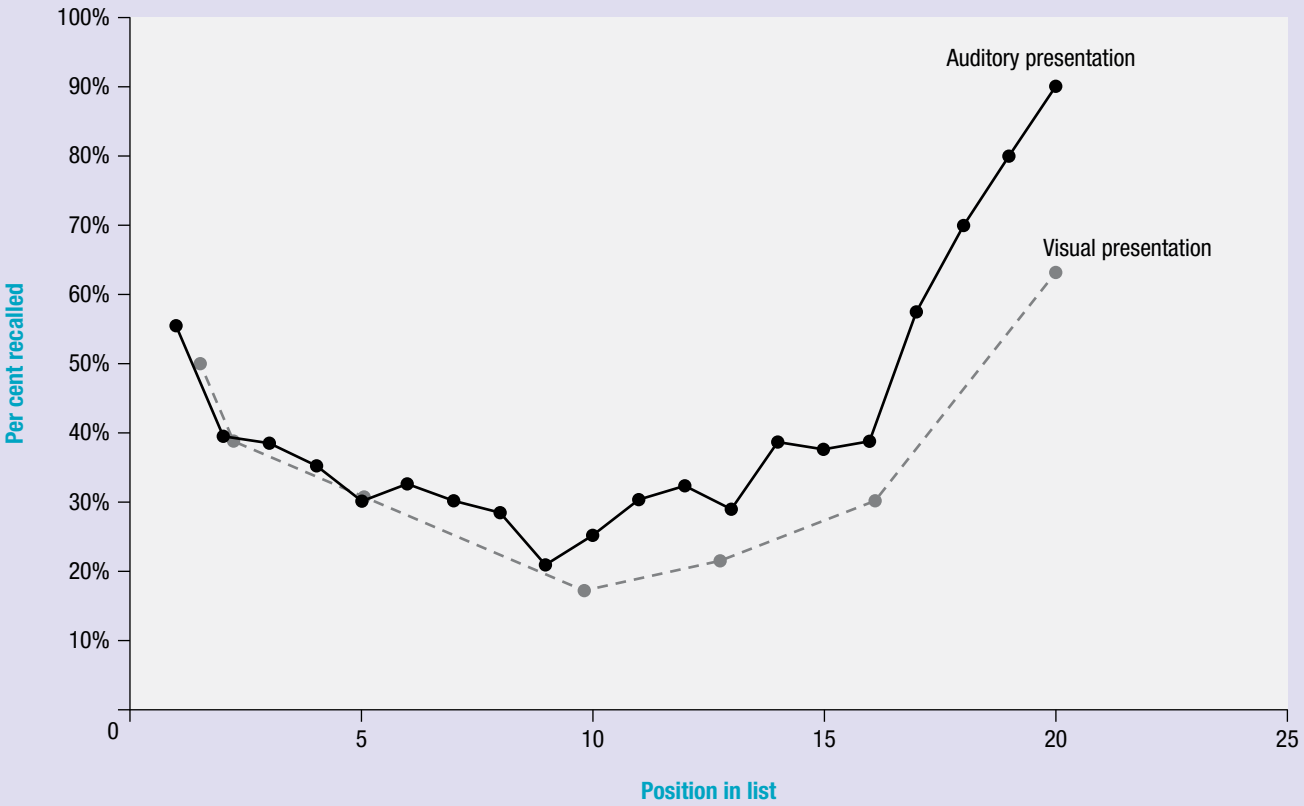
2. What implications does the serial position effect have for:
(a) a prosecutor or barrister presenting their case to a jury?
(b) three politicians before an election, each delivering a brief policy speech one after the other on television?
(c) a potential employee deciding on their interview time when allowed to choose from an interview schedule?

3. An advertiser will present a 30-second commercial to promote a new drug for headache relief. When in the commercial should the advertiser present the positive information (such as the name of the drug and its benefits) and negative information (such as age restrictions and potential side effects)? Explain with reference to the serial position effect.

4. You have just begun casual work at the local supermarket. On your first day you are introduced to 15 other employees, one after the other. According to the serial position effect, which names are you most likely to remember and why?

5. Draw two conclusions from the results shown in the graph below.

6. Suggest a way of getting around the serial position effect when required to learn a list of information.



Based on Beaman, P. C., & Morton, J. (2000). The effects of rime on auditory recency and the suffix effect, *Journal of Cognitive Psychology, 12*(2), 223–242.

LEARNING ACTIVITY 7.21

Reflection

What properties of memory make it highly functional or useful, what properties make it prone to error or unreliable and what properties make it both functional and prone to error?

BOX 7.11 Minimising forgetting

Some day we might be able to effortlessly encode, store and retrieve information by taking some kind of 'memory pill', or by hooking up through a direct electrical link from our brains to a mobile phone app or some other device. In the meantime, however, those of us who want to improve our memories must rely on specific mental strategies.

Of course, some things are very easy to remember. If you arrived at school one day and saw the principal sitting on top of the flagpole you would not have to rehearse this information to remember it. Observing such an unusual event would be enough to ensure that the scene remained with you always. Similarly, you would probably easily learn and remember the name of the next prime minister of Australia when they were elected. But often we must learn and remember information that is much more difficult. This requires conscious effort. Mere exposure, even very frequent exposure, to information is often insufficient to produce efficient retrieval.

To make sure that information goes beyond sensory memory, attention must be given to it. It must also be organised and integrated into the information already stored in LTM. However, while this may sound like a tedious process, improving or enhancing your memory is not very difficult.

Techniques for improving or enhancing memory are known as *mnemonics* (from the Greek word Mnemosyne, the goddess of memory). They can be as basic as an acronym or complicated strategies that themselves take considerable time to learn. Many of these techniques were developed in ancient times by scholars, politicians, orators, actors and priests when written records were scarce or non-existent. It is only in relatively recent times that psychologists have examined them and recognised their value in improving memory.

Mnemonic techniques use information that is already stored in LTM. The devices do not simplify information; they actually make it more *elaborate*. More information is stored, not less. However, it is believed that the additional information tends to make the material easier to locate and retrieve because it has enhanced organisation in LTM. Mnemonic devices tend to organise new information into a cohesive whole, so that retrieval of part of the information generally assists retrieval of the rest of it. These facts suggest that the ease or difficulty with which we learn new information depends not on *how much* we must learn, but on *how well it fits with what we already know*. Generally, the better it fits, the easier it is to retrieve.

Many mnemonic techniques emphasise the logical organisation of information to be remembered, and use a particular structure to facilitate this; for example, consider rhymes, acronyms acrostics and narrative chaining.

Rhymes

As with acronyms, you are also likely to have used rhymes as a way of improving memory. A rhyme is a phrase or string of words (such as a jingle), often with an emphasis on similar sounding key words. For example, the rhyme '*i before e, except after c*' assists memory for the correct spelling of words containing *ie* and *ei*, and the rhyme '*Big fat Italy kicked poor Sicily into the Mediterranean Sea*' assists memory for a specific geographic location.

These types of rhymes organise information by associating the information with a particular rhythm (sound) and with rhyming words. If we make an error in using a rhyme mnemonic, the rhythm is broken or the rhyme is ruined or both. Consequently, we immediately know an error in retrieval has occurred.

Another rhyme, used to remember the number of days in each month, is:

> *Thirty days hath September, April, June and November; all the rest have thirty-one, except February alone, which has but twenty-eight days clear, and twenty-nine in each leap year.*

Some people, however, find this rhyme difficult to remember. There are many different ways to remember the same information. You need to find a mnemonic that works for you.

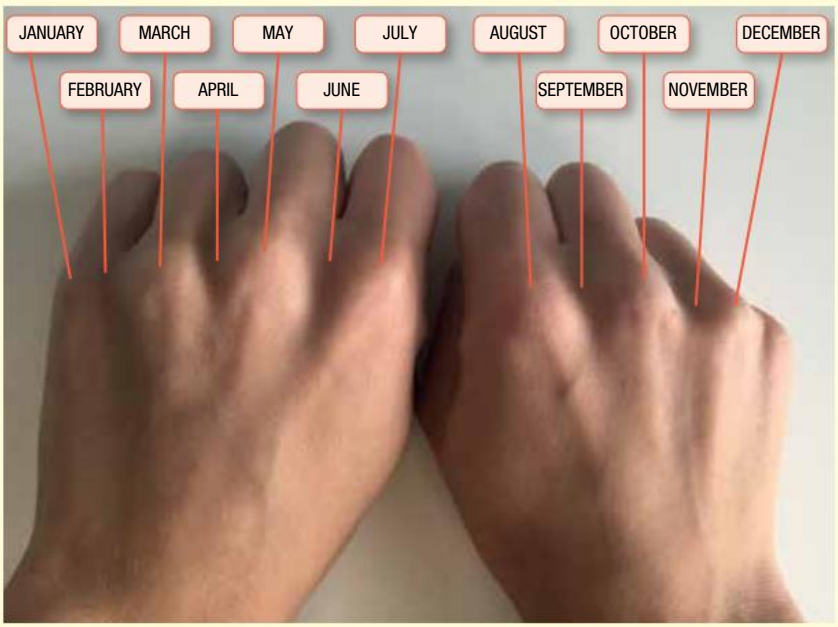


Figure 7.37 This mnemonic helps remember which months have 31 days. Hold your fists in front of you, side by side, and count from left. The longer months will fall on the knuckles and the shorter months in the hollows.

(continued)

(continued from previous page)

Acronyms

When using acronyms, organisation of information is important. Acronyms are pronounceable words formed from the first letters of a sequence of words. The acronym doesn't have to be a real word. An acronym is often a pronounceable abbreviation. The letters of the abbreviation act as a retrieval cue for recall of more complex material.

Acronyms are formed using a type of chunking procedure. ANZAC, for example, is an abbreviation of 'Australian and New Zealand Army Corps', and EFTPOS is an abbreviation of 'electronic funds transfer (at the) point of sale'. For both examples, the abbreviation is a pronounceable word. Similarly, a large number of organisations are known by their acronyms rather than by their names: UNESCO, NATO, SEATO and so on. Acronyms can also be used for remembering other types of information. For example, the colours in the rainbow or visual colour spectrum can be remembered by relating them to the pronounceable name 'Roy G. Biv' (red, orange, yellow, green, blue, indigo, violet).

Acrostics

Acrostics involve making verbal associations for items to be remembered by constructing phrases or sentences using the first letters of the information to be remembered. You may have used this method if you recall the names of the original planets (in order from the sun) by linking them to a phrase such as 'my very energetic mother just sits up near pop' (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto). Similarly, in music classes you may have learned the phrase 'every good boy deserves fruit'. The first letters of these words are the same as the names of the musical notes on the lines of a staff (E, G, B, D, F).

Acrostics can also be useful when you have to remember information in sequential order, such as sets of points for an essay or lists of information. For example, if you wanted to remember several reasons for the colonisation of Australia you could choose key words (e.g. *convicts*, *staple*, *imperialism*) and organise them into a sentence. You could then recall the sentence and each word in the sentence would act as a retrieval cue for the recall of specific related information.

Narrative chaining

Narrative chaining involves linking otherwise unrelated items to one another ('chaining') to form a meaningful sequence or story ('narrative'). For example, consider all the following words that have no apparent relationship:

> bird, costume, letterbox, head, river, nurse, theatre, wax, eyelid, fireplace

Research studies have found that you will be far more likely to remember all of them if you linked them in a story such as the following:

> A man dressed in a *bird costume* and wearing a *letterbox* on his *head* was seen leaping into the *river*. A *nurse* ran out of a nearby *theatre* and applied *wax* to his *eyelid*, but her efforts were in vain. He died and was tossed into the *fireplace* (Bower & Clark, 1969).

In one experiment conducted by Elizabeth Loftus (1980), participants who used narrative chaining remembered six times more information than participants who learned by simply repeating the words to themselves. These results provide strong evidence that using a technique that adds *organisation* and *meaningfulness* to otherwise meaningless material is a form of elaborative rehearsal that will improve retrieval. Narrative chaining is a particularly useful mnemonic technique when you want to remember information in a particular order. However, a narrative will not be helpful if it hangs together so loosely that you cannot remember the story (Matlin, 2002).

Figure 7.38 Memory when studying for an exam can be improved or enhanced through the use of mnemonics.

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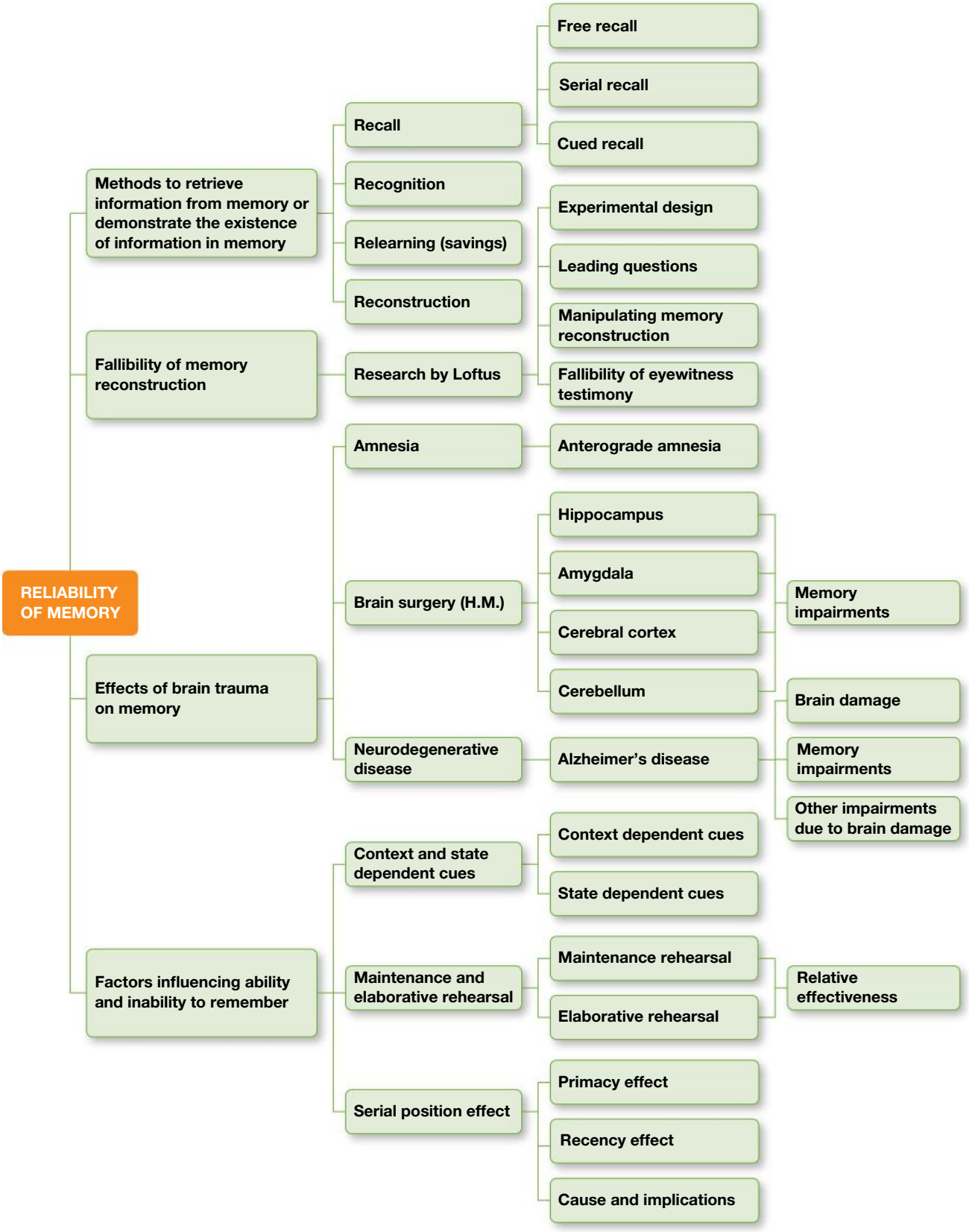
Practical activity
Comparing imagery techniques

CHAPTER SUMMARY



KEY TERMS

Alzheimer's disease p. 397
amnesia p. 385
amygdala p. 392
anterograde amnesia p. 385
beta amyloid plaque p. 398
brain injury p. 385
brain trauma p. 385
cerebral cortex p. 394
cerebellum p. 395
context dependent cue p. 404
context-dependent retrieval p. 404
cued recall p. 373
dementia p. 397
elaborative rehearsal p. 410
eye-witness testimony p. 379
forgetting p. 403
free recall p. 373
hippocampus p. 390
leading question p. 379
maintenance rehearsal p. 409
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reconstruction (of memory) p. 377
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retrieval failure p. 403
retrieval method p. 403
savings (relearning) calculation p. 375
serial position effect p. 412
serial recall p. 373
state dependent cue p. 406
state-dependent retrieval p. 406
tau p. 398

LEARNING CHECKLIST

Complete the self-assessment checklist below, using ticks and crosses to indicate your understanding of this chapter's key knowledge (a) before and (b) after you attempt the chapter test. Use the 'Comments' column to add notes about your understanding.

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Word copy of checklist

Key knowledge I need to know about reliability of memory	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
Methods to retrieve information from memory or demonstrate the existence of information in memory			
Recall			
• free recall			
• serial recall			
• cued recall			
Recognition			
Relearning (savings)			
Reconstruction			
Fallibility of memory reconstruction			
Research by Loftus			
• experimental design			
• leading questions			
• manipulating memory reconstruction			
• fallibility of eye-witness testimony			

(continued)

Key knowledge I need to know about reliability of memory	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
Effects of brain trauma on memory			
Amnesia			
• anterograde amnesia			
Brain surgery (H.M.)			
• Memory impairments associated with damage to:			
– hippocampus			
– amygdala			
– cerebral cortex			
– cerebellum			
Neurogenerative disease			
• Dementia			
– Alzheimer's disease (AD)			
– Brain damage associated with AD			
– Memory impairments associated with AD			
Factors influencing ability and inability to remember			
Retrieval cue			
Context and state dependent cues			
• Context dependent cues			
• State dependent cues			
Maintenance and elaborative rehearsal			
• Maintenance rehearsal			
• Elaborative rehearsal			
Serial position effect			
• Primacy effect			
• Recency effect			
• Cause and implications			

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Unit 3 > Area of study 2 > Topic 6

Concept screens and practice questions

CHAPTER 7 TEST

SECTION A — Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Question 1

Anything that assists recovery of information stored in LTM is called a _____ cue.

A. retrieval
B. recovery
C. constructive
D. reconstruction

Question 2

Which retrieval method will most effectively demonstrate the existence of information in memory?

A. recall
B. relearning
C. reconstruction
D. recognition

Question 3

When the recognition method is used, the required information

A. is reproduced in no particular order.
B. acts as a retrieval cue.
C. is unavailable for retrieval unless it can be seen.
D. must be selected from among incorrect alternatives.

Question 4

A neurodegenerative disease is best described as a

A. brain trauma.
B. brain injury.
C. brain-related disorder associated with older people.
D. progressive decline in the structure and/or function of brain neurons.

Question 5

Anterograde amnesia involves loss of memory of events occurring

A. backward in time.
B. before brain trauma.
C. after brain trauma.
D. before or after brain trauma.

Question 6

Someone with anterograde amnesia involving only semantic and episodic memories probably experienced brain trauma that impacted at the

A. synapse.
B. hippocampus.
C. amygdala.
D. cerebellum.

Question 7

Which structure is primarily involved in memory formation of classically conditioned fear responses?

A. cerebellum
B. hippocampus
C. cerebral cortex
D. amygdala

Question 8

Memory reconstruction typically involves

A. re-creating a memory using all accessible information in long-term memory.
B. building up a new memory using information planted in leading questions.
C. re-creating a distorted memory that has been manipulated by a researcher.
D. building up an accurate account of what was actually experienced at some time in the past.

Question 9

On recovering consciousness, a cyclist who was knocked unconscious in an accident is unable to recall events that occurred in the half hour or so before the accident.

How would his amnesia be explained by the consolidation process?

A. lack of time for consolidation of sensory information in short-term memory
B. lack of time for completion of structural changes in neurons and synapses
C. lack of attention during the half hour before the brain trauma
D. lack of processing by the hippocampus in the parietal lobe

Question 10

Blake learns to play poker at his friend's house. When he gets home, he decides to teach his younger sister, but can't recall whether 'three of a kind' is a better hand than a 'full house'. When he returns to his friend's house a few days later and plays poker again, he recalls with ease that a 'full house' beats a 'three of a kind'.

A probable explanation for Blake's inability to recall the information at home is

A. source confusion.
B. context dependent memory.
C. lack of savings.
D. state dependent memory.

Question 11

The amygdala is located

A. in the medial lobe.
B. next to the hippocampus.
C. in the cerebral cortex.
D. next to the temporal medial lobe.

Question 12

Brain surgery resulting in severe damage to both amygdalae is unlikely to affect

A. retrieval of the details of an emotional memory such as where and when it was experienced.
B. acquisition of a conditioned fear response.
C. expression of a fight, flight or freeze reaction to a conditioned fear stimulus.
D. implicit, classically conditioned memory formation.

Question 13

Studies of animals and people with brain damage provide evidence that the _____ stores some relatively simple classically conditioned motor responses.

A. cerebellum
B. hippocampus
C. cerebral cortex
D. amygdala

Question 14

Forgetting as a result of retrieval failure usually occurs when

A. we fail to encode the to-be-remembered information.
B. we use an incorrect cue to locate and recover information.
C. the hippocampus is severely damaged.
D. the neural representation of a memory degenerates.

Question 15

Enhancing memory by weaving otherwise unrelated information into a meaningful event is an example of

A. context dependent memory.
B. maintenance rehearsal.
C. elaborative rehearsal.
D. the encoding specificity principle.

Question 16

Studies of patients with brain damage indicate that short-term memories are probably formed and stored in the

A. hippocampus.
B. amygdala.
C. cerebral cortex.
D. cerebellum.

Question 17

A professional cyclist falls off her bike on day one of the Great Victorian Bike Ride. She breaks various bones in her body and is very upset about not being able to continue in the race. However, she does not sustain significant brain trauma, as she was wearing protective headgear. Afterwards, she remembers very little about the events leading up to, during and following the accident. She eventually recovers and enters the Around Tasmania Bike Race. Again she has an accident on day one, breaks various bones in her body, gets upset, but doesn't suffer significant brain trauma. However, soon after falling, the events surrounding the fall in the Great Victorian Bike Ride come flooding back.

The cyclist's recovery of memory of the first fall is an example of the

A. memory consolidation process.
B. memory reconstruction process
C. context dependency of certain memories.
D. state dependency of certain memories.

Question 18

The serial position effect for superior recall of items at the end of a list is called the _____ effect.

A. recency
B. primacy
C. serial
D. recall

Question 19

Which of the following could serve as a state dependent retrieval cue?

A. sadness
B. a face
C. a sound
D. a location

Question 20

Which of the following memory processes is most likely to be experienced if there is damage to the frontal lobes?

A. reconsolidation
B. retrieval of explicit memories
C. retrieval of classically conditioned fear responses
D. expression of classically conditioned fear responses

SECTION B

Answer **all** questions in the spaces provided. Write using black or blue pen.

Question 1 (1 mark)

Which retrieval method is considered to be the most sensitive?

Question 2 (4 marks)

(a) What is Alzheimer's disease? 1 mark

(b) What type of long-term memory is primarily affected? 1 mark

(c) What is a possible biological or neurological explanation of the increasingly severe memory decline associated with the disease? 2 marks

Question 3 (2 marks)

Distinguish between the recall of an episodic memory using context dependent and state dependent retrieval cues.

Question 4 (5 marks)

(a) What is a distinguishing characteristic of a reconstructed memory following manipulation of memory, as proposed by Loftus? 1 mark

(b) Explain why the reconstruction of memories is evidence for the fallibility of memory, with reference to Loftus's research on the effect of leading questions on eye-witness testimony. 4 marks

Question 5 (3 marks)

Explain how the serial position effect provides evidence for the existence of separate short-term and long-term memory stores.

Question 6 (12 marks)

Patient A.B. had life-saving brain surgery to remove a malignant tumour that was aggressively spreading in the medial temporal lobe area. The surgeon removed the hippocampus in each hemisphere, along with areas of adjacent sub-cortical limbic system tissue and cortical tissue. The amygdala and cerebellum were left intact.

A.B. was subsequently found to have serious memory problems. These included:

- loss of memory for information and events experienced in the period leading up to the surgery, but only partial loss of episodic and semantic memories formed many years previously
- a 'working' short-term memory but loss of new episodic or semantic information unless maintained through rehearsal
- anterograde amnesia for episodic or semantic memories
- deficits in spatial awareness in new locations and some familiar places e.g. got lost very easily when in new or unfamiliar location (e.g. a hospital ward not previously visited) but not in familiar well-known locations (e.g. own home).

A.B. was found to have no loss of motor skills that have been well-learned over many years prior to the surgery, such as bicycle riding and golf putting. In addition, A.B. retained abilities to:

- acquire a conditioned fear response
- learn and retain simple conditioned reflex responses
- learn and retain more complex motor skills never previously experienced, such as mirror drawing and serving a table tennis ball (but unable to retain a memory of ever having participated in a training session).

(a) Explain why A.B.'s case provides evidence for the separation of explicit and implicit memories. 2 marks

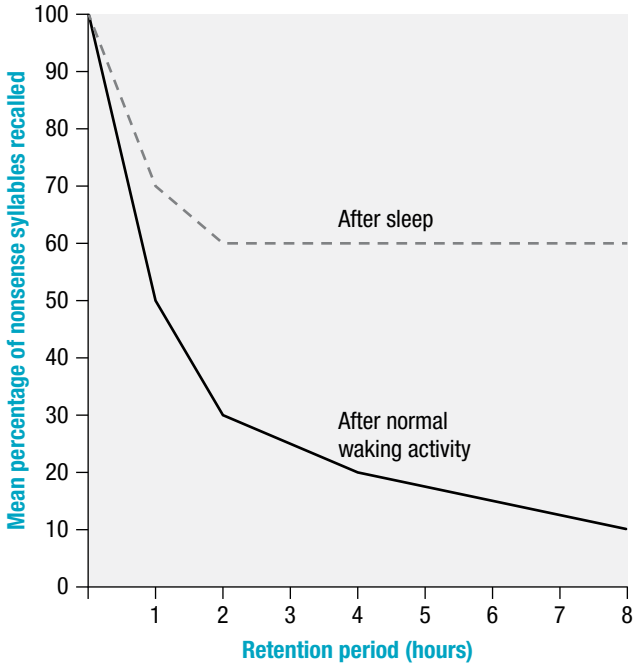
(b) With reference to A.B's brain surgery, abilities and inabilities, explain the likely roles of each of the following in the formation, storage and retrieval of short-term memory and specific types of long-term memory. 10 marks

(i) cerebral cortex

(ii) hippocampus

Question 7 (13 marks)

The graph below shows the results of a pioneering study conducted on sleep and memory. The researchers were interested in finding out whether it was better for recall of newly learned information to go to sleep immediately after learning.



Jenkins and Dallenbach (1924) had two groups of first-year psychology students at their university learn a list of nonsense syllables. Immediately after the learning, Group A participants were required to go to sleep, whereas Group B participants continued with their usual activities for 30 minutes before going to sleep. When tested for recall on the nonsense syllables at different times after awakening, it was found that retrieval was lower for Group B.

(a) Which data in the graph shows the results for Group B? Explain your answer. 2 marks

(b) Suggest a possible explanation of the results. 2 marks

(c) Formulate a research hypothesis of relevance to this particular experiment. 2 marks

(d) Identify the operationalised independent and dependent variables. 2 marks

independent variable:

dependent variable:

(e) Suggest two potential extraneous or confounding variables that may not have been adequately controlled and explain your choice of each variable. 3 marks

(f) Write a possible conclusion for the experiment, based on the results obtained. 2 marks

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The answers to the Section A multiple-choice questions are in the answer section at the end of this book and in eBookPLUS. The answers to the Section B questions are in eBookPLUS.

Unit 4

How is wellbeing developed and maintained?

AREA OF STUDY 1

How do levels of consciousness affect mental processes and behaviour?

CHAPTER 8 Nature of consciousness
CHAPTER 9 Sleep
CHAPTER 10 Sleep disturbances

AREA OF STUDY 2

What influences mental wellbeing?

CHAPTER 11 Mental health
CHAPTER 12 Mental disorder
CHAPTER 13 Specific phobia
CHAPTER 14 Maintenance of mental health

On completion of this unit, the student should be able to:

OUTCOME 1

- explain consciousness as a continuum, compare theories about the purpose and nature of sleep, and elaborate on the effects of sleep disruption on a person's functioning

OUTCOME 2

- explain the concepts of mental health and mental illness including influences of risk and protective factors, apply a biopsychosocial approach to explain the development and management of specific phobia, and explain the psychological basis of strategies that contribute to mental wellbeing.

Source: ©VCAA, VCE Psychology Study Design (June 2017 update), p. 33.

UNIT 4 KEY KNOWLEDGE

CHAPTER 8 **Nature of consciousness**	• consciousness as a psychological construct that varies along a continuum, broadly categorised into normal waking consciousness and altered states of consciousness (naturally occurring and induced) • the measurement of physiological responses to indicate different states of consciousness, including electroencephalograph (EEG), electromyograph (EMG), electro-oculograph (EOG) and other techniques to investigate consciousness (measurement of speed and accuracy on cognitive tasks, subjective reporting of consciousness, including sleep diaries, and video monitoring) • changes in a person's psychological state due to levels of awareness, controlled and automatic processes, content limitations, perceptual and cognitive distortions, emotional awareness, self-control and time orientation • changes in levels of alertness as indicated by brain waves patterns (beta, alpha, theta, delta) due to drug-induced altered states of consciousness (stimulants and depressants) • the effects on consciousness (cognition, concentration and mood) of one night of full sleep deprivation as a comparison with effects of legal blood-alcohol concentrations.
CHAPTER 9 **Sleep**	• sleep as a regular and naturally occurring altered state of consciousness that follows a circadian rhythm and involves the ultradian rhythms of REM and NREM Stages 1–4 sleep, excluding corresponding brain wave patterns and physiological responses for each stage • theories of the purpose and function of sleep (REM and NREM) including restoration theory and evolutionary (circadian) theory • the differences in sleep across the lifespan and how these can be explained with reference to the total amount of sleep and changes in a typical pattern of sleep (proportion of REM and NREM).
CHAPTER 10 **Sleep disturbances**	• changes to a person's sleep-wake cycle and susceptibility to experiencing a circadian phase disorder, including sleep-wake shifts in adolescence, shift work and jet lag • the effects of partial sleep deprivation (inadequate sleep either in quantity or quality) on a person's affective (amplified emotional responses), behavioural and cognitive functioning • the distinction between dyssomnias (including sleep-onset insomnia) and parasomnias (including sleep walking) with reference to the effects on a person's sleep-wake cycle • the interventions to treat sleep disorders including cognitive behavioural therapy (with reference to insomnia) and bright light therapy (with reference to circadian phase disorders).
CHAPTER 11 **Mental health**	• mental health as a continuum (mentally healthy, mental health problems, mental disorders) influenced by internal and external factors that can fluctuate over time • the typical characteristics of a mentally healthy person, including high levels of functioning, social and emotional well-being and resilience to life stressors • ethical implications in the study of, and research into, mental health, including informed consent and use of placebo treatments.
CHAPTER 12 **Mental disorder**	• the distinction between predisposing risk factors (increase susceptibility), precipitating risk factors (increase susceptibility and contribute to occurrence), perpetuating risk factors (inhibit recovery) and protective factors (prevent occurrence or re-occurrence) • the influence of biological risk factors including genetic vulnerability to specific disorders, poor response to medication due to genetic factors, poor sleep and substance use • the influence of psychological risk factors including rumination, impaired reasoning and memory, stress and poor self-efficacy • the influence of social risk factors including disorganised attachment, loss of a significant relationship and the role of stigma as a barrier to accessing treatment • the concept of cumulative risk.
CHAPTER 13 **Specific phobia**	• the distinctions between stress, phobia and anxiety; variation for individuals with stress, phobia and anxiety on a mental health continuum • the relative influences of contributing factors to the development of specific phobia with reference to: gamma-amino butyric acid (GABA) dysfunction, the role of stress response and long-term potentiation (biological); behavioural models involving precipitation by classical conditioning and perpetuation by operant conditioning, cognitive bias including memory bias and catastrophic thinking (psychological); specific environmental triggers and stigma around seeking treatment (social) • evidence-based interventions and their use for specific phobia with reference to: the use of short-acting anti-anxiety benzodiazepine agents (gamma-amino butyric acid [GABA] agonists) in the management of phobic anxiety and relaxation techniques including breathing retraining and exercise (biological); the use of cognitive behavioural therapy (CBT) and systematic desensitisation as psychotherapeutic treatments of phobia (psychological); psychoeducation for families/supporters with reference to challenging unrealistic or anxious thoughts and not encouraging avoidance behaviours (social).
CHAPTER 14 **Maintenance of mental health**	• resilience as a positive adaptation to adversity including the relative influence of protective factors with reference to: adequate diet and sleep (biological); cognitive behavioural strategies (psychological); support from family, friends and community (social) • models of behaviour change with reference to the transtheoretical model including the stages of pre-contemplation, contemplation, preparation, action and maintenance/relapse.

Source: © VCAA, VCE Psychology Study Design (June 2017 update).

8 NATURE OF CONSCIOUSNESS

KEY KNOWLEDGE

- consciousness as a psychological construct that varies along a continuum, broadly categorised into normal waking consciousness and altered states of consciousness (naturally occurring and induced)
- the measurement of physiological responses to indicate different states of consciousness, including electroencephalograph (EEG), electromyograph (EMG), electro-oculograph (EOG) and other techniques to investigate consciousness (measurement of speed and accuracy on cognitive tasks, subjective reporting of consciousness, including sleep diaries, and video monitoring)
- changes in a person's psychological state due to levels of awareness, controlled and automatic processes, content limitations, perceptual and cognitive distortions, emotional awareness, self-control and time orientation
- changes in levels of alertness as indicated by brain waves patterns (beta, alpha, theta, delta) due to drug-induced altered states of consciousness (stimulants and depressants)
- the effects on consciousness (cognition, concentration and mood) of one night of full sleep deprivation as a comparison with effects of legal blood-alcohol concentrations.

Source: © VCAA, VCE Psychology Study Design (June 2017 update), pp. 28–29.

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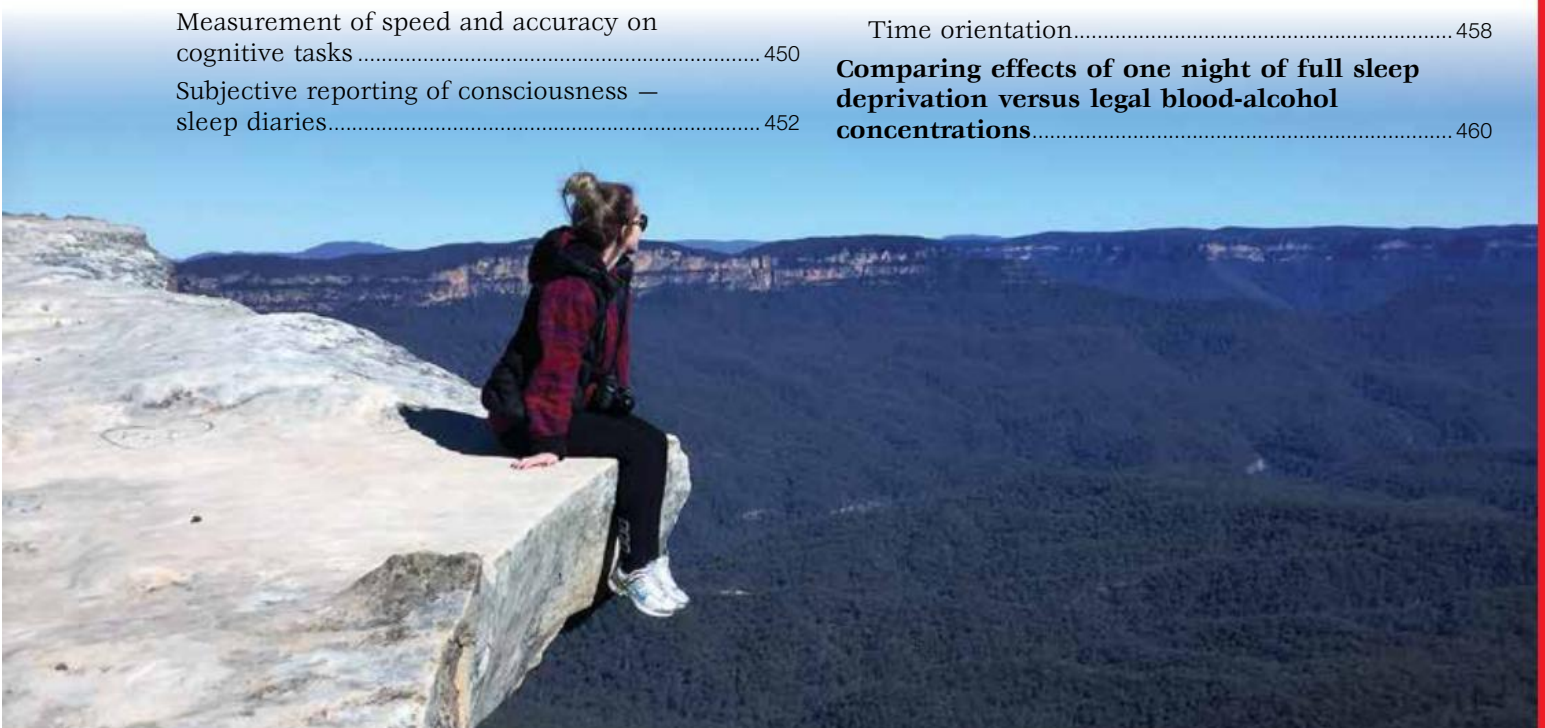

Stop for a moment and focus your attention on your thoughts and feelings right now. Are you thinking about the words in this paragraph, something a friend said to you, how hungry you are, what someone else in the room is saying, or something completely different? Now focus your attention on how you feel. Do you feel tired, bored, happy or even curious? Next, switch your attention to the sounds around you. Try to identify the different sounds you can hear. Now change the focus of your attention to what you can see, or the texture of your clothes against your skin. Try to become aware of the rhythm of your breathing, the aromas in your nose, and any aches, itches or pressure you may feel. Before your attention was directed to any of these things, were you actually aware of them or did they just exist without your awareness? The answer can be found in the study of consciousness.

Differences in our level of awareness of our sensations, thoughts, feelings and surroundings influence our interactions with our environment and other people. In this chapter, we examine the nature of consciousness and the relationship between consciousness and thoughts, feelings and behaviours. We also explore the different ways in which consciousness can be studied from physiological and psychological perspectives and how our state of consciousness can be altered intentionally or unintentionally.

Figure 8.1 Sometimes your consciousness is dominated by internally focused thoughts and feelings; at other times it is dominated by sensations and perceptions from the external environment.

CONSCIOUSNESS AS A PSYCHOLOGICAL CONSTRUCT

A challenge in studying consciousness is that it cannot be actually seen, unlike the study of physical characteristics such as eye colour or height, or behaviour such as walking and talking. Consciousness is therefore referred to as a psychological (or hypothetical) construct.

A **psychological construct** is a concept that is 'constructed' to describe specific 'psychological' activity, or a pattern of activity, that is believed to occur or exist but cannot be *directly* observed. In studying an individual's state of consciousness, researchers typically rely on:

- information provided by the individual (e.g. self-reports), and/or
- behaviour that is demonstrated (e.g. responses during experimental research), and/or
- physiological changes that can be measured (e.g. recording brain activity).

On the basis of such information, *inferences* are made about an individual's underlying state of consciousness. As techniques for studying consciousness have become more sophisticated, so too has the understanding of consciousness and how it is defined.

There have been many different definitions of consciousness throughout the history of psychology. It is commonly described as a psychological state and virtually all definitions refer to awareness of external and internal stimuli, but not just sensory stimuli because consciousness also involves *self*-awareness. More specifically, **consciousness** can be defined as our awareness of objects and events in the external world, and of our sensations, mental experiences and own existence at any given moment. Our consciousness helps provide us with a sense of self — a personal identity through which we experience the world.

Whatever we are aware of at any given moment is commonly referred to as the *contents* of consciousness. The contents of consciousness can include anything you think, feel and physically or mentally experience; for example:

- your awareness of your internal sensations, such as your breathing and the beating of your heart
- your awareness of your surroundings, such as your perceptions of where you are, who you are with and what you see, hear, feel or smell
- your awareness of your self as the unique person having these sensory and perceptual experiences
- the memories of personal experiences throughout your life
- the comments you make to yourself
- your beliefs and attitudes
- your plans for activities later in the day.

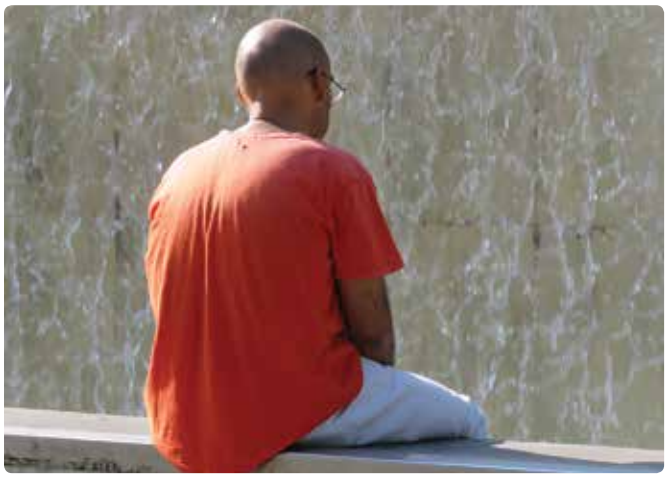

Figure 8.2 Consciousness is a psychological construct — it cannot be directly observed or measured.

Consciousness is an *experience* — a moment by moment experience that is essential to what it means to be human. The experience is commonly described as being personal, selective, continuous and changing.

It is *personal* because it is your subjective ('personalised') understanding of both your unique internal world and the external environment — it is individual to you.

Consciousness is *selective* because you can choose to attend to certain things and ignore others. You can voluntarily shift your attention from the words on this page to a voice in the room or the memory of what you did last Saturday night.

Consciousness is *continuous* because there is never a time in the course of a typical day when your consciousness is 'empty'.

Consciousness is constantly *changing*, with new information continually coming into awareness, particularly while you are awake. One moment your conscious awareness may be focused on the sound of a person talking to you, and the next moment your consciousness may be filled with thoughts of an argument you had with a friend. There are times when your consciousness is dominated by the internal thoughts and feelings you experience, while at other times sensations from the external environment dominate.

Over 125 years ago, the eminent American psychologist William James (1890) likened consciousness to a continuously flowing 'stream' because its contents are continuously moving and changing, just as the water in a stream continuously flows. The never-ending flow of thoughts, feelings, sensations and so on, are ever-changing, multi-layered and vary in the depth or 'levels' of awareness that we have of these experiences. The different levels of awareness that we experience at different times are commonly referred to as *states of consciousness* and the various states of consciousness have each been associated with distinguishable psychological and physical characteristics.

Figure 8.3 An example of what William James (1890) called the 'stream of consciousness' — a never-ending, ever-changing flow of thoughts, feelings, sensations and so on which often occur in a random way

LEARNING ACTIVITY 8.1

Reflection

A snapshot of your consciousness

For the next five minutes, write down all the sensations, perceptions, memories, thoughts, images and feelings that flow into your consciousness. Write continuously for the whole time. If you can't think of anything to write, write 'I can't think of anything to write' (because that's what is in your consciousness) until the flow of other things continues. You may find that your hand can't keep up with the ever-changing flow of thoughts and feelings passing through your consciousness.

At the end of the time, count the number of different ideas that entered your consciousness. Compare your result with that of other class members. What is a possible explanation for any differences?

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- TED talk: Our shared condition — consciousness 15m 7s
- TED talk: The quest to understand consciousness 18m 35s

CONSCIOUSNESS VARIES ALONG A CONTINUUM OF AWARENESS

Consciousness is not an 'all or nothing' phenomenon. As well as ongoing content changes, we experience variations in the extent or degree of overall awareness at different times. At times, we are highly focused and acutely aware; for example, when we are concentrating on learning how to use a new email function or lining up to shoot a goal. At other times, we experience a medium level of awareness, such as when we are daydreaming. There are still other times, such as when we are in deep, dreamless sleep, when our overall level of awareness is very low.

Psychologists often describe consciousness as varying along a *continuum of awareness* with two distinctive extremes — total awareness (e.g. focused attention) and complete lack of awareness (e.g. unconscious in a deep coma or a vegetative state). In between are other states involving more or less overall awareness.

In a typical day we experience many different states of consciousness and therefore many levels of awareness. Each level of awareness varies in distinctive qualities. As shown in the example of a continuum below, there are no clear-cut boundaries to indicate where one state of consciousness ends and another begins.

Figure 8.4 Psychologists often describe consciousness as ranging along a continuum of awareness from total awareness to a complete lack of awareness. There is, however, no precise location for each state of consciousness within the continuum.

At one end of the continuum, when attention is highly focused, concentration on specific thoughts, feelings or sensations dominates our consciousness to such an extent that other incoming information may not be noticed. For example, if you were totally absorbed in important school work during the first class of the day, you might not feel hungry despite having missed breakfast and not eating much for dinner the night before. At the other end of the continuum, an individual may not experience any thoughts, feelings or sensations at all. For example, someone in a deep coma or a vegetative state usually shows no evidence of awareness of themself or of their environment (see Box 8.1 below).

There are many states of consciousness between either end of the continuum in which individuals have differing levels of overall awareness and specific qualities of awareness. These variations of consciousness may occur, for example, when people are in a fight, flight or freeze mode, fatigued, drowsy, daydreaming, asleep, in a meditative state or under the influence of alcohol, medication or an illegal drug. While it is sometimes difficult to distinguish between the different states of consciousness and associated levels of awareness within a continuum, psychologists generally agree on a broadly based distinction in terms of normal waking consciousness and altered states of consciousness.

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BOX 8.1 Coma, vegetative and minimally conscious states

To be aware, we need to be awake but when awake, we are not necessarily aware. This is apparent when consciousness is impaired through brain injury, particularly to cortical areas and/or to brainstem structures regulating sleep and wakefulness. For example, some brain injuries may cause a coma or a vegetative state involving a decrease in, partial or complete loss of consciousness. In most cases of severe brain injury, the patient recovers within a few weeks, but in some cases, they may remain in a state of no awareness or minimal consciousness for several months, years or even decades.

Belgian psychologist Olivia Gosseries and her colleagues (2011) have described different conditions involving impaired consciousness that are attributable to brain injury. These include the following.

Coma

Coma is a state in which there is a complete or nearly complete loss of all basic functions of consciousness. Typically, the patient lies with eyes closed, cannot verbalise or respond to commands and cannot be awakened even when intensively stimulated. There is no evidence of awareness of self or of the environment. Comatose patients can, however, often present reflexive responses to painful stimulation. Autonomous nervous system functions such as breathing and regulation of body temperature are reduced and the patients require respiratory assistance. Prolonged comas are rare but can last 2–5 weeks and then progress to a vegetative state, locked-in syndrome or brain death.

Vegetative state

The vegetative state, sometimes called 'unresponsive wakefulness syndrome', involves loss of consciousness, but the patient may open their eyes, either spontaneously or after stimulation. As with coma, patients in a vegetative state cannot verbalise or make voluntary responses. Nor is there any sign of awareness of self or the environment. The patient in a vegetative state is awake but not aware, which suggests that wakefulness and awareness may be different components of consciousness.

Unlike coma, autonomic nervous system functions are preserved and breathing usually occurs without assistance. Someone in a vegetative state may also be able to perform a variety of actions, such as grinding teeth, blinking and moving eyes, swallowing, chewing, yawning, crying, smiling, grunting or groaning, but these are always reflexive, unrelated to the context and often lacking in intensity.

(continued)

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Minimally conscious state
The minimally conscious state is characterised by inconsistent signs of awareness of self and the environment and there is evidence of voluntary, intentional behaviour, such as responding to verbal commands, making understandable verbalisations and tracking a moving object, mirror or person. Emotional behaviours, such as smiles, laughter or tears may also be observed. The minimally conscious state may be temporary, long-lasting or permanent, as is the vegetative state.

Locked-in syndrome
Locked-in syndrome, also called 'pseudocoma', is a rare condition involving full consciousness and complete paralysis of the body. Oral and gestural communications are impossible, but patients are often able to blink and move the eyes. Despite the fact that the patients cannot move, their sensations are still intact and they are fully aware of their environment and themselves. The most common way for patients with locked-in syndrome to communicate with their environment is through eye movements (such as blinking once for yes and twice for no), but they may recover control of their fingers, toes or head and use these as a means for communication too.

Brain death
In Australia, brain death is defined as (a) irreversible cessation of all function of the brain of the person; or (b) irreversible cessation of circulation of blood in the body of the person. Whole brain death is also required for the legal determination of death. Assessments occur when the patient transitions from a deep comatose state. If the condition causing coma and loss of all brainstem function has affected only the brainstem and there is still blood flow to the cerebral cortex, this does not meet the legal definition. In addition, brain death cannot be determined unless there is evidence of severe brain injury sufficient to cause death.

There is no recovery from brain death. Before clinical testing for brain death can even begin, other causes of coma such as drugs, high or low blood sugar levels and abnormal electrolyte levels must be ruled out. There must also be a minimum of four hours observation and mechanical ventilation, during which the patient is completely unresponsive to any external stimuli (Australian and New Zealand Intensive Care Society, 2014).

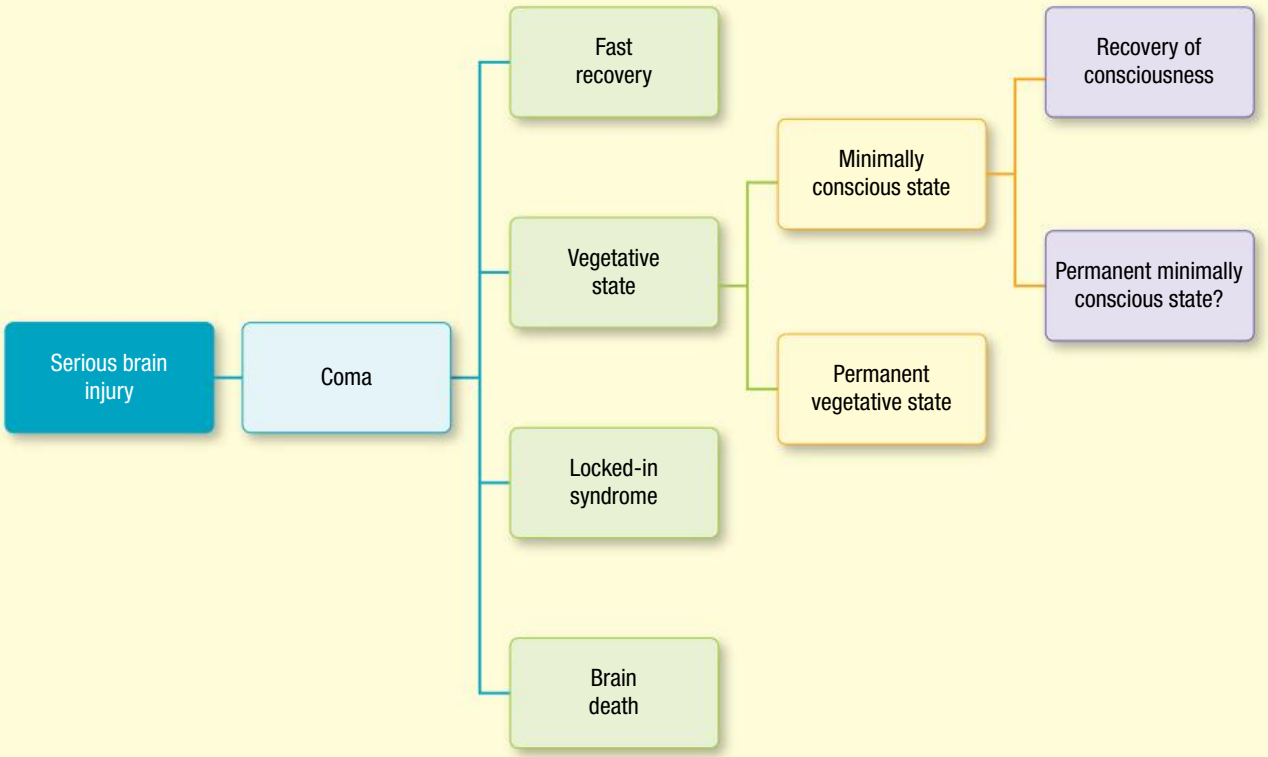

Figure 8.5 Different conditions may follow serious brain injury. Often, coma lasts for a couple of days and once the patients open their eyes, they evolve into a vegetative state. Then, they may enter a minimally conscious state after showing some signs of consciousness and eventually they recover full consciousness. In rare cases, a person may develop locked-in syndrome, a nearly complete paralysis of the body's voluntary motor responses.

Source: Gosseries, et al., (2011). Disorders of consciousness: Coma, vegetative and minimally conscious states. In D. C. Cvetkovic & I. Cosic (Eds.), *States of consciousness — Experimental insights into meditation, waking, sleep and dreams* (pp. 29–55). Verlag Berlin Heidelberg: Springer.

LEARNING ACTIVITY 8.2

Recognising different states of consciousness and levels of awareness

1. People travelling on a plane from Melbourne to Singapore may each experience different states of consciousness.

Consider the following list and indicate where each person would be on the consciousness continuum in Figure 8.4 on page 432.

- Person 1: a pilot who is monitoring their cockpit instruments
- Person 2: a teacher who is thinking about her holiday and who has just finished her third alcoholic drink and likely to have a 0.05 recording on a breathalyser
- Person 3: a 12-year-old playing a video game
- Person 4: the mother of a two-year-old child who is watching the inflight movie while simultaneously looking after her child
- Person 5: a tertiary student gazing aimlessly out the window
- Person 6: an anxious passenger who has taken a 'sleeping pill' and can be heard snoring.

2. Where would you place yourself on the continuum right now?

LEARNING ACTIVITY 8.3

Review questions

1. Define consciousness, with reference to internal and external factors.

2. In what ways is consciousness personal, subjective, continuous and changing?

3. Explain the term state of consciousness.

4. Which term could be used interchangably with the term consciousness?

5. (a) Why is consciousness considered to be a psychological construct?

(b) Give three examples of other psychological constructs.

6. (a) Box 8.1 on pages 433–4 describes a vegetative state, a minimally conscious state and locked-in syndrome. Where would you place each of these on the consciousness continuum?

(b) Box 8.1 also describes brain death. Explain whether this condition can be placed on the consciousness continuum.

7. Do you think there is an upper limit to human awareness? For example, should the upper part of the continuum in Figure 8.4 extend beyond 'total awareness'?

LEARNING ACTIVITY 8.4

Reflection

Comment on whether non-human animals experience consciousness as humans do and criteria that could be used to determine this.

NORMAL WAKING CONSCIOUSNESS AND ALTERED STATES OF CONSCIOUSNESS

Psychologists often distinguish between two broad categories of consciousness called normal waking consciousness and altered states of consciousness.

Normal waking consciousness refers to the states of consciousness associated with being awake and aware of objects and events in the external world, and of one's sensations, mental experiences and own existence. As described by William James, normal waking consciousness is constantly changing. However, despite this changing experience, our perceptions and thoughts continue to be organised and clear, and we remain aware of our personal identity — who we are. We also perceive the world as real and we maintain a sense of time and place.

As shown in the continuum in in Figure 8.4 on page 432, normal waking consciousness is not one single state, as there are varying levels or 'degrees' of awareness when we are awake. Generally, normal waking consciousness includes all states of consciousness that involve heightened awareness. This does not mean, however, that all our waking time is spent in the same state of consciousness. We continually shift between different states, and therefore levels of awareness, within normal waking consciousness.

Most people spend about two-thirds of each day in normal waking consciousness during which there are variations in mental awareness as streams of information flow in and out of awareness. Arbitrary dividing lines cannot be drawn between different states of waking consciousness to clearly indicate when one state starts and ends. However, when changes in mental awareness occur to the extent that you can notice differences in alertness and your responsiveness to internal and external stimuli, you may have entered an altered state of consciousness (Glicksohn, 1991).

The term **altered state of consciousness (ASC)** is used to describe any state of consciousness that is distinctly different from normal waking consciousness in terms of level of awareness and experience. In an ASC, mental processing of internal and external stimuli shows distinguishable, measurable changes. For example, self-awareness, emotional awareness and perceptions of time, place and one's surroundings may change. In addition, normal inhibitions or self-control may weaken (Martindale, 1981; Reisberg, 2013).

Psychologists also distinguish between naturally occurring and induced altered states of consciousness. Some ASCs, such as sleep, dreaming during sleep and daydreaming when awake, are a normal part of our lives and occur **naturally** in the course of our everyday activities without the need for any aid. For example, each day we experience natural changes in levels of alertness and awareness as we go through cycles of wakefulness, drowsiness and sleep. Other ASCs do not occur naturally and are instead **induced** — they are intentionally achieved by the use of some kind of aid, for example, through meditation, hypnosis, alcohol ingestion or by taking certain medications or illegal drugs. Some psychologists also describe altered states that are induced unintentionally due to an accident, disease or some other disorder. For example, brain trauma from a blow to the head can produce concussion or a comatose state and a medical condition such as epilepsy produces recurring seizures that alter conscious experience.

Figure 8.6 (a) We spend about two-thirds of each day in normal waking consciousness, during which we experience variations in mental awareness. (b) During an altered state of consciousness, self-awareness, emotional awareness and perceptions of time, place and our surroundings may change.

There are many reasons why an individual may deliberately try to achieve an ASC. For example, meditation is a useful technique to induce a state that can help people relax or manage stress. Hypnosis may be practiced as part of therapy; for example, in trying to help someone deal with fear of flying or to give up smoking. Alternatively, some people use medications and illegal drugs to reduce pain, for psychological pleasure or as an escape from the pressures of their life.

Naturally occurring and induced ASCs are not necessarily mutually exclusive. Some naturally occurring states may be induced. For example, sleep is naturally occurring and can be purposely induced with medication that promotes drowsiness.

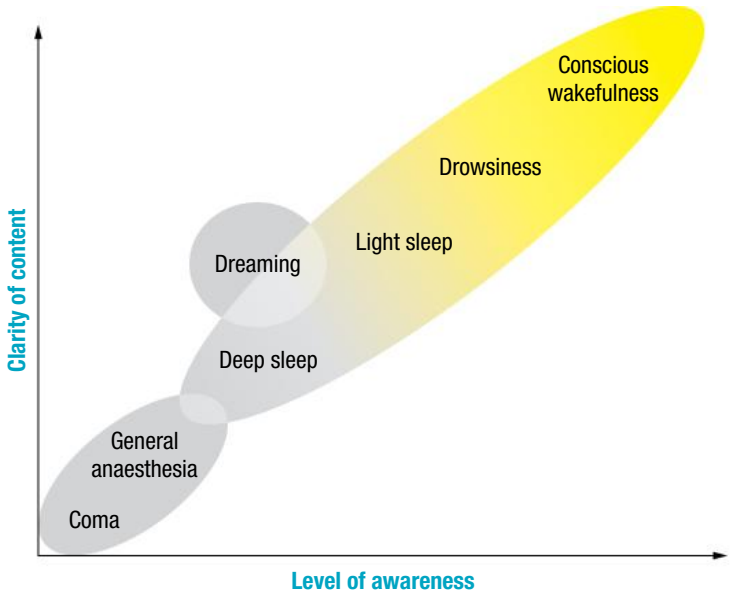

Figure 8.7 Some researchers have described a relationship between the level of awareness and the clarity of the contents of consciousness.

Source: Based on Gosseries, et al., (2011). Disorders of consciousness: Coma, vegetative and minimally conscious states. In D. C. Cvetkovic and I. Cosic (Eds.), *States of consciousness — Experimental insights into meditation, waking, sleep and dreams* (p. 31). Verlag Berlin Heidelberg: Springer.

Role of attention

Researchers often use attention as a measure of awareness and as a way of distinguishing between different states of consciousness. **Attention** is a concentration of mental activity that involves focusing on a specific stimulus while ignoring and therefore excluding other stimuli. Generally, the more attention, the higher the degree of awareness and vice versa. States of consciousness within the range of normal waking consciousness at the top end of the consciousness continuum involve more awareness and therefore require more attention than altered states of consciousness at the lower end of the continuum.

In normal waking consciousness, our attention can be focused either on *internal* thoughts or feelings (e.g. how tired you feel) or on *external* stimuli (e.g. what the person sitting next to you is saying). The focus of attention is like a spotlight that can be moved around. A shift in the focus of your attention, and therefore conscious awareness, can be intentional, such as when you concentrate on listening to arrangements for meeting friends. However, a shift in the focus of attention more often occurs without our being aware of it (LaBerge, 1995). For example, when you are focused on a teacher's explanation and the person sitting next to you starts talking to you, the focus of your attention will usually shift to their comments, even if only for a second or two.

Researchers also distinguish between selective attention and divided attention.

Selective attention

Selective attention involves choosing and attending to a specific stimulus to the exclusion of others. The concept illustrates the fact that at any given moment the focus of our awareness is on only a limited range of all that we are capable of experiencing. This occurs for an internally sourced event such as the perception of a pain in the foot or an externally sourced event such as watching a car drive past. Research studies on selective attention have shown that people often notice, and therefore become aware of, very little of the information that is not attended to (Milliken et al., 1998).

What factors determine whether we will attend to a particular stimulus during normal waking consciousness? It seems that we are more likely to attend to a stimulus if it is important to us, if it changes in some way or if it is novel.

If a stimulus is of *personal importance* to us, we are more likely to take notice of it. For example, suppose you are at a party. Loud music is playing and you are surrounded by many conversations. Despite being totally involved in one conversation, your attention is likely to be automatically drawn to a different conversation if you hear your name being mentioned. This commonly occurring experience is known as the 'cocktail party phenomenon' (Wood & Cowan, 1995). Our attention is also attracted by any *changes* in stimulation or the introduction of a *novel* stimulus; that is, a stimulus that is new or unusual in some way. This may explain why many television and radio advertisers pitch their commercials at a higher or lower volume than the programs they interrupt.

If our attention is selective, does that mean we take in no other information presented to us when our attention is completely focused on one thing? For example, during the first class on Monday morning your attention may be selectively focused on hearing what happened at a weekend party. However, you may still process some of what the teacher is saying or doing with the rest of the class, which is selectively attending to what the teacher is saying. You may be aware that you need to have your book open at a particular section, or that you need to be copying down some questions from the board even if you

Figure 8.8 The cocktail party phenomenon describes how a person's attention is drawn when they hear their name mentioned in a nearby conversation.

don't know what the questions actually ask. Thus, even when your attention is focused on one thing, you are still capable of reacting to other stimuli. This suggests that we can process some information outside conscious awareness.

Divided attention

As we begin to move down the consciousness continuum, the level of attention required is generally not as focused or selective. For example, in normal waking consciousness, people are often able to divide their attention among competing stimuli, such as washing a car while listening to the radio and watching their children playing. **Divided attention** refers to the ability to distribute our attention and undertake two or more activities simultaneously.

It seems that our ability to divide our attention and 'multitask' depends on how much conscious effort is required for the various tasks in which we are engaged. In turn, this depends on the similarity of the tasks, their complexity and how accomplished, or 'experienced', we are at doing them. Research findings indicate that our perceptual systems can more competently perform tasks requiring divided attention when the tasks are sufficiently similar, not complex, well known and therefore do not demand considerable mental effort. Often, especially for more complex tasks, we may think we are using divided attention but we are actually shifting attention from one task to another.

In one experiment, British psychologist John Duncan (1993) required participants to make two simultaneous judgments about an object that was visually presented to them on a screen. They were required to both identify the object and determine its location on the screen. Generally, participants were able to complete both tasks with few errors. However, the rate of errors increased significantly when participants were required to make two simultaneous judgments about two different objects, such as the location of each object. These results indicate that performing a complex task requires selective attention and a higher level of awareness than a simple or familiar task requires.

To test your ability to divide your attention between two tasks, try simultaneously tapping three times on the table with your left hand while at the same time tapping four times on the table with your right hand. Most people are unable to successfully divide their attention between these tasks without considerable practice.

Understanding the limits of our attention has become important in the debate about the use of mobile phones while driving. Research findings support the view that using a mobile phone while driving, whether handheld or not, distracts the driver's attention. If the driver's attention is divided between two tasks, one or both of which demand considerable attention (such as when manually dialling a phone number or texting), there is a significant increase in the likelihood that the driver will fail to notice a potentially dangerous situation in time to respond and avoid an accident (McKnight & McKnight, 1993; Royal Society for the Prevention of Accidents, 2016).

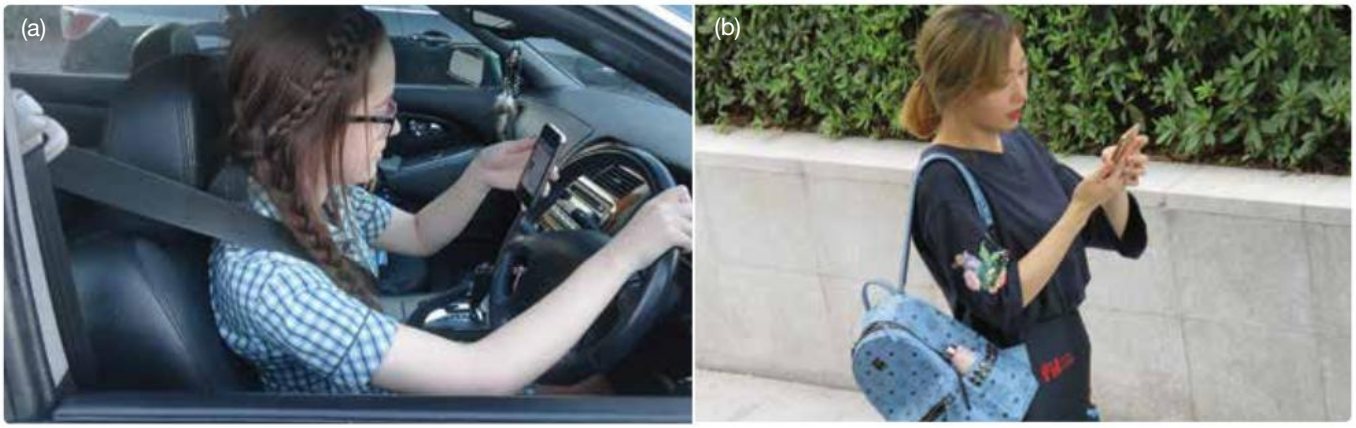

Figure 8.9 (a) Using a mobile phone while driving requires divided attention to simultaneously perform two relatively complex tasks and puts the driver and other road users at risk. (b) Researchers are now also increasingly raising concerns about pedestrian use of mobile phones as they divide attention when navigating or crossing streets.

BOX 8.2 Research on selective attention

To test selective attention, American psychologists Ulric Neisser and Robert Becklen (1975) had research participants view a video with two superimposed scenes showing overlapping events occurring at the same time (as in Figure 8.10c below). One scene showed two people playing a hand-slapping game (as in Figure 8.10a). The other scene showed three people passing a basketball to each other (as in Figure 8.10b).

Neisser and Becklen used an independent groups experimental research design. Each participant was randomly allocated to one of two groups. Each group was asked to watch either the hand-slapping or basketball game.

The participants in the group that watched the hand-slapping game were required to press a response key whenever the people in the game slapped hands. Those watching the basketball game were required to respond in the same way whenever the basketball was passed.

The results showed that participants in both groups were able to selectively attend to the designated stimulus and effectively block the other stimuli that were present. Their 'attention filtering' processes were so successful that of the 24 participants who focused on the basketball game, only one noticed that the hand-slappers had finished their game and were shaking hands. When the experimenter replayed the videotape, the participants reported that they were surprised at what they had missed.

According to Neisser and Becklen, their results suggested that information may enter or be excluded from our consciousness through the process of selective attention.

Figure 8.10 Figures (a) and (b) are drawings from scenes in the two videos in the Neisser and Becklen (1975) experiment. Figure (c) shows the two scenes superimposed, as seen by research participants.

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Weblink
Selective attention test 1m 21s

Practical activity
Selective versus divided attention

LEARNING ACTIVITY 8.5

Review questions

1. Define the meaning of
   (a) normal waking consciousness
   (b) altered state of consciousness (ASC).
2. In what main ways is an ASC different from normal waking consciousness?
3. Can an ASC be experienced during normal waking consciousness? Explain your answer with reference to an example.
4. State two naturally occurring ASCs and two purposely induced ASCs.
5. When we drift into dream sleep from non-dream sleep, do we shift into an ASC? Explain your answer.
6. An employer is concerned that one of her employees has been arriving at work in an altered state of consciousness and is not in a fit state to operate the machinery for which he is responsible. She is not sure what the characteristics of different ASCs are and wants to be more confident of her information before discussing the issue with him. List three characteristics of ASCs that may be helpful for the employer to know.
7. Distinguish between selective and divided attention with reference to an example not used in the text.

LEARNING ACTIVITY 8.6

Reflection

Comment on whether an ASC is simply any state of consciousness 'which is not normal waking consciousness'.

LEARNING ACTIVITY 8.7

Evaluation of research by Neisser and Becklen (1975) on selective attention

Evaluate the research on selective attention conducted by Neisser and Becklen (1975) described in Box 8.2 on page 439. Your evaluation should respond to the following:

1. Formulate a research hypothesis for the experiment.
2. Identify the operationalised independent and dependent variables in the experiment.
3. Suggest why an independent groups design is more appropriate for this particular experiment, rather than a repeated measures or matched participants design.
4. Briefly state the results that were obtained.
5. Briefly state the conclusion(s) drawn by the researchers on the basis of the results obtained.

METHODS USED TO STUDY CONSCIOUSNESS

Psychologists may use a variety of techniques to study states of consciousness and identify specific responses associated with different states. The most commonly used techniques can be organised in four different categories: measurement of physiological responses, measurement of performance on cognitive tasks, self-reports and video monitoring. The techniques can be used independently or in combination. We consider examples from each category.

Measurement of physiological responses

Measurements of physiological responses enable researchers to obtain data on bodily changes and responses during various states of consciousness. These have provided valuable information on levels of alertness and underlying bodily changes that occur in different states. Three commonly measured physiological responses are changes in brain wave patterns, muscle activity and eye movements.

eGuide*plus*

Practical activity
Divided attention

Electroencephalograph (EEG)

In 1924, German psychiatrist Hans Berger developed the electroencephalograph (*electro-en-sef-uh-low-graf*) to record and analyse electrical activity of the brain associated with different behavioural responses and mental processes (Springer & Deutsch, 1998). An **electroencephalograph**, or **EEG**, is a device that detects, amplifies and records general patterns of electrical activity of the brain over a period of time.

The electrical activity spontaneously and continuously produced by the brain's neurons, particularly neurons in the cerebral cortex just below the scalp, can be detected outside the skull. This is achieved using small electrodes that are attached to the surface of the scalp at the top and sides of the head. Alternatively, a participant may be required to wear a head cap with prepositioned or adjustable electrodes to suit individual requirements.

Each electrode simultaneously detects and receives signals from many thousands of neurons that are activated in the vicinity and the EEG averages this out. The EEG

then amplifies and translates the activity in cortical areas beneath the electrodes into a visual pattern of brain waves. The brain waves are recorded and displayed as a graph on a computer monitor or as a moving sheet of graph paper (see Figure 8.11 below). These EEG records are called *electroencephalograms*. The brain waves in the graph illustrate activity that can be matched to brain areas that correspond with the location of electrodes.

The rate, height, and length of brain waves vary depending on the brain area being studied, and every individual has a unique and characteristic overall brain wave pattern. Age and the current state of consciousness also cause changes in wave patterns.

Since the brain may produce different activity in different areas, multiple electrodes are used. The more that are used, the more detailed the brain wave data and the overall picture of the brain's electrical activity. The placement of the electrodes is also critical to the reading of the data. In most cases, their number and position across the skull matches an international standard called the *10-20 system*. This was developed as a standardised procedure so that the results of different patients and research participants can be compared to each other and to support replication of EEG assessments and research studies.

Brain wave patterns shown in EEG recordings vary in frequency and amplitude. *Frequency* refers to the number of brain waves per second. A pattern of *high-frequency* brain wave activity is faster and therefore has *more* brain waves per unit of time. A pattern of *low-frequency* brain wave activity is slower, and therefore has *fewer* brain waves per unit of time.

The *amplitude* or intensity of brain waves is measured in microvolts and can be visually judged by the size of the peaks and troughs of the waves from a baseline of zero activity. *High-amplitude* brain waves have *bigger* peaks and troughs, whereas *low-amplitude* brain waves have *smaller* peaks and troughs.

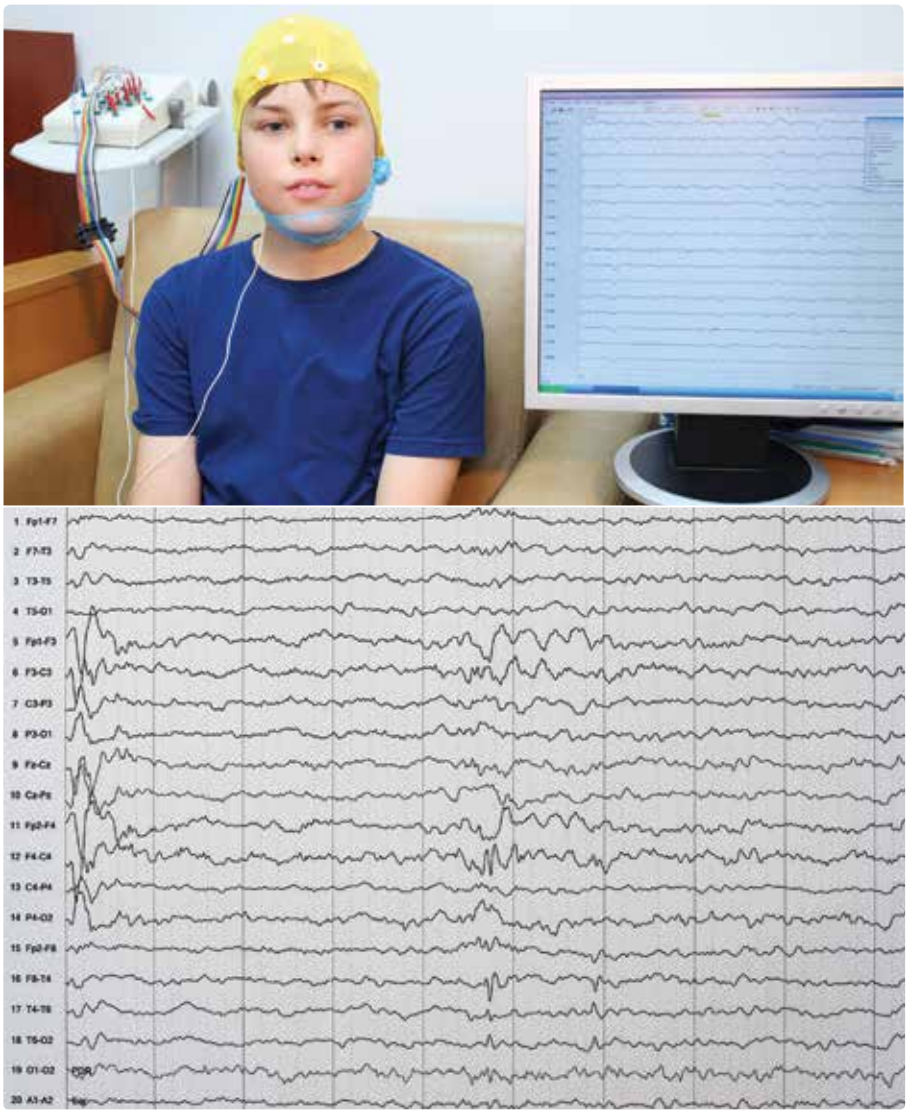
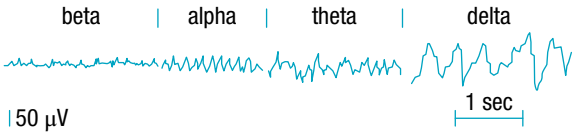


Figure 8.11 An EEG records the electrical activity at different locations in a participant's brain through precisely located electrodes attached to the scalp. Each electrode detects activity at a different point on the skull and is displayed as a row of EEG data.

Beta, alpha, theta and delta brain wave patterns

Four commonly described brain waves are named after letters in the Greek alphabet — theta, delta, alpha and beta. These waves are shown below in an order ranging from highest to lowest frequency. Beta have the highest frequency and lowest amplitude, whereas delta have the lowest frequency but highest amplitude.



EEG recordings indicate that brain wave patterns, or 'rhythms', change as level of alertness changes within a state of consciousness. Distinguishable brain wave patterns have also been associated with various altered states of consciousness.

The predominance of different brain wave patterns varies with age. For example, the EEGs of infants and children are normally characterised by a greater mixture of brain waves than is found in adults. Furthermore, although one brain wave pattern may predominate at any given time, depending on the activity type and level of the individual, the remaining three waves are present in the mix of brain waves that may be recorded at all times under normal circumstances. For example, while somebody is an aroused state and showing a beta brain wave pattern, there also tends to exist in that person's brain a component of alpha, theta and delta, even though these may be present only at the trace level (Herrmann, 2017).

We consider typical patterns and when they are most commonly observed under normal circumstances.

Beta pattern

A predominantly *beta brain wave pattern* is associated with alertness and intensive mental activity during normal waking consciousness. For example, when we are awake, attentive to external stimuli and actively concentrating or thinking, our brain's electrical activity is at its highest. This means that beta waves are characteristic of a brain strongly engaged in cognitive function. A person in active conversation would show predominantly beta, as would a teacher presenting an inspiring lesson, a talk show host during a live broadcast and an electrician reorganising wiring when repairing a switchboard. Beta waves are also present during states of tension, anxiety, threat, fear and when dreaming during a period of rapid eye movement sleep (Jovanov, 2011).

The beta pattern comprises high-frequency (fast) and low-amplitude (small) brain waves. Beta are the fastest of the waves.

Alpha pattern

When we are awake and alert but mentally and physically relaxed and internally focused, the EEG shows a predominantly *alpha brain wave pattern*. For example, if you complete a mentally active task and sit down to rest and calmly reflect on what you did, your brain waves will be mostly alpha, especially if you close your eyes. Alpha waves in humans mostly originate in the visual cortex area in the occipital lobe at the back of the brain. If a relaxed person with eyes closed is disturbed or opens their eyes, alpha waves abruptly stop.

Typically, the alpha pattern is regular or 'rhythmic' (rather than irregular or 'jagged') in appearance, with a medium to relatively high frequency (but slower than beta waves) with low amplitude (but a slightly larger amplitude than beta waves).

Theta pattern

A predominantly *theta brain wave pattern* is most commonly produced when we are very drowsy, such as when falling asleep or just before waking. They may also be produced when awake and engaged in creative activities, during dream-like visual imagery, when excited and when deeply meditating (Jovanov, 2011; Tatum, 2014). Relatively little theta activity is ordinarily recorded in adults during normal waking consciousness when compared with the other brain waves (but it is common in young children during normal waking consciousness).

The theta wave pattern has a medium frequency and some high-amplitude (large) waves mixed with some low-amplitude (small) waves.

Delta pattern

Delta waves are most commonly associated with deep, dreamless sleep or unconsciousness. They begin to appear in stage 3 of non-rapid eye movement sleep. In stage 4, during which we experience the deepest sleep, there is a predominantly *delta brain wave pattern*. Stage 4 occurs before a period of rapid eye movement sleep that is associated with dreaming. Delta waves are usually considered normal when observed in the very young and elderly during waking states. They are predominant in waking states throughout infancy and early childhood, decreasing to less than 10% of waking time by about age 10 years (Tatum, 2014).

Delta waves have a pattern of low-frequency (slow) and high (large) amplitude. They are very slow and the slowest of all the brain waves.

Advantages and limitations of the EEG

Brain wave patterns are used in conjunction with other physiological or psychological measures to help identify and describe an individual's level of alertness and the associated state of consciousness. The distinctive brain wave patterns also make the EEG a reliable technique for determining abnormal brain activity, for monitoring changes within a state of consciousness (such as sleep stages), and to identify different states of consciousness. A living person's brain always has electrical activity. Still slower waves than delta appear during anaesthesia or when a person is in a coma. When 'brain death' occurs, the EEG becomes a flat line. In some cases, severe drug-induced sedation can cause a flat EEG.

Beta waves
Beta waves have a high frequency (fast) and low (small) amplitude, and are irregular. They are typically associated with normal waking consciousness when alert, when attentive to external stimuli and with intensive mental activity e.g. someone who is awake and physically or mentally active, with eyes open and concentrating on some mentally engaging task.

Alpha waves
Alpha waves have a high frequency (but slower than beta waves) and low amplitude (but slightly larger than beta waves). A distinguishable feature is their regular configuration, which resembles the teeth of a comb. They are typically associated with a relaxed, calm, internally focused, wakeful state, with eyes closed.

Theta waves
Theta waves have a medium frequency (slower than alpha and beta waves) and a mixture of high and low amplitude waves. They are typically associated with drowsiness, falling asleep, awakening from sleep, creative activities, excitement and when in a deep meditative state in which there is no awareness of external stimuli. When falling asleep there is usually a changeover from alpha to theta waves across a period of several minutes.

Delta waves
Delta waves have the lowest frequency and the highest amplitude. They are typically associated with the deepest stage of sleep which precedes periods of rapid eye movement sleep and unconsciousness.

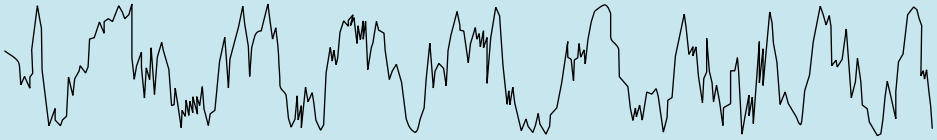


Figure 8.12 Four brain wave patterns in an order ranging from fastest activity (beta) to slowest activity (delta)

The EEG is useful in providing general, or 'overall', information about brain activity in real time without being invasive. Since its development in the 1920s, it has provided valuable information about different levels and types of brain wave activity associated with various thoughts, feelings and behaviours in different states of consciousness.

The EEG is also widely used to assist with the diagnosis and study of various brain-related medical conditions, including brain damage and neurological disorders, particularly epilepsy which is characterised by uncontrollable bursts of brain activity. Different types of brain waves are seen as abnormal only in the context of variations from what would normally be expected from the location of the waves and for a person's age, their state of consciousness and level of alertness when the EEG is conducted.

In general, disease (or 'illness') typically increases slow activity, such as theta or delta waves, but decreases fast activity, such as alpha and beta waves. Additionally, the theta waves normally found in adults during drowsiness and sleep are also normal in children when awake, and delta waves commonly occur during normal waking consciousness in infancy but not in adulthood (Colrain, et al., 2010).

A limitation of the EEG is that it poorly measures neural activity that occurs below the outer layer of the brain (i.e. the cortex). Nor does it provide detailed information about which particular structures of the brain are activated and what their specific functions might be, especially areas beneath the cortex. Multiple electrodes are positioned across the top of a relatively large area of the brain and it can be difficult to pinpoint exactly where in the brain the activity is coming from. Specific changes in brain wave activity do occur in response to the presentation of a particular stimulus, such as a flash of light, but the changes in brain wave activity can be hidden by the overall background activity of the brain. Furthermore, the strength of the electrical activity at its source is reduced after having travelled through the thick bone structure of the skull. Therefore, the EEG merely provides a summary of all the activity of neurons firing within different areas of the brain. Using an EEG to understand overall brain function has been likened to studying the activity of a car engine by listening to the hum of the motor (Myers, 2007).

LEARNING ACTIVITY 8.8

Reflection

Does conscious awareness or the brain activity enabling awareness occur first? Perhaps they are a single event that occur together? What do you think? Explain your answer. Can you suggest a way in which this could be experimentally investigated?

Brain wave patterns due to drug-induced altered states of consciousness

A **drug** is any substance that can change a person's physical and/or mental functioning. Certain types of drugs can induce an altered state of consciousness and changes in brain wave patterns. Two broad categories of drugs that can initiate such changes are called stimulants and depressants. Drugs within each of these categories have opposite effects on central nervous system activity, as indicated by the category names — they either 'stimulate' or 'depress' activity.

Like all other drugs, stimulants and depressants exert their effects by influencing specific neurotransmitters, receptors or by chemically altering neuronal function in other ways. Their potential effects are further influenced by a range of variables such as:

- the type of stimulant or depressant that is taken
- the dose (amount) and potency (strength)
- personal characteristics of the individual e.g. body weight, physiology, sex, age, health and wellbeing, prior use, personality, mood, expectations
- method of administration e.g. oral, injection, inhalation, skin patch
- when administered e.g. daytime or night time before sleep
- whether other drugs are also taken
- context e.g. alone or with others, social or medical situation.

There is an interplay between these variables that influences psychological and physiological responses to a drug. Moreover, specific drug effects can vary from person to person and even for the same person in different situations. A drug's effects can also change as a person develops a tolerance to the relevant chemical. However, some effects are reasonably predictable. In this section, we refer to the *typical* effects of stimulants and depressants, focussing on overall changes in levels of alertness as indicated by brain wave patterns.

Stimulants

Stimulants are drugs that increase activity in the central nervous system and the rest of the body. They therefore have an alerting, activating effect.

Stimulants range from mild, widely available drugs, such as *caffeine* which is found in coffee, tea, chocolate, cola, energy drinks and some non-prescription medications, and *nicotine*, which is found in cigarettes and other tobacco products, to strong, carefully regulated or illegal drugs, such as *amphetamines*, *cocaine* and *ecstasy*.

Figure 8.13 Stimulants increase activity in the central nervous system and the rest of the body. Caffeine and nicotine are widely available stimulants. Others are carefully regulated drugs, or illegal drugs such as amphetamines and ecstasy.

eBook*plus*

Weblinks

- Alcohol and Drug Foundation (formerly Australian Drug Foundation)
- drugscience (UK)

Some types of amphetamines are legally prescribed by doctors to treat conditions such as attention deficit hyperactivity disorder (ADHD) or the sleep disorder narcolepsy which involves excessive sleepiness when usually awake. Amphetamines that can be legally prescribed are often accessed by someone without the relevant symptoms and misused to 'get high'. Other types of amphetamines such as 'speed' and the more potent form called 'ice' (crystal methamphetamine) are produced and sold illegally.

Even mild stimulants, especially when taken in large amounts, are capable of altering conscious experience. Stimulants may alter attention, mood, emotional awareness, self-control, time orientation, memory, judgment, decision making and other cognitive processes. For example, possible psychological effects of a powerful stimulant such as amphetamine include increased alertness, focus, confidence, feelings of wellbeing and motivation. People using an amphetamine will often become happier and more confident, talkative and sociable. Many report clearer thoughts and perceptions (Alcohol and Foundation [ADF], 2018a; McKim & Hancock, 2012).

Amphetamines also stimulate the sympathetic nervous system, producing physiological changes not unlike fight–flight reactions to a threat or stressor. For example, blood pressure and heart rate increase, arousing the body and contributing to the overall energising effects. The energising effects of amphetamines can reduce feelings of tiredness and have often been used by people who want to do something active, like dance for long periods of time. As amphetamines can increase energy levels, motivation and focus, they are also used as a performance enhancer. For instance, some people use them to temporarily increase alertness, maintain wakefulness or delay sleep to work for long periods of time.

As with all drugs that are misused or abused, stimulants will have side-effects. A 'speed crash' always follows the high and may leave the person feeling nauseous, irritable, depressed and extremely exhausted for days. At very high doses and frequent heavy use, amphetamine use can result in 'amphetamine psychosis', characterised by hallucinations, paranoid delusions and out of character aggressive or violent behaviour. Psychotic symptoms are especially evident in people who abuse methamphetamine ('ice') (Advokat, Comaty & Julien, 2014; ADF, 2018a; drugscience, 2018a).

There are also measurable changes in brain wave patterns associated with stimulants and these tend to occur relatively quickly, especially for the more potent stimulants. Stimulants increase physiological arousal and there is a corresponding excitatory pattern of brain wave activity. Generally, when compared to the baseline brain wave activity of normal arousal during normal waking consciousness under normal everyday conditions that would be expected for the individual's age, there is an increase in higher frequency (faster) activity and a decrease in lower frequency (slower) activity. More specifically, there is *a pattern of increased beta wave activity and decreased delta, alpha and theta activity*. The more potent the stimulant, the longer these changes are likely to persist, and vice versa (Kennedy, 2016a; Saletu, Anderer & Saletu-Zyhlarz, 2006, 2010).

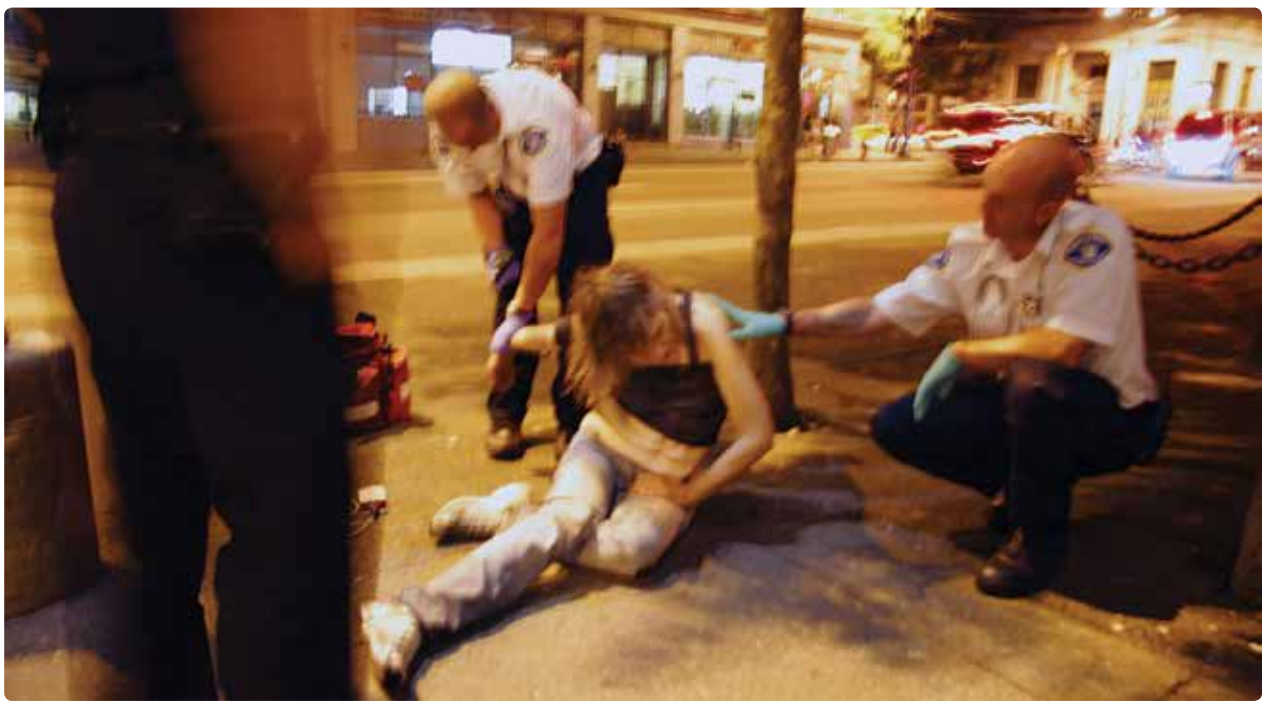


Figure 8.14 A 'speed crash' follows amphetamine use, leaving the person feeling ill and exhausted. Frequent use of high doses of amphetamines may cause the user to experience delusions and violent behaviour.

Depressants

Depressants are drugs that decrease activity in the central nervous system and the rest of the body. Generally, their effects result in a state of calm, relaxation, drowsiness, sleep or anaesthesia as doses of the drug increase. They do not necessarily make a person feel 'depressed'.

As with stimulants, depressants range from mild, widely available drugs through to strong, carefully regulated or illegal drugs. All reduce alertness, environmental awareness, responsiveness to sensory stimulation, cognitive functioning and physical activity to some extent. Loss of self-control is common. In small doses, depressants can cause a person to feel more relaxed and less inhibited. In larger doses, they can cause unconsciousness and death (ADF, 2018b).

Depressant drugs frequently multiply the effects of other CNS depressants. Thus, the depressant effects that are observed in a person who has taken more than one drug is greater than would be predicted if the person had taken only one. Such intense CNS depression is often unpredictable and unexpected, and it can lead to dangerous or even fatal consequences (Advokat, Comaty & Julien, 2014).

Barbiturates and *benzodiazepines* are the two major categories of depressant drugs used as medications, most commonly to aid sleep and sometimes to alleviate symptoms of anxiety or seizure activity. Often these drugs are referred to as sleeping pills and tranquillisers or sometimes just as sedatives. Some well-known barbiturates are secobarbital (brand name Seconal) and pentobarbital (Nembutal). Among the most common benzodiazepines prescribed in Australia are diazepam (Valium), temazepam (Normison), oxazepam (Serapax) and nitrazepam (Mogodon). Flunitrazepam (Rohypnol) is a benzodiazepine related to Valium (about 10 times more potent) that is illegally used to spike drinks. Drink spiking occurs when a person deliberately adds a drug to a drink without the knowledge of the person who will be drinking it (ADF, 2018c).

Opiates and their derivatives are another class of depressants. These include *heroin*, *morphine* and *codeine* which are primarily used as analgesics to provide pain relief. They are attractive to people seeking to induce an altered state of consciousness because they produce feelings of relaxation and euphoria. Opiates have long been abused in many cultures. When injected, the user feels an immediate 'rush' — a strong wave of pleasurable relaxation and relief from anxiety. The user may go 'on the nod' — shifting back and forth from feeling alert to drowsy. With large doses, the user cannot be awakened. Breathing slows down and death may occur. In some cases, severe drug-induced sedation can cause a flat EEG.

Figure 8.15 Depressants decrease activity in the central nervous system and the rest of the body. Alcohol is a widely available depressant. Others include medications such as sedatives that aid sleep or alleviate anxiety, and various analgesics such as heroin and morphine that provide pain relief but may also be misused or abused recreationally to induce a relaxed or pleasant ASC.

Alcohol is also classed as a depressant, which is contrary to popular belief given that it is commonly used to achieve a positive or elevated mood. Brain areas affected by alcohol include those that control inhibition, thought, perception, attention, judgment, memory, sleep and coordination. Within the nervous system, alcohol can initially have a stimulant phase followed by a more prolonged depressant phase (Hendler, et al., 2013). Higher levels of alcohol inhibit or slow brain functioning, with the depressant effects seen behaviourally. For example, alcohol dampens motor and sensory areas and makes perceptual judgments, co-ordination and balance more difficult. Risky behaviour is also a common result of alcohol use because areas involved in decision-making and self-control are dampened. High enough concentrations can cause the user to eventually lose consciousness. The effects of alcohol consumption together with another drug(s) — including over-the-counter or prescribed medications — can be unpredictable, dangerous and even fatal (ADF, 2018d; drugscience, 2018b).

As with stimulants, various depressants designed for medical purposes are also used recreationally. People misusing or abusing depressants generally take larger doses than would be prescribed. Typically, the desired effect is an elevated mood, with bad feelings of tension or dejection replaced by a relaxed, pleasant state accompanied by lowered inhibitions.

There are also measurable changes in brain wave patterns associated with depressants. Depressants decrease physiological arousal and there is a corresponding inhibited pattern of brain wave activity. Generally, there is an increase in lower frequency (slower) activity and a decrease in higher frequency (faster) activity. More specifically, there is *a pattern of reduced beta wave activity and increased delta, alpha and theta activity* (Kennedy, 2016a). As with stimulants, the more potent the depressant, the longer-lasting these changes are likely to persist, and vice versa. Similarly, measurable changes depend on other usage related variables, as well as the specific procedures used by researchers conducting their EEG studies (Gunkelman, 2009; Kumar & Palatty, 2013; Saletu, Anderer & Saletu-Zyhlarz, 2006, 2010).

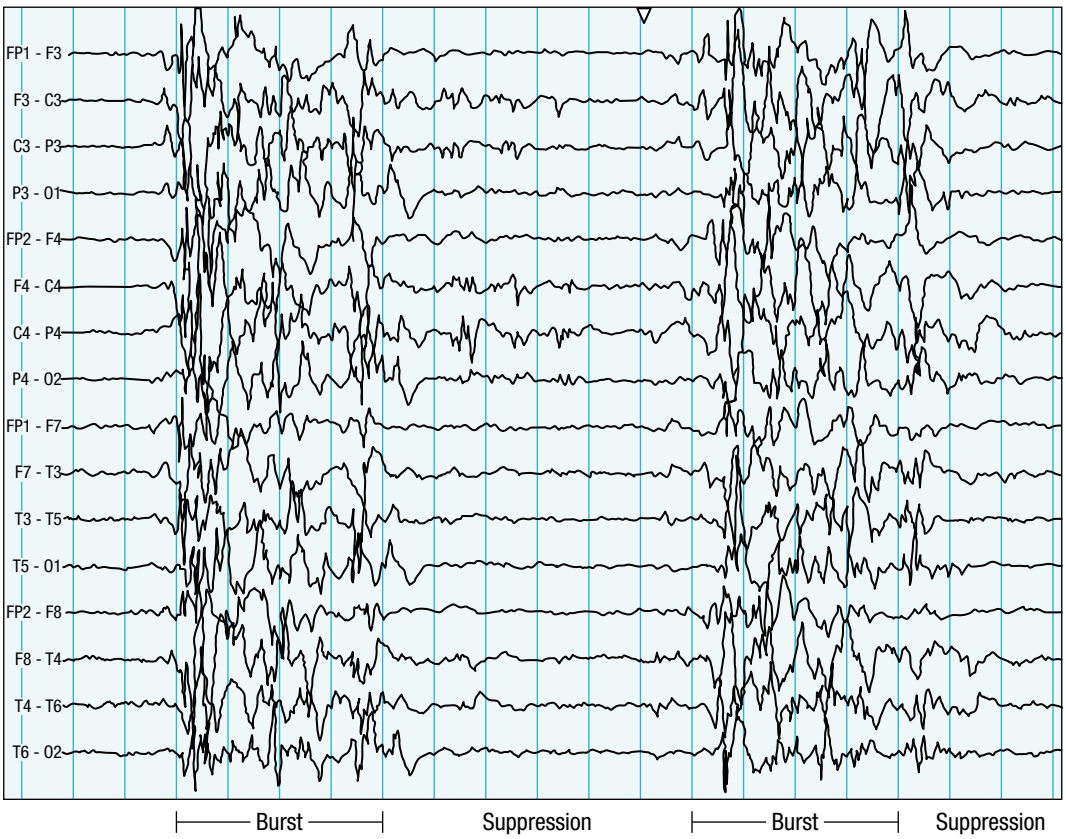


Figure 8.16 In high dosage or severe depressant overdose cases, the EEG may show a burst suppression pattern. This usually consists of bursts of EEG activity every 2 to 10 seconds separated by periods of suppression during which there is little or no EEG activity. This pattern can last for hours or even days depending on whether the depressant is still present.

Source: Saletu, B., Anderer, P., & Saletu-Zyhlarz, G.M. (2006). EEG topography and tomography (LORETA) in the classification and evaluation of the pharmacodynamics of psychotropic drugs. *Clinical EEG Neuroscience*, *37*, 66–80.

BOX 8.3 Sleeping tablets

What are sleeping tablets?
They are drugs that you take to try to get to sleep or stay asleep. Some tablets that are used to help with sleep have been specifically created for this. Other types (e.g. antihistamines) are used to treat other medical problems and feeling sleepy is a common side effect.

What are some of the commonly used sleeping tablets?
Benzodiazepines — This group includes Temazepam, Mogadon, Normison and Serepax. You can only get them on prescription. They are used to treat insomnia in the short-term (usually 3–4 weeks). In the longer term they can stop working. There is also the risk of 'getting hooked' on them.

Antidepressants or *antipsychotics* — This group includes antidepressants (e.g. Doxepin, Endep, Dothiepin, Avanza) and antipsychotics (e.g. Seroquel or Zyprexa). They are prescription only. In most cases, they are prescribed when sleep problems occur with mental health problems.

Antihistamines — You don't need a prescription to get these from pharmacies but they're not designed as sleeping tablets. They can be very sedating and can last a long time. You can end up feeling more tired in the morning which is potentially dangerous, for example, when riding a bike or driving. The effect of an antihistamine such as Restavit and Phenergan tends to wear off quickly.

Important things to know about sleeping tablets
- They can only deal with sleep problems in the short term.
- You should only use them for more than four weeks on the advice of your doctor.
- They can cause side effects such as dependence.
- Using them with other drugs or alcohol can be dangerous.
- They tend to help more to get you to sleep than to stay asleep.
- If you take them every night, they might not work as well as they used to.
- There are other things that can be tried if you are having problems with your sleep

Source: Sleep Health Foundation (2018). *Sleeping tablets* [Facts sheets]. Retrieved from https://www.sleephealthfoundation.org.au/public-information/fact-sheets-a-z/sleeping-tablets.html

Electromyograph (EMG)

The **electromyograph**, or **EMG**, is used to detect, amplify and record the electrical activity of muscles. EMG recordings generally show the strength of electrical activity occurring in the muscles, which indicates changes in muscle activity (movement) and muscle tone (tension). This data is obtained by attaching electrodes to the skin above the relevant muscles. Sometimes the activity in facial muscles is recorded. At other times, leg muscles, muscles on the torso (main part of the body), or a combination of these are recorded.

The records of the EMG are displayed as line graphs, similar to those produced by the EEG. They can be produced on paper or on a computer monitor.

EMG records show that there are identifiable changes in muscular activity during certain states of consciousness. For example, when falling asleep, we usually become less and less alert as we drift into deeper stages of sleep. While this is occurring, our muscles progressively relax (i.e. decrease in muscle tone). There are also distinguishable periods when our muscles may spasm (during light sleep) or be completely relaxed (during deep sleep). Overall, though, EMG measures of people during different states of consciousness indicate that the higher the level of muscular activity and tone, the more alert we tend to be and vice versa.

Electro-oculargraph (EOG)

The **electro-oculargraph**, or **EOG**, measures eye movements or eye positions by detecting, amplifying and recording electrical activity in eye muscles that control eye movements. This is done through electrodes attached to areas of the face surrounding the eyes. The records of the EOG are displayed as line graphs, similar to those produced by the EEG and EMG. They can also be produced on paper or on a computer monitor.

The EOG is most commonly used to measure changes in eye movements over time during different types and stages of sleep and while dreaming. In particular, sleep research studies that have used EOGs have been of immense value in clarifying the distinction between the two different types of sleep called *rapid eye movement* sleep and *non-rapid eye movement* sleep.

Figure 8.17 EMGs and EOGs are used to record muscle activity and eye movement during studies of consciousness, most commonly during sleep to study changes during different sleep stages, including dream periods. Electrodes attached to the skin on facial areas above muscles that control eye movements detect electrical activity of the muscles and hence eye movements. These are then amplified and recorded.

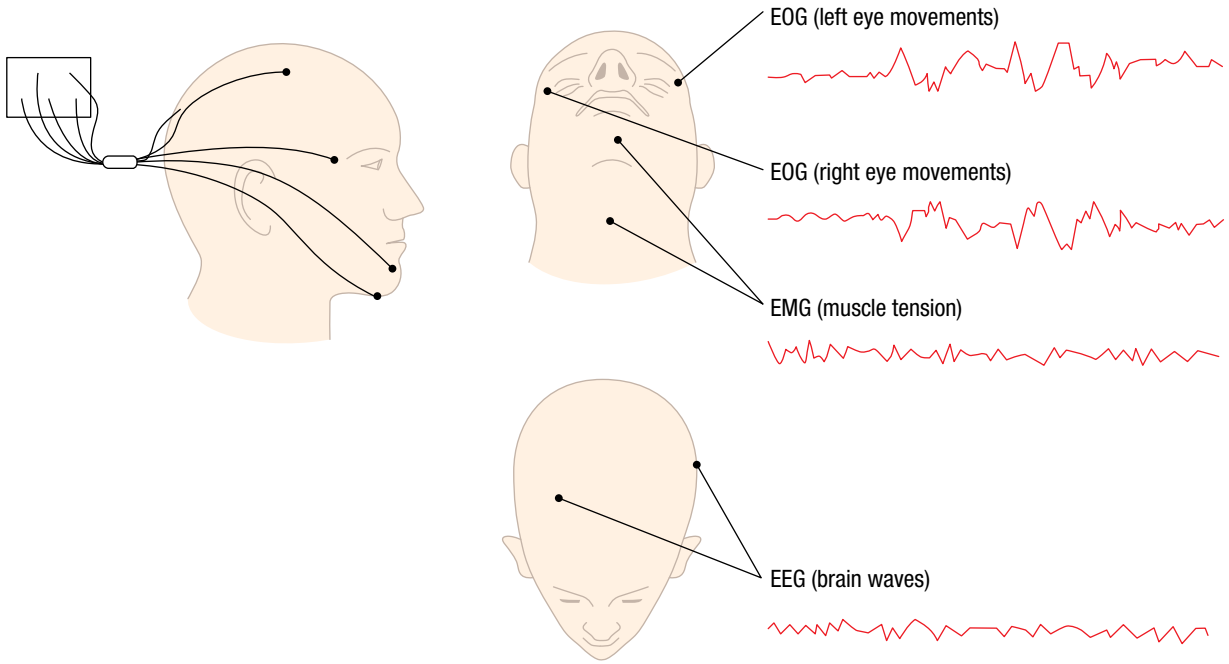


Figure 8.18 Three commonly measured physiological responses when studying consciousness are electrical activity of the brain, measured using an EEG; muscle tension, measured using an EMG; and eye movements, measured using an EOG. Electrodes that are strategically placed on the scalp (EEG), around the eyes (EOG) and near muscles on the face and body (EMG) detect, amplify and record patterns of activity.

LEARNING ACTIVITY 8.9

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Word copy of table

Review questions

1. Construct a table that summarises the three devices used to measure physiological responses during different states of consciousness. Headings should include: *name of device, what it measures* and *examples of responses associated with alertness or SOCs.*
2. (a) Explain the difference between frequency and amplitude in relation to brain waves.
   (b) Which brain wave is the fastest? the slowest?
3. Construct a table that summarises the frequency (slow or fast) and amplitude (large or small) of the four different kinds of brain wave patterns and levels of alertness and behaviours with which each pattern is associated.
4. Name the brain waves shown below.
   (a) _____
   (b) _____
   (c) _____
   (d) _____
5. For each of the following activities, state which brain wave pattern(s) would most likely be dominant — alpha, beta, theta or delta:
   (a) lying on the beach, having just fallen asleep
   (b) playing a video car racing game
   (c) using a phone app to measure your heart rate when relaxed
   (d) using visual imagery when entirely focused on a creative task
   (e) naturally awakening from a normal sleep episode
   (f) being woken up by an alarm mid-dream during a normal sleep episode
   (g) in the deepest stage of sleep
   (h) learning how to use a mathematical formula for the first time
   (i) watching a Disney family movie
   (j) anaesthetised
   (k) feeling frightened by an approaching unleashed dog
   (l) feeling very drowsy and struggling to keep eyelids open
   (m) feeling very elated on learning about an excellent result for an important assessment
   (n) worried about being late when on the way to a job interview
   (o) resting with eyes closed, just having entered a relaxed meditative state
   (p) extremely relaxed in a very deep meditative state
   (q) making a reflexive response to painful stimulation when in a coma
6. Complete the following table to summarise changes in levels of alertness as indicated by changes in brain wave patterns due to drug-induced ASCs.

Drug type	Examples of drugs	Overall effect on the nervous system and body	Brain wave pattern
stimulant			
depressant			

Measurement of speed and accuracy on cognitive tasks

The EEG, EMG and EOG involve measurement of physiological responses in the study of consciousness. Researchers also study psychological and behavioural responses during different states of consciousness. This may be achieved using objective and/or subjective measures.

The speed and accuracy of responding are two commonly used objective measures. For example, a researcher may measure speed and accuracy of participants when perceiving and responding to road stimuli in a driving simulator after different periods of sleep deprivation, ranging from 30 minutes through to a day or more. Similarly, speed and accuracy may be used to assess how varying amounts of a stimulant or depressant affect performance on a cognitive task involving learning, memory, spatial processing, reasoning, decision making or problem solving. In most speed and accuracy experiments, participants complete one or more cognitive tasks (sometimes called *neurocognitive assessments*) across a number of trials and mean scores are calculated.

Measurement of **speed** typically involves response or reaction time to a stimulus — how much time elapses between the presentation of some stimulus and the individual's response to the stimulus. This is usually measured in thousandths of a second (called milliseconds). These time measures are very small but nonetheless significant. Mental events and their underlying processes when performing a cognitive task take time. Precise measurements enable researchers to pinpoint how long it takes in real time to complete them. In a driving simulator, the speed measure often involves 'perception reaction time' to unpredictable road stimuli such as traffic lights, railway level crossing signals, road signs, pedestrians and other vehicles. Many speed reactions in real world tasks involve an initial reaction time, followed by a precise movement which also contributes to the overall response time. Consequently, the researcher may take account of this aspect too.

Measurement of **accuracy** typically involves the number of correct responses and incorrect responses (errors) made

by the individual. Usually, the researcher calculates the proportions of correct and incorrect responses in relation to the total number of possible responses to pinpoint accuracy. In a driving simulator study, accuracy may be measured in relation to the number of road stimuli to which the participant correctly reacts.

Speed and accuracy are considered *objective* performance measures because their scores are not subject to personal opinion or interpretation by the researcher. For example, speed can be measured using an electronic timing device which will provide exactly the same data regardless of the researcher collecting it. In addition, the data collected can be verified (confirmed) by another researcher. Similarly, accuracy can be measured in terms of responses with clear cut boundaries such as 'Yes' or 'No' and 'Present' or 'Not present' that are not open to interpretation and therefore vulnerable to personal opinion or bias. Such responses can also be electronically recorded to maintain objectivity. In many cases, measurements are computer assisted, requiring responses involving a simple tap of a key following presentation of an onscreen stimulus, a procedure which captures both speed and accuracy.

In a typical experiment, an aspect of consciousness and a relevant cognitive task are isolated and operationalised for study. Under different conditions involving experimental and control groups (or a repeated measures design), both the speed and accuracy of performance are then measured (often scored digitally by computer), usually multiple times (in different trials) to help ensure reliability of the results.

For example, the effects of drowsiness when awakened from deep sleep on processing verbal information in short-term (working) memory could be assessed in an independent groups experiment. Participants may be presented with anagrams (scrambled words) one at a time, then required to select the correct word for each anagram from among alternatives. They would usually be instructed to respond as quickly and accurately as possible. This would clarify requirements and also help ensure participants do not focus more on accuracy than speed, or vice versa. For each experimental condition, accuracy would depend on the number of errors and speed would be calculated as the mean of response times by all participants on each trial (sometimes assessed on correct trials only).

In some experiments, it is not uncommon for a researcher to exclude response times that are extreme ('outliers') and vary too much from the mean (e.g. 2.5 standard deviations) because they could be attributable to an accidental key press. In all experiments, however, both speed and accuracy scores are considered when assessing performance under different conditions. In relation to speed, faster = better performance and for accuracy, fewer errors = better performance (Glickman, Gray & Morales, 2005).

For a wide variety of real world cognitive and behavioural tasks we perform in everyday life, speed and accuracy tend to be highly related — the faster responders tend to also be more accurate, and vice versa, regardless of the type of movement required when responding. For example, in a driver drowsiness study, the required response may involve a foot movement such as pressing on a brake or accelerator pedal in a simulator rather than a hand movement. Experience on a task ('practice') also tends to improve both speed and accuracy over long periods of time. For some tasks, however, we may intentionally change our performance to respond faster if necessary, but at the cost of reducing the accuracy of our response. Similarly, if high accuracy is required, then we can compromise speed and slow down our response time in order to increase our accuracy if we want to (Glickman, Gray & Morales, 2005; Proctor & Vu, 2003; Triggs & Harris, 1982).

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Weblink
Example of a poster report on EEG stimulant and depressant research using a speed and accuracy measure

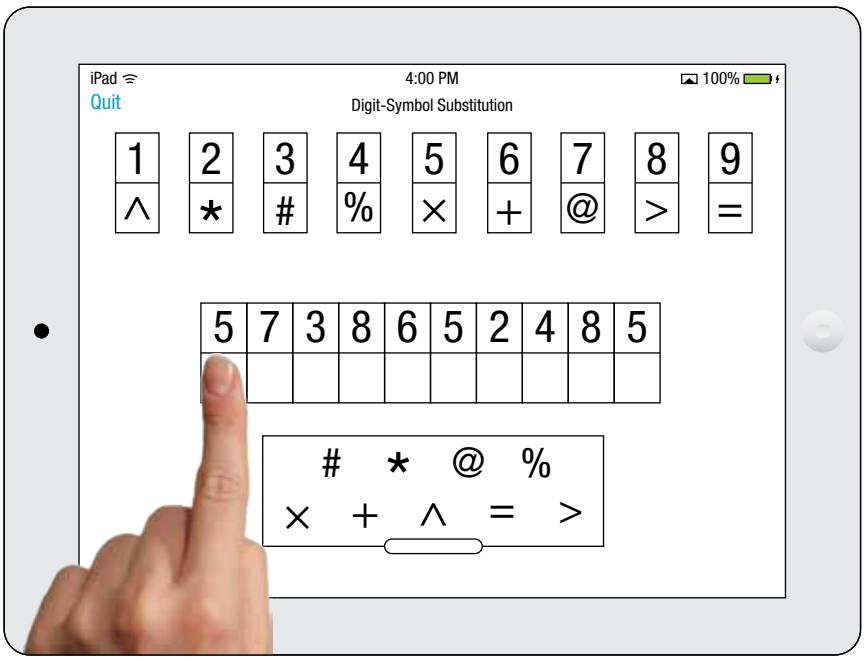

Figure 8.19 An example of a computer-delivered cognitive task that usually requires speed and accuracy. Shown is a digit symbol substitution test. Note the digit-symbol pairs top of screen. The test taker must match each number at centre screen with its corresponding symbol as fast as possible. Symbols can be dragged from the panel at the bottom of the screen and dropped into place. The number of correct symbols within the allowed time (e.g. 90 or 120 seconds) is usually measured.

Subjective reporting of consciousness — sleep diaries

Subjective reporting involves the use of *self-reports* — the participant's written or spoken responses to questions, statements or instructions presented by the researcher.

Self-reports are considered to be *subjective* because the data collected from a participant is based on their personal opinion, interpretation, point of view or judgment. Unlike data obtained through objective measures, subjective data is often biased, can vary from person to person, day to day from the same person, and is not always entirely accurate. However, this does not mean that subjective reporting is not useful or cannot provide valuable information about consciousness. Often, asking someone to report one or more aspects of their experience during normal waking consciousness or an altered state is the most appropriate and best way of obtaining information of research interest.

Subjective reporting via self-reports is commonly used in the study of sleep. The sleep diary, sometimes called a *sleep log*, is the most widely used method. A **sleep diary** is a 'log' used to self-record and self-report sleep and waking time activities over a period of time, usually one week or more. When the activities are to be recorded for children, a parent may maintain the required records.

Sleep diaries are most often used in conjunction with physiological measures such as EEG and EMG to support the assessment of sleep disturbances or disorders, particularly their nature, severity and possible causes. Sleep diary recording typically involves *self-monitoring* of relevant data, whereas physiological measures involve data collection by someone else. The data an individual is required to record in a sleep diary depends on what is being investigated. For example, records may be kept of:

- the time when trying to fall asleep
- the time when it is believed sleep onset occurred
- the number, the time and length of awakenings during sleep
- the time of waking up in the morning
- the time of getting up after waking up in the morning
- how well rested the individual feels upon awakening
- how sleepy the individual feels at different times during the day.

In addition, records may be kept of events that can affect sleep, such as naps, the number of caffeinated or alcoholic drinks, use of medication, meals, exercise type, time or length, and other potentially influential activities when awake or asleep. Records may be in paper and pencil format or digital.

The sleep diary records are analysed by the researcher to identify patterns of behaviour or practices of relevance to their topic of research interest. If the researcher is investigating a sleep onset disturbance, they will be interested in behaviours that might be interfering with sleep. For example, participant habits such as vigorously exercising at night, watching television or using social media in bed have all been found to impair sleep onset.

Figure 8.20 A sleep diary is a type of self-report that can be used to analyse patterns or practices that are helping or hindering sleep. Record keeping is relatively simple and requires minimal time each day.

An example of sleep diary data and record keeping is shown in Figure 8.21 opposite. The eBookPLUS has links to examples of other versions of a sleep diary. In all cases, the participant (or patient) is given detailed verbal and written instructions on how to record entries and maintain the diary.

Video monitoring

Video monitoring is most commonly used in the study of sleep and sleep disturbances or disorders. Most sleep centres, clinics or laboratories are fitted with one or more video cameras to record externally observable physiological responses throughout a sleep episode, including behaviours when falling asleep and when waking. Video monitoring may also be conducted in a home environment.

Responses that may be observed include:

- changes in posture or body position
- amount of 'tossing and turning'
- sleep-related breathing problems
- what happens when awakening from a nightmare or night terror
- behaviours associated with sleepwalking.

These types of responses can be examined together with those of other types of recordings, then linked to different sleep stages, sleep types or the specific aspect of sleep under investigation. Video monitoring is particularly important with participants (or patients) who have a serious sleep disorder.

Video cameras can simultaneously record sounds and use infrared technology so that recordings can be made in conditions of little or no light. Recordings are made in real time, but computer-assisted technologies can be used for later analysis of a scene or even a single frame. For example, software packages can be used for frame-by-frame analysis (motion segmentation), enhancement of blurred images and 3D enhancements.

Sleep diary

Instructions

1. Write the date, day of the week, and type of day: work, school, day off or vacation.
2. Draw a downward arrow (↓) when you lie down to sleep.
3. Draw an upward arrow (↑) when you wake up.
4. Shade in all the boxes that show when you are asleep at night or when you take a nap during the day.
5. Leave boxes unshaded to show when you are awake at night and when you are awake during the day.
6. Write the following letters in the diary when you do any of the following:
   C = when you have coffee, cola, tea or an energy drink
   M = when you take medicine
   A = when you drink alcohol
   E = when you exercise
7. Complete this diary in the morning and evening. Do not complete this diary during the night. Write any additional comments on the back.

SAMPLE

Date	6 am	8 am	10 am	12 pm	2 pm	4 pm	6 pm	8 pm	10 pm	12 am	2 am	4 am	6 am
16 August	↑	C		M			A	M	↓				

WEEK 1

Date	6 am	8 am	10 am	12 pm	2 pm	4 pm	6 pm	8 pm	10 pm	12 am	2 am	4 am	6 am

Figure 8.21 Example of sleep diary data and record keeping

eBook*plus*

Weblinks
- Sleep Health Foundation (Aust) sleep diary
- National Sleep Foundation (USA) sleep diary
- Sleep Council (UK) sleep diary

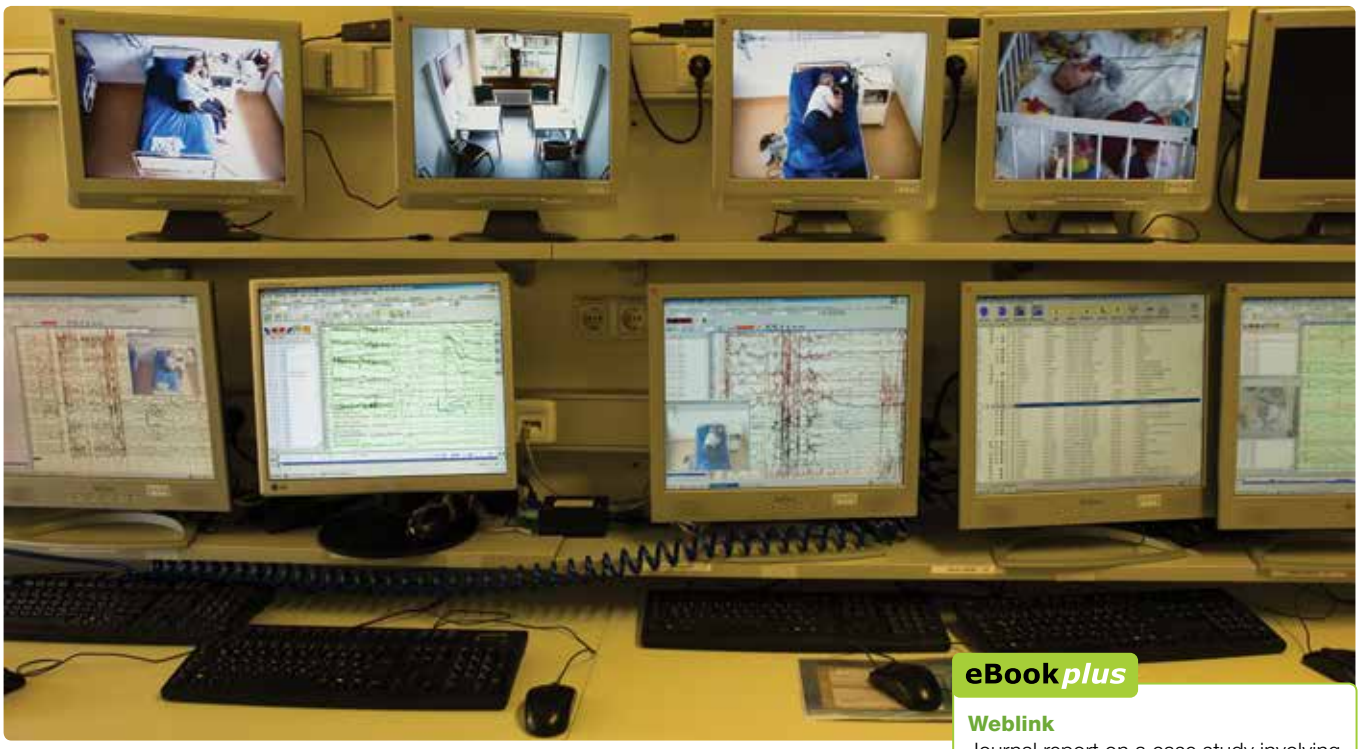

Figure 8.22 Video monitoring allows changes in responses, such as changes in position and 'tossing and turning', to be observed in a sleep laboratory.

eBook*plus*

Weblink
Journal report on a case study involving use of home video monitoring for data collection on sleepwalker behaviour

LEARNING ACTIVITY 8.10

Review questions

1. Distinguish between each of the following with reference to examples relevant to consciousness:
   (a) objective and subjective measures
   (b) physiological and psychological responses.
2. (a) Explain how a measure of speed and accuracy on a cognitive task could be used to identify or describe someone's level of alertness.
   (b) Suggest an example of a study of alertness using speed and accuracy, other than an example given in the text.
3. Explain, with reference to relevant statistics, why individual scores with a standard deviation of 2.5 or more are sometimes discarded by researchers using speed and accuracy measures.
4. (a) What is a sleep diary and what data is commonly recorded?
   (b) How are the recorded data likely to be used by a sleep researcher or clinician?
   (c) Why is the sleep diary referred to as a self-monitoring method?
   (d) Suggest an advantage and a limitation of using a sleep diary for research purposes when compared with a sleep questionnaire using closed-ended questions.
   (e) One limitation of sleep diaries from a researcher's perspective is that they are non-standardised.
      (i) What does non-standardised mean in relation to sleep diaries?
      (ii) What is a potential benefit of standardising sleep diaries for specific sleep disorders?
      (iii) What are two other potential limitations of sleep diaries?
5. (a) What does video monitoring involve?
   (b) Give an example of when video monitoring might be useful for a study on an aspect of normal waking consciousness rather than sleep.

CHANGES IN PSYCHOLOGICAL STATE DUE TO LEVELS OF AWARENESS

Most of our life is spent in normal waking consciousness. Although we shift between different states within normal waking consciousness, our awareness is most often at a heightened level. When we are awake, aware and alert, we know the world is real, we have a sense of time and place, our perceptions and thoughts tend to be organised, clear and meaningful, and we can usually maintain a good deal of control over how we think, feel and behave. Our experience of normal waking consciousness provides the standard by which we judge other states as being altered, distorted or unreal in some way.

When describing, analysing or comparing different states, psychologists do not only refer to the level of awareness. Other qualities of the 'awareness' experience to which they may refer include the contents of consciousness, use of controlled or automatic information processing when engaged in one or more tasks, perceptual and cognitive distortions, changes in emotional awareness, changes in self-control and the experience of real time.

Content limitations

Generally, the *content*, or information and other stimuli of which we are aware, held in our normal waking consciousness tends to be more restricted, or limited, than the content of consciousness during an altered state. We are able to exercise some control over what we allow into our normal waking consciousness, for instance, through selective attention. Because a significant amount of information that enters our consciousness is within our conscious control during normal waking consciousness, we can block our awareness of information that makes us feel self-conscious, embarrassed, sad, repulsed, afraid, hurt and so on. However, during altered states of consciousness we generally don't have the same control, therefore the content of our consciousness is not as limited.

The content of normal waking consciousness also tends to be more organised and logical than that in an altered state of consciousness. For example, when we are awake and alert, we are generally able to follow logical steps in solving a simple, everyday problem. By comparison, when we are in an altered state of consciousness, such as when dreaming, the content of our consciousness — the images and content of our dreams — is often nonsensical, illogical and disorganised.

Controlled and automatic processes

Towards the total awareness end of the consciousness continuum are the states of consciousness experienced during activities demanding a lot of attention or concentration, such as playing a computer game, solving a complex problem during an exam, or abseiling down a steep and dangerous rock face. According to American psychologists Walter Schneider and Richard Shiffrin (1977), who led research in this area, activities such as these use a controlled process.

A **controlled process** is a type of information processing that involves conscious, alert awareness and mental effort in which the individual actively focuses their attention on achieving a particular goal.

Figure 8.23 (a) Successful execution of this performance by each individual involves a controlled process with a high level of attention. (b) Relatively simple tasks such as taking a photo may also involve a controlled process for successful execution.

A controlled process is often required when a task is novel (unfamiliar) or difficult. For example, when you first learn to drive a manual car, you require controlled processing. You have to concentrate on steering correctly while coordinating use of the accelerator and brake, as well as monitoring events outside the vehicle such as traffic, pedestrians, road signs and traffic lights. When you are learning to drive, you require a lot of concentrated attention.

Controlled processing of information tends to be *serial*; that is, you can usually only perform one task involving a controlled process at a time. It is effortful, makes heavy demands on attention and requires a high level of conscious awareness to be dedicated to a task. It also tends to be relatively slow. For example, because it is often required in unfamiliar or new situations, we don't have a reliable way to respond quickly.

As you gain experience, however, driving becomes a more automatic process that does not demand the same level of attention. Generally, experienced drivers have little trouble driving, listening to music or talkback radio and maintaining a conversation with a passenger all at the same time. This is because driving a vehicle, as well as detecting and interpreting important information about traffic and the environment that is needed to drive safely, occurs more automatically and requires less attention for the well-practiced driver than for inexperienced drivers. Any activity that requires a low level of attention and therefore a low level of conscious awareness usually involves automatic processing.

According to Schneider and Shiffrin (1977), an **automatic process** is information processing that involves little conscious awareness and mental effort, minimal attention and does not interfere with the performance of other activities. It is used when a task is simple or familiar and tends to be rapid (e.g. an experienced driver can usually reverse-park more quickly than a learner driver). Unlike controlled processing, automatic processing also tends to be *parallel*. This means that we usually can handle two or more tasks at the same time.

Despite the automatic nature of some tasks, an individual's state of consciousness can influence information processing. For example, some ASCs involve a lower level of awareness and therefore alertness. Consequently, a task ordinarily involving automatic processing may not necessarily be so easy to perform when in an ASC. Consider, for example, how being in a significant alcohol-induced state can impair bicycle riding or the ability to drive a motor vehicle even for the most experienced riders or drivers.

studyon

Figure 8.24 When we learn a new task, it is often complex at first and we depend on controlled processing. This enables us to selectively focus our attention on each important aspect of the task. When the task becomes familiar we are often able to use automatic processing, enabling us to divide our attention between a range of other mental and/or physical activities.

Perceptual and cognitive distortions

Compared with normal waking consciousness, the way we experience sensations and perceptions in an ASC is often different. An ASC tends to have one of two effects on the senses — it either makes them more receptive to external stimuli, or dulls them to such an extent that some sensations are not experienced at all. For example, some drug-induced ASCs make perception of sensory experiences more vivid, so that colours seem brighter, tastes and smells stronger, sounds louder or more variable, and touch more sensitive. In some instances, people may even hallucinate, experiencing perceptions of stimuli or events that are not really occurring. They may see visions or hear non-existent voices. Alternatively, during meditation, an individual may be able to focus their concentration to such an extent that their normal pain threshold (tolerance) is so high that regardless of what is done to them, they report experiencing no pain at all.

Perceptions can be so distorted in an ASC that people may lose their sense of identity (who they are). Some people experience the feeling either that they are someone else or that they are 'outside themselves' looking in. The feeling of losing touch with reality accompanies many ASCs.

Cognitive functioning also tends to become impaired during an ASC. Thought processes are often more disorganised during a waking ASC, as well as during the ASC of dreaming when asleep. In an ASC, thinking is often illogical and lacking in sequence, and difficulties may be experienced in decision making and problem solving. In addition, people often have trouble remembering events that occur during an ASC. For example, after experiencing an alcohol-induced ASC, people are often unable to recall in detail the events that occurred while they were intoxicated. ASCs induced through marijuana use also result in short-term memory impairment and subtle changes in thinking. In addition, when in an ASC, some individuals also have difficulty recalling information from long-term memory. However, retrieval of information from memory is usually restored when the individual returns to normal waking consciousness.

Emotional awareness

A change in our awareness and experience of emotion is also associated with many ASCs. ASCs appear to sometimes put an individual's feelings into a state of turmoil, resulting in uncharacteristic responses. For example, in an alcohol-induced ASC, some people become more emotional and may express their emotions more openly than in normal waking consciousness. In other ASCs, people have reported feeling emotionless. They have no feelings at all for events or situations that in normal waking consciousness would produce a highly emotional reaction in them. ASCs have also been associated with inappropriate emotional reactions, such as laughing at being told of a friend's death or crying when told a joke. Unpredictable emotional responses are also often associated with ASCs. While intoxicated, for example, an individual may burst into tears or become highly aggressive or excitable for no apparent reason.

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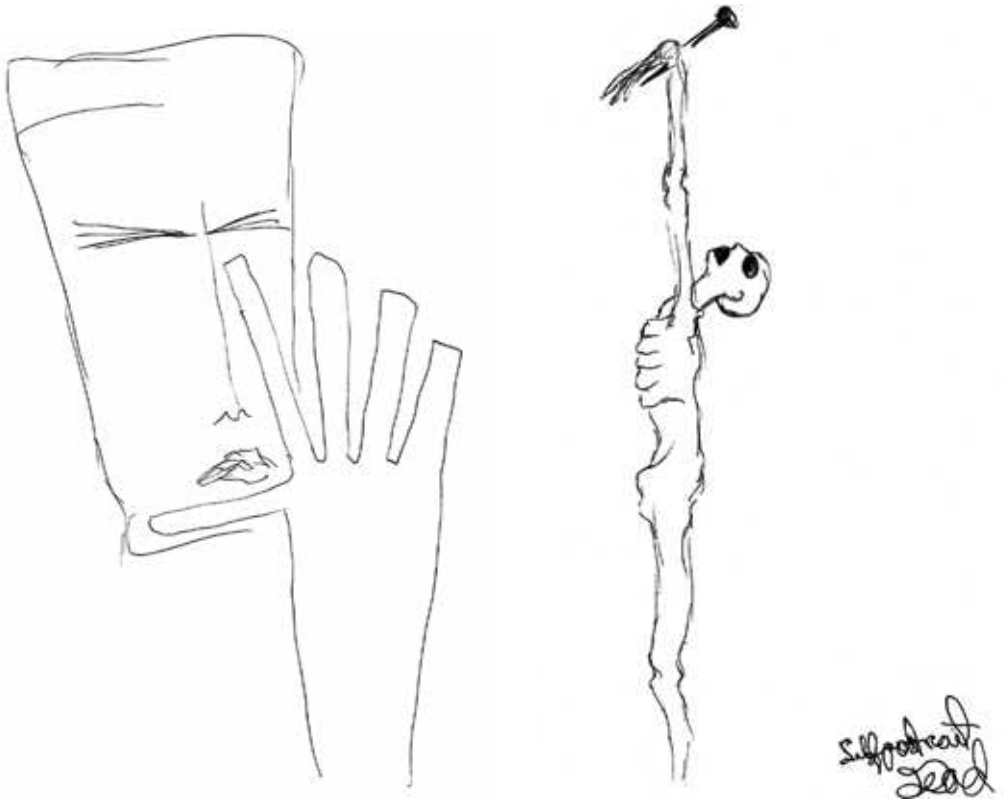

Figure 8.25 When in an ASC, people typically experience alterations in their perception of the world. These sketches were drawn by a person while in a drug-induced ASC.

Self-control

Changes in our ability to maintain self-control are often evident during ASCs. For example, in an alcohol-induced ASC, individuals often have difficulty coordinating and controlling movements, sometimes being unable to walk down a hallway without stumbling into the walls. As described previously, they may also have difficulty maintaining control of their emotions; for example, behaving aggressively or affectionately to people with whom they would normally not behave this way in a state of normal waking consciousness. Additionally, emotional responses may be amplified; for example, stronger or in excess or what would normally occur when not in the ASC.

Similarly, when in a hypnotic state, people are more susceptible to suggestion than when in their normal waking state. This can result in them behaving in a less inhibited way. An ASC induced through hypnosis has also been shown to help people gain greater self-control. For example, therapeutic use of hypnosis has helped some people to stop smoking, gambling or overeating and has assisted others to manage chronic pain (Miller & Bowers, 1993).

Figure 8.26 This Thai woman is able to control her pain response while in an altered state of consciousness when being pierced for a culturally important festival.

Time orientation

Time orientation generally refers to our perception of time and time-related experiences in relation to the past, present and future (Zimbardo & Boyd, 1999). In NWC, we are ordinarily aware of our present circumstances and can choose to reflect on past experiences or contemplate future experiences. In some ASCs, however, there may be a loss of 'contact' with time or our perception of time to the extent that there is a loss of awareness of the past, present and/or future. This may occur in a naturally occurring altered state, such as during sleep or when daydreaming, or in a purposely induced altered state, such as when in a drug-induced state or a relaxed, meditative state.

Estimation of time is frequently distorted in an ASC. Time seems to pass at a different speed than normal. For some individuals in some ASCs, the passing of time may appear to be quicker, while in other ASCs, time appears to pass very slowly. For example, when you are woken from a nap you may be surprised to learn that only an hour has passed since you fell sleep. It may seem as though you have been asleep for much longer. At other times, you can feel as though you have slept for a much shorter time than you actually have.

Figure 8.27 Time may appear to pass quickly to a person in an alcohol-induced ASC.

eGuide*plus*

Practical activity
Perception of time during an ASC

Weblinks
Zimbardo Time Perspective Inventory

BOX 8.4 Automatic processing and the Stroop effect

Automatic processing has been demonstrated by the Stroop effect. In a series of three well-known experiments, American psychologist John Ridley Stroop (1935) found that participants were slower to perform a task and made more errors when they were required to visually process incongruent (conflicting or mismatched) information.

For example, consider the tasks in Table 8.1 opposite. In condition 2, participants found it difficult to name the colour of the ink of a printed word if the actual word was the name of a different colour, such as the word *red* written in purple ink. Furthermore, in condition 4, they often stated the *name* of the word by mistake (e.g. red) when they were required to identify the *colour* of the print (e.g. purple).

Stroop used a different group of research participants for each of the three experiments. In addition, a repeated measures research design was used with each experiment — each participant was involved in both the experimental and control condition). Counterbalancing was also used to control potential order effects of practice and fatigue — half the participants attempted one experimental condition first, followed by the other experimental condition, while the other half of the participants attempted the two experimental conditions in the reverse order.

In all three of Stroop's experiments, participants took significantly longer to identify an incongruent colour (where there were conflicting tasks) than to identify a colour under any other kind of condition. The greatest difference was noted in the second experiment, where participants took 73% longer to identify an incongruent colour than to identify the colour block.

The findings of this research have become known as the Stroop effect. The *Stroop effect* is the observation that it takes longer to name the colour of the ink in which a word is printed if the word spells the name of a different colour than it does to identify a block of colour. It has been proposed that the Stroop effect occurs because when we are presented with a word, our automatic response is to read the word (Macleod, 1991). When we are simultaneously confronted with competing cognitive tasks — that is, to read a word that names a colour and to identify the colour of the print — our automatic response to read interferes with our attempt to name the colour of the print. Thus, completing the latter task of colour identification requires cognitive effort and attention as well as controlled processes (Lindsay & Jacoby, 1994).

Using variations of the Stroop experiments, psychologists have found that even when there is no incongruence in the task, such as when a familiar word such as 'truck' is printed in different colours, automatic processing still makes it difficult not to read the words when people are asked to name the colour of the print (as in Table 8.1, condition 4). It seems that when we are simultaneously presented with more than one cognitive task, those tasks involving automatic processing override tasks that involve controlled processing. In fact, some researchers have found that when presented with conflicting stimuli, we cannot prevent automatic processing from dominating — even if we want to (Macleod, 1991; Macleod & MacDonald, 2000).

TABLE 8.1 Various conditions of the Stroop task

Condition 1: Colour words in black print **Task:** *Read the word*	**Condition 2:** Incongruent colour words **Task:** *State the colour of the ink*	**Condition 3:** Blocks of colour **Task:** *State the colour of the block*	**Condition 4:** Familiar words in colour print **Task:** *State the colour of the ink*
red	red		truck
green	purple		store
blue	green		couch
purple	brown		table
brown	blue		shirt
green	green		store
brown	red		couch
red	brown		truck
purple	blue		shirt
blue	purple		table

eGuide*plus*

Practical activity
Controlled versus automatic processing — testing for the Stroop effect

Weblink
Online Stroop effect demonstration

LEARNING ACTIVITY 8.11

eBook*plus*
Word copy of tables

Review questions

1. Define the meaning of controlled and automatic processes.
2. Complete the following table to compare and contrast controlled and automatic processes.

Feature	Controlled process	Automatic process
level of conscious awareness required		
level of attention/mental effort required		
selective or divided attention		
speed at which the processing is performed		
task complexity		
ability to undertake other tasks simultaneously		
example		

3. (a) Describe a task you have learned that initially involved controlled processing but that you can now perform using automatic processing.
(b) What change in level of attention was required to perform the task during learning compared with after the learning?
(c) How do you know this task now involves automatic processing rather than controlled processing?
4. (a) Describe a task that you are currently learning that involves controlled processing.
(b) How will you know when your performance of this task involves automatic processing?
5. Are controlled and automatic processes likely to involve explicit or implicit memories? Explain your answers.

(continued)

(continued from previous page)

6. Complete the following table to summarise changes in psychological states associated with levels of alertness.

Characteristics	Description	Examples	
		NWC	ASC
content limitations			
controlled and automatic processes			
perceptual and cognitive distortions			
emotional awareness			
self-control			
time orientation			

7. Give an example of each of the following possible measures of consciousness:
(a) an objective measure
(b) a subjective measure
(c) a behavioural or performance measure.

8. Give two examples of psychological indicators and two examples of physiological indicators of an individual's state of consciousness.

COMPARING EFFECTS OF ONE NIGHT OF FULL SLEEP DEPRIVATION VS LEGAL BLOOD-ALCOHOL CONCENTRATIONS

In an influential study on how sleep deprivation can change conscious experience and adversely impact on human performance, Australian psychologist Drew Dawson and neurologist Kathryn Reid (1997) identified a significant relationship between fatigue due to a moderate level of sleep deprivation, legal levels of alcohol consumption and impaired performance. They found that performance on a variety of cognitive tasks following 17 hours of full sleep deprivation (which they called 'sustained wakefulness') had decreased to a level that was equivalent to that of a person with a blood-alcohol concentration (BAC) of 0.05% (which is the legal driving limit in Australia and many other countries). Performance following 24 hours of sustained wakefulness was equivalent to that of someone with a BAC of 0.10%.

Dawson and Reid obtained their results using 40 participants in a repeated measures experiment with counterbalancing. In the first condition, the participants were kept awake for 28 hours (from 8.00 am to 12 noon the following day). In the second condition, they were asked to consume 15 grams of alcohol every 30 minutes until their BAC reached 0.10%. An Australian standard drink contains 10 grams of alcohol (12.5 ml of pure alcohol).

In both conditions, participants were assessed on 'cognitive psychomotor performance' at half-hourly intervals. This required completion of a computer-administered test of eye–hand coordination involving an unpredictable tracking task (i.e. the correct tracking movement could not be predicted). Eye–hand coordination involves the visual processing of information to guide hand movements. As well as visual–motor integration, the eye–hand task used in the experiment requires concentration (e.g. selective attention), speed, accuracy and decision making. Performance can also be influenced by other participant variables such as mood and motivation.

As shown in Figure 8.28 opposite, performance on the tasks decreased significantly in both experimental conditions. Statistical analysis led Dawson and Reid to conclude that the effects of moderate sleep deprivation (i.e. 24 hours) on performance are similar to moderate alcohol intoxication (i.e. 0.05%). Furthermore, the results showed that the performance impairment effects of moderate sleep deprivation are equivalent to or greater than the level of alcohol that is deemed legally unacceptable when driving, working and/or operating dangerous machinery.

Dawson compared the effects of moderate sleep deprivation and alcohol on a range of other cognitive tasks and concentration tasks in another repeated measures experiment. This research is described in Box 8.5 on pages 462–3. The results were generally consistent with those of Dawson's previous research study.

Although there are exceptions, similar results have since been obtained by other researchers on a variety of cognitive and concentration tasks. However, generalising the findings to real life settings from computer simulations often involving relatively simple tasks under controlled laboratory conditions requires careful consideration of a wider range of variables that also impact on human performance, including the interactions between sleep deprivation and alcohol consumption combined.

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Mood is one such variable that can impact on the results of BAC and sleep deprivation studies. There is considerable research evidence that sleep deprivation and alcohol consumption, either independently or in combination, influence and are influenced by our mood state.

Generally, sleep deprivation results in a negative mood state (e.g. irritability, short-tempered), which you probably know through personal experience, and alcohol consumption results in either a positive or negative mood state, depending on such variables as the amount of sleep deprivation or alcohol, the individual and the context. In turn, our mood state influences our conscious experience and can either enhance or impair concentration and cognitive performance. For example, inadequate sleep can make us cranky and thereby interfere with our ability to concentrate and think clearly. This can undermine performance on a variety of simple and complex cognitive tasks. In addition, our mood can influence alcohol consumption, such as whether or not to drink, what we drink and the rate and amount of consumption. Similarly, our mood can influence sleep deprivation, for example, whether or not we have difficulty falling or staying asleep.

In sum, sleep deprivation, alcohol, cognition, concentration and mood are intertwined and may interact in complex ways in influencing conscious experience.

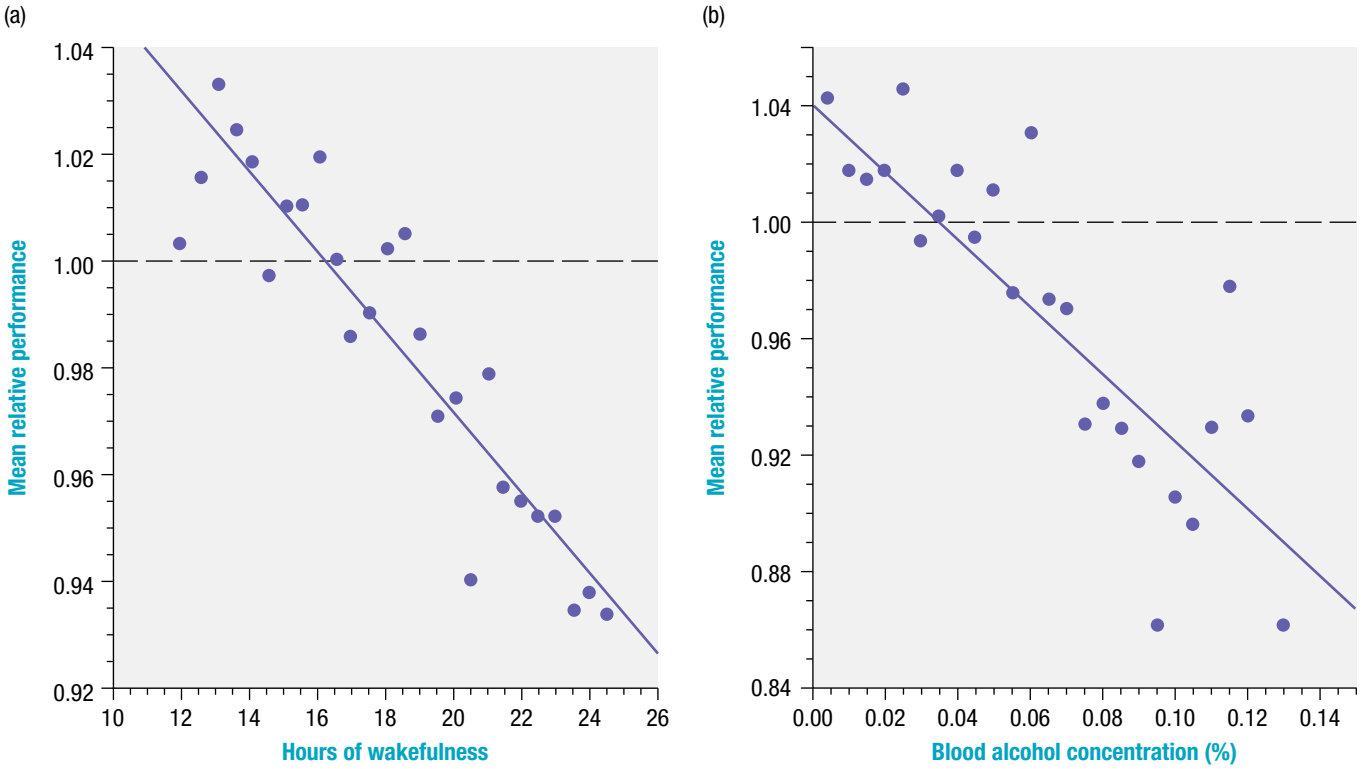


Figure 8.28 Scatterplots showing performance in the (a) wakefulness and (b) alcohol conditions in the Dawson and Reid (1997) experiment

Source: Dawson, D., & Reid, K. (1997). Fatigue, alcohol and performance impairment. *Nature*, 388, 235.

Figure 8.29 Research studies have found that cognitive performance after 17 hours of full sleep deprivation is like that of a person with a BAC level of 0.05%.

BOX 8.5 Follow-up research on links between sleep deprivation, BAC level and cognitive function

Twenty-two participants aged 19–26 years were selected from a group of volunteers after screening for any type of sleep or health problem. Cigarette smokers, non-social drinkers (i.e. more than six standard alcoholic drinks per week) and anyone on medication known to interact with alcohol were also excluded.

There were three experimental conditions to which participants were randomly allocated and completed in a sequence:

Condition 1: alcohol intoxication — consume an alcoholic drink at half-hourly intervals until BAC of 0.10% is reached; complete performance tests hourly

Condition 2: placebo — rim of drinking glass pre-dipped in ethanol to give impression it contained alcohol; equal number of participants drink the placebo or alcohol to help ensure participants remain blind to the treatment condition they are participating in

Condition 3: sustained wakefulness — deprived of sleep for one night; complete performance tests hourly

The performance tests completed by participants in each condition were all computer administered.

These included:

- *eye–hand coordination* — a tracking task using a joy stick
- *concentration* — button pressing depending on a particular light being illuminated
- *sensory comparison* — identify the correct visual stimulus from among alternatives
- *grammatical reasoning* — decide whether logical statements are true or false.

Each test session lasted for 15 minutes. Speed and accuracy was also measured and participants received no feedback on their performance to avoid knowledge of their scores affecting performance levels.

The results showed that as the level of blood-alcohol concentration or amount of sleep deprivation increased, performance on the tasks tended to decrease. The drink consumed in the placebo condition did not significantly affect performance. Results on some of the tests are shown in figures 8.30 and 8.31. Overall, the effects of one full day's sleep deprivation were like the effects of the legal blood-alcohol concentration of 0.05%. Note also the effects of less than one day's sleep deprivation compared with the effects of a BAC of less than 0.05% (Lamond & Dawson, 1999).

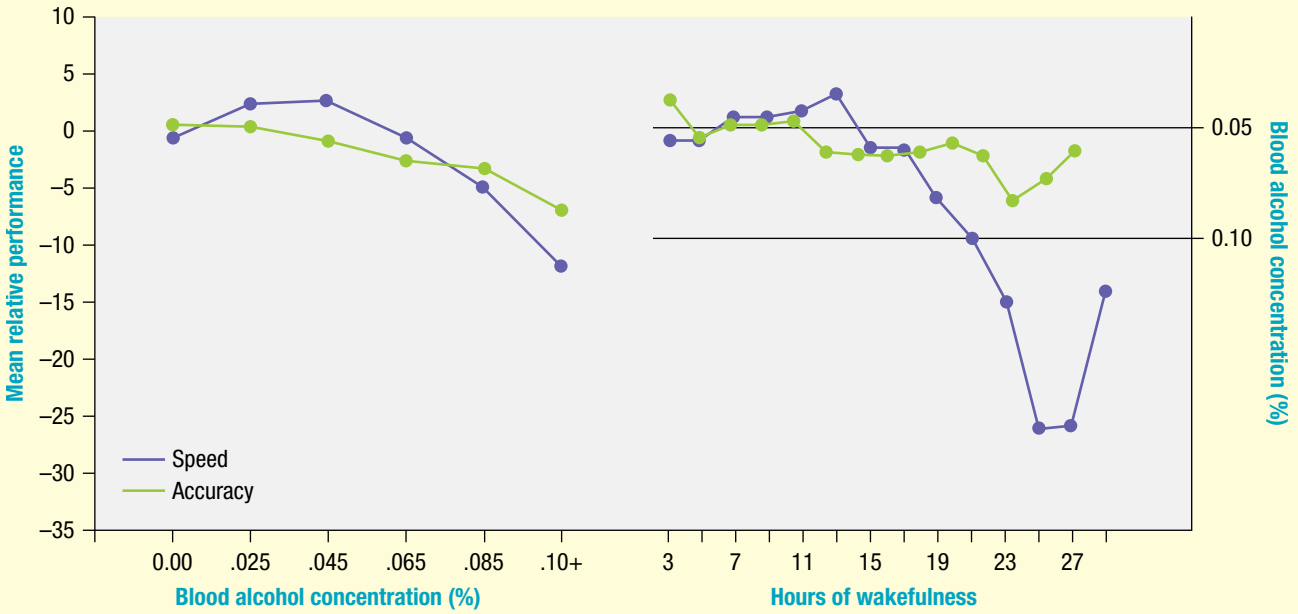


Figure 8.30 Mean performance levels for speed and accuracy tests component of grammatical reasoning in the alcohol intoxication and sustained wakefulness conditions.

Source: Lamond, N., & Dawson, D. (1999). Quantifying the performance impairment associated with fatigue. *Journal of Sleep Research, 8*, 255–262.

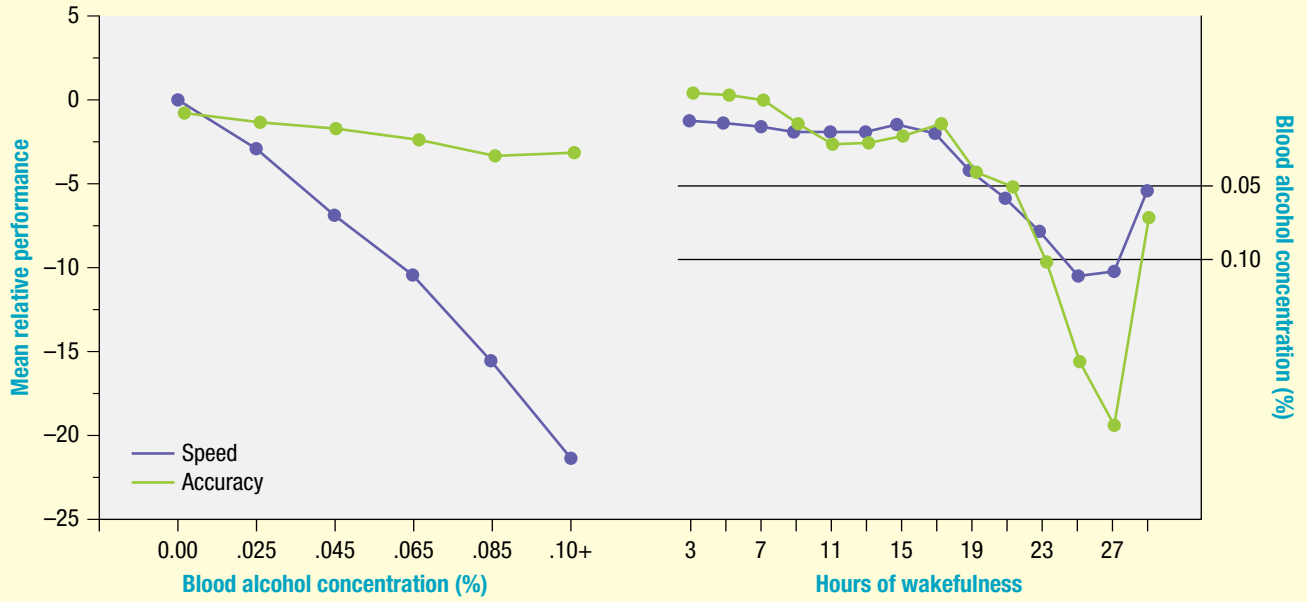


Figure 8.31 Mean performance levels for speed and accuracy tests of concentration in the alcohol intoxication and sustained wakefulness conditions

Source: Lamond, N., & Dawson, D. (1999). Quantifying the performance impairment associated with fatigue. *Journal of Sleep Research*, *8*, 255–262.

LEARNING ACTIVITY 8.12

Review questions

1. (a) In what way are the effects of a full day's sleep deprivation on cognitive and concentration tasks like the effects of the legal BAC of 0.05%?
(b) Briefly outline a research study that provides evidence of this conclusion and refer to results preceding and up to 0.05% BAC/24 hours wakefulness.

2. How was sleep deprivation operationalised in the Dawson and Reid (1997) experiment?

3. Dawson and Reid used a repeated measures experimental design with a counterbalancing procedure.
(a) Explain what counterbalancing involves in relation to the Dawson and Reid experiment and why it was used.
(b) Explain an advantage and a limitation of the repeated measures design used by Dawson and Reid.

4. Draw a diagram to show a possible interrelationship between a full day's sleep deprivation, a BAC of 0.05% and mood state.

LEARNING ACTIVITY 8.13

Reflection

The effects of moderate sleep deprivation on concentration have been found to be similar to those of the legally permissible BAC level when driving and in various work settings where safety is a major concern.

In light of this, comment on whether there should be a legally permissible level of sleep deprivation. What difficulties might there be in enforcing such legislation?

LEARNING ACTIVITY 8.14

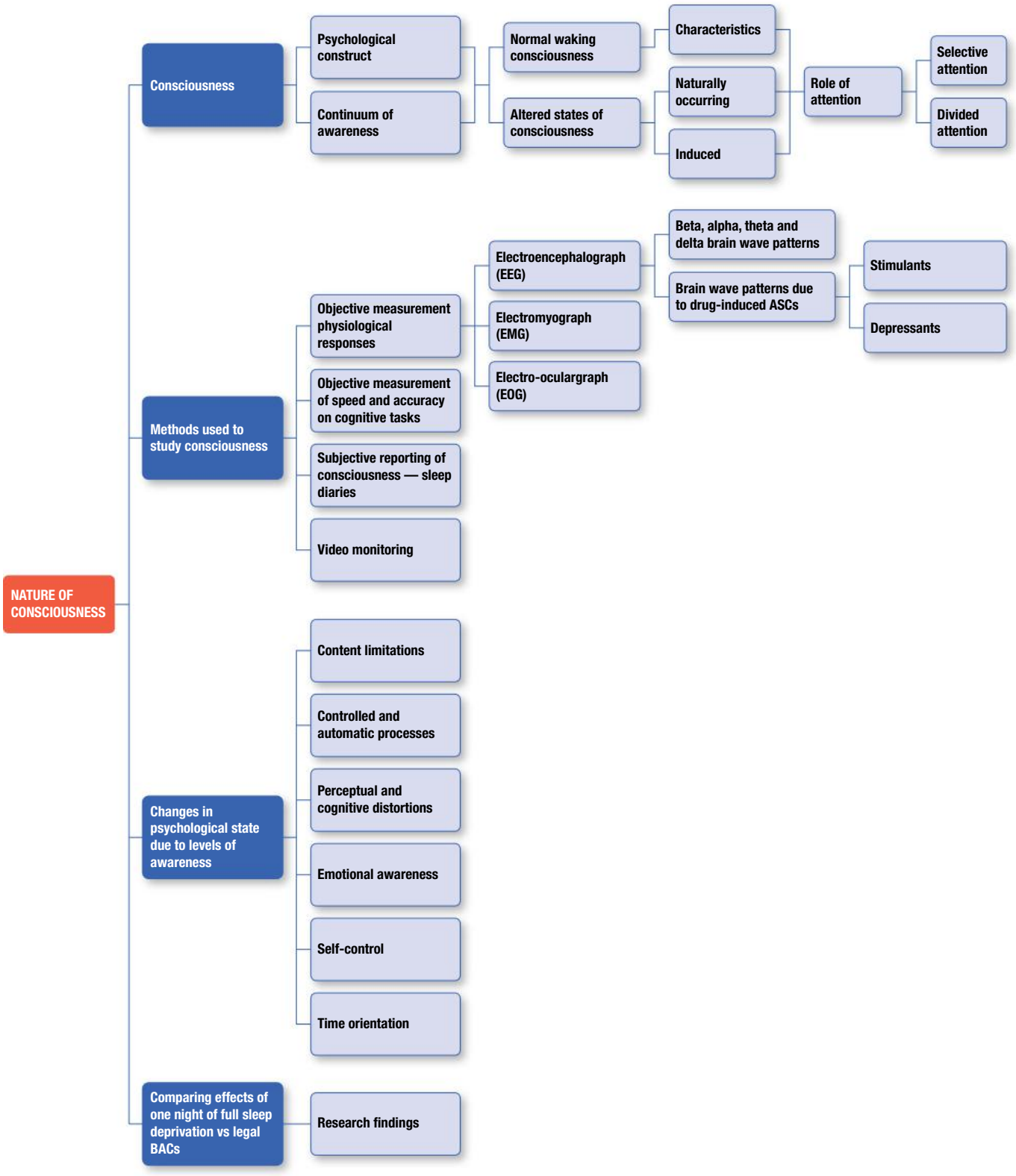
Evaluation of research by Dawson on sleep deprivation, alcohol consumption and performance

Construct a flow chart to summarise and evaluate one of the experiments conducted by Dawson to compare the effects of sleep deprivation and alcohol consumption on performance of various cognitive and concentration tasks.

Your flow chart should include:

1. a possible research hypothesis for the experiment
2. descriptions of operationalised independent and dependent variables relevant to sleep deprivation, alcohol and at least one of the cognitive or concentration tasks
3. the name of the experimental design
4. participant numbers and selection procedure
5. outline of the experimental conditions
6. statement of results obtained or overall pattern of results in relation to the hypothesis
7. conclusion(s) drawn by the researchers on the basis of the results obtained.
8. a limitation of the research design
9. a comment on the generalisability of the results from the lab setting to real life.

CHAPTER SUMMARY



KEY TERMS

alpha brain wave p. 442
altered state of consciousness p. 436
amplitude (of brain wave) p. 441
attention p. 437
automatic process p. 455
beta brain wave p. 442
blood alcohol concentration (BAC) p. 460
brain wave pattern p. 441
cognitive distortion p. 456
cognitive task p. 450
consciousness p. 430
consciousness continuum p. 432
content limitation p. 454
controlled process p. 454
delta brain wave p. 442
depressant p. 446
divided attention p. 438
drug-induced state (of consciousness) p. 444
electroencephalograph (EEG) p. 440
electromyograph (EMG) p. 448
electro-oculargraph (EOG) p. 449
emotional awareness p. 456
frequency (of brain wave) p. 441
induced state (of consciousness) p. 436
naturally occurring state (of consciousness) p. 436
normal waking consciousness p. 436
objective measurement p. 451
perceptual distortion p. 456
psychological construct p. 430
selective attention p. 437
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sleep diary p. 452
speed and accuracy test p. 450
state of consciousness p. 432
stimulant p. 444
subjective measurement p. 452
subjective report p. 452
theta brain wave p. 442
time orientation p. 458
video monitoring p. 452

LEARNING CHECKLIST

Complete the self-assessment checklist below, using ticks and crosses to indicate your understanding of this chapter's key knowledge (a) before and (b) after you attempt the chapter test. Use the 'Comments' column to add notes about your understanding.

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Word copy of checklist

Key knowledge I need to know about the nature of consciousness	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
Consciousness			
• psychological construct			
• consciousness continuum			
• normal waking consciousness			
• altered state of consciousness			
– naturally occurring			
– induced state			
Role of attention			
selective attention			
divided attention			
Methods used to study consciousness			
Measurement of physiological responses			
• Electroencephalograph (EEG)			
Beta, alpha, theta and delta brain wave patterns			
Brain wave patterns due to drug-induced ASCs			
– stimulants			
– depressants			

Key knowledge I need to know about the nature of consciousness	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
• Electromyograph (EMG)			
• Electro-oculargraph (EOG)			
• Measurement of speed and accuracy on cognitive tasks			
• Subjective reporting of consciousness — sleep diaries			
• Video monitoring			
Changes in psychological state due to levels of awareness			
content limitations			
controlled and automatic processes			
perceptual and cognitive distortions			
emotional awareness			
self-control			
time orientation			
Comparing effects of one night of full sleep deprivation vs legal BACs			
Research findings			

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Unit 4 > Area of study 1 > Topic 1

Concept screens and practice questions

CHAPTER 8 TEST

SECTION A — Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Question 1

When experiencing normal waking consciousness

A. we cannot shift to an alternate state unless we choose to do so.
B. we are usually aware of our internal state but not the external world.
C. we can usually restrict the type or amount of information flowing in and out.
D. we are usually aware of our internal state but not the external world.

Question 2

James can sing along to music on the radio while driving his car and efficiently navigate to his friend's house at the same time. This illustrates a feature of consciousness involving

A. concentration.
B. selective attention.
C. divided attention.
D. controlled processing.

Question 3

Which of the following data collection procedures usually involves self-monitoring?

A. video monitoring
B. sleep diary
C. laboratory observation
D. naturalistic observation

Question 4

A computer-assisted speed and accuracy test is best described as a/an _____ measure.

A. subjective
B. objective
C. biased
D. physiological

Question 5

High-frequency brain waves are _____ and therefore involve _____ brain waves per unit of time.

A. faster; more
B. slower; less
C. faster; less
D. slower; more

Question 6

Brianna is relaxing with eyes closed after having concentrated for more than 15 minutes while solving a complex maths problem. When solving the problem, Brianna's brain wave pattern was predominantly _____ waves, and when she relaxed and closed her eyes it was predominantly _____waves.

A. alpha, beta
B. beta; alpha
C. theta, alpha
D. beta; delta

Question 7

Ollie has a very high fever after contracting a virus. While lying awake in bed, he begins to feel as though ants are crawling all over his body, and says he can see them, despite there being no ants.

Ollie is most likely experiencing _____ with _____ .

A. normal waking consciousness; self-control
B. normal waking consciousness; divided attention
C. an altered state of consciousness; perceptual distortions
D. normal waking consciousness; perceptual distortions

Question 8

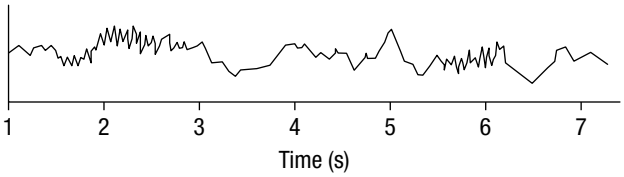
Which of the following sequences best illustrates the consciousness continuum from most aware to least aware?

A. coma → asleep → drowsy → answering an exam question
B. answering an exam question → asleep → drowsy → coma
C. coma → asleep → answering an exam question → drowsy
D. answering an exam question → drowsy → asleep → coma

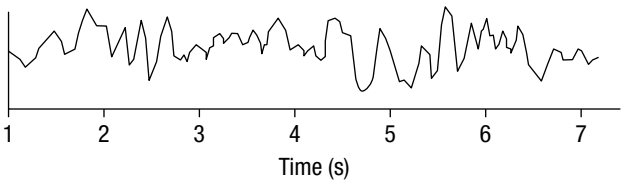
Question 9

Which pattern shows the brain waves of a very alert person during normal waking consciousness?

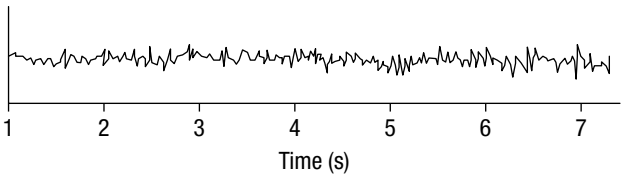
A.



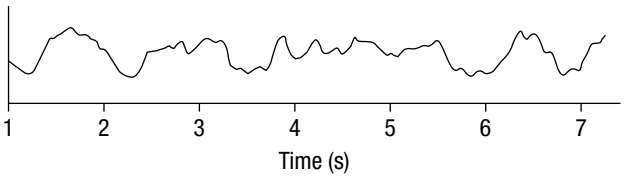
B.



C.



D.



Question 10

Which of the following is the most likely effect to be associated with an altered state of consciousness rather than normal waking consciousness?

A. misperception of the passage of time
B. self-control
C. emotional control
D. heightened self-awareness

SECTION B

Answer **all** questions in the spaces provided. Write using blue or black pen.

Question 1 (1 mark)

You want to observe theta waves as they actually occur in an adult during normal waking consciousness. What mental and/or physical activity should the person perform to increase the likelihood of theta wave activity?

Question 2 (1 mark)

Why is consciousness best described as a continuum?

Question 3 (2 marks)

An _____ is used to collect data on muscle tone and activity, whereas an _____ is used to collect data on eye movements and position.

Question 4 (2 marks)

Explain why consciousness is considered to be a psychological construct.

Question 5 (2 marks)

Explain why daydreaming is considered to be an altered state of consciousness.

Question 6 (4 marks)

(a) State two variables that can directly influence the specific effects of a depressant or stimulant drug on consciousness. 2 marks

(b) Describe the brain wave pattern most likely to be induced by:

(i) a depressant 1 mark

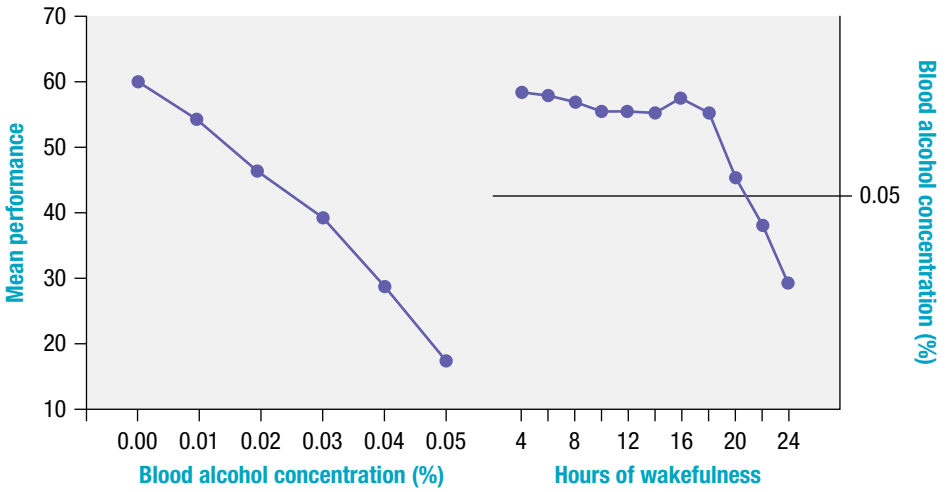
(ii) a stimulant 1 mark

Question 7 (4 marks)

Distinguish between controlled and automatic processes with reference to the activity of the juggler shown at right.

Question 8 (3 marks)

(a) Describe the effects on consciousness of one full night of sleep deprivation compared with the effects of legal blood-alcohol concentrations (BAC). Refer to the graph below showing results on a cognitive task requiring concentration. 2 marks



(b) Suggest a reason why the experiment was designed so that the BAC of participants did not exceed 0.10%. 1 mark

Question 9 (11 marks)

An experiment was conducted to investigate the effects of consuming chocolate on brain wave activity. There were 122 participants who were randomly assigned to one of three conditions and consumed either chocolate with a high (60%) concentration of cacao (the active ingredient in chocolate), low (0%) cacao chocolate, or water. Brain waves and mood were measured before and after a 60-minute digestion period.

The results showed a decrease in theta and alpha activity and an increase in beta activity in the frontal and parietal lobes following consumption of a 60% cacao chocolate bar compared with control conditions. No condition-specific mood changes or sex differences were found.

(a) Name the device used to measure brain wave activity. 1 mark

(b) Name the experimental design. 1 mark

(c) Identify the experimental and control groups. 2 marks

experimental group(s):

control group(s):

(d) What was the placebo treatment and why was it used in this particular experiment? 2 marks

(e) Explain whether chocolate is a stimulant or depressant on the basis of the results obtained. 3 marks

(f) Give an example of a cognitive task the researcher may have used to assess levels of alertness after the digestion period and explain why this would be a suitable task. 2 marks

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The answers to the Section A multiple-choice questions are in the answer section at the end of this book and in eBookPLUS. The answers to the Section B questions are in eBookPLUS.

9 SLEEP

KEY KNOWLEDGE

- sleep as a regular and naturally occurring altered state of consciousness that follows a circadian rhythm and involves the ultradian rhythms of REM and NREM Stages 1–4 sleep excluding corresponding brain wave patterns and physiological responses for each stage
- theories of the purpose and function of sleep (REM and NREM) including restoration theory and evolutionary (circadian) theory
- the differences in sleep across the lifespan and how these can be explained with reference to the total amount of sleep and changes in a typical pattern of sleep (proportion of REM and NREM).

Source: © VCAA, VCE Psychology Study Design (June 2017 update), p. 29.

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Sleep and biological rhythms 475
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Just as we experience differing states of consciousness within normal waking consciousness, it is the same when we sleep. Sleep involves a cyclical progression through different states which are associated with different levels of alertness and physiological responses. It is a naturally and regularly occurring altered state of consciousness that follows an internally regulated daily cycle of about 24 hours. Within this cycle are shorter cycles of distinguishable stages and activity.

Sleep is often defined by comparing and contrasting it with other states of consciousness, particularly an alert, wakeful state. Many definitions refer to loss of conscious awareness and other characteristics that we commonly associate with sleep.

Eminent American sleep researchers Mary Carskadon and William Dement (2011) have proposed a definition in behavioural terms that has been widely adopted in psychology. **Sleep** is defined as a reversible behavioural state of perceptual disengagement from and unresponsiveness to the environment. It is typically experienced in a comfortable position, apparently relaxed, with eyes closed and so on, but these other behavioural indicators do not necessarily indicate sleep. In contrast, reversibility, perceptual disengagement and unresponsiveness to the environment are key characteristics that enable sleep to be distinguished from other states of consciousness. All must be evident for an organism to be considered asleep.

Reversibility means that a sleeper can always be awoken with a strong enough stimulus, such as noise or bodily force, and therefore 'reverse back' to the waking state quite quickly. If not, then the state may be a coma, an anaesthetic state or some other similar condition. *Perceptual disengagement* means that the sleeper has no awareness of the sights, sounds, smells and other sensory stimuli in their external environment of which they are usually conscious in the waking state. There is therefore also *unresponsiveness* by the sleeper to environmental stimuli, although a strong enough sensory stimulus may awaken a sleeper (as per the reversibility characteristic). When this occurs, the exact nature of the stimulus is not perceived by the sleeping person as it would be by an awake person.

According to Carskadon and Dement (2011), behaviours associated with a conscious, waking state may occur during sleep. These behaviours can include walking, talking, teeth grinding and other physical activities. However, these occur in unusual circumstances and are not typical of sleep.

Although there are extended periods during which there is a dramatic reduction or loss of conscious awareness, we can be conscious while asleep because awareness is possible during sleep. For example, during lucid dreaming a person becomes aware that the events being experienced are part of a dream. Similarly, a sleep walker is typically in a deep sleep state, yet they are walking or performing other more complex behaviours much like when awake (Kennedy, 2011; Schredl & Erlacher, 2011).

Over a lifetime, we spend about one-third of our time asleep. This means that if we live to be 75 years of age, we will spend about 25 years sleeping (including about five years dreaming). In this chapter we examine the nature and purpose of sleep, and age-related differences in sleep patterns that occur across the lifespan.

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Figure 9.1 For an organism to be considered asleep, it must show the characteristics of reversibility, perceptual disengagement and unresponsiveness to the environment.

SLEEP AND BIOLOGICAL RHYTHMS

Rhythmic events occur constantly in the environment. The sun rises and sets each day, the moon moves through its monthly cycle, and the tides and seasons regularly repeat themselves in the same order through time. These rhythms are naturally occurring and predictable — night follows day and when winter comes we know that spring isn't far away. With these rhythmic changes come many specific environmental changes, such as changes in temperature, hours of daylight and weather conditions which can all affect how we think, feel or behave.

Many of our naturally occurring physiological responses also follow a set pattern of periodic fluctuations. These cyclic changes in bodily functions or activities that repeat themselves through time in the same order are called **biological rhythms**. Examples include body temperature, blood pressure, blood sugar level, digestive secretions, secretion of certain hormones (such as cortisol, testosterone and melatonin), mental alertness and the sleep–wake cycle.

Each biological rhythm is maintained and controlled by an internal mechanism or neural system commonly referred to as a 'biological clock'. Our biological rhythms and the neurological clocks that drive them influence what time of day we are most alert, hungry, tired or physically primed to undertake various activities.

The brain coordinates all the biological clocks so that they function in a synchronised way. It is believed that every single normally functioning cell in our body is controlled by its own biological clock and that there is at least one, probably more, 'master clocks' in the brain (Dean, 2015; Kolb & Whishaw, 2014; Miller, 2017).

Two categories of biological rhythms are called circadian and ultradian rhythms. These are primarily distinguished on the basis of the time period over which they occur under normal circumstances.

Circadian rhythms

A **circadian rhythm** is a biological rhythm that involves changes in bodily functions or activities that occur as part of a cycle with a duration of about 24 hours. The term circadian comes from the Latin words *circa dies* which mean 'about one day'. The daily human sleep–wake cycle is the most extensively studied circadian rhythm. Under normal circumstances, sleepiness is highest at night and lowest in the day. The circadian rhythm also causes us to feel more or less alert at certain points of the day.

Although internally produced and persisting in the absence of external cues such as sunrise and sunset, our sleep–wake cycle is nonetheless influenced by environmental time-giving stimuli which are used to keep it in sync with the 24-hour day–night cycle that occurs as the Earth rotates on its axis.

Numerous studies of individuals in isolated environments where no natural light or other indicators of the time of day are available have found that the circadian sleep–wake rhythm is different when compared with before and after isolation. When in the time-free environment, the sleep–wake cycle becomes 'free running' and tends to be pushed forward. Participants tend to go to sleep slightly later and awaken a little later as they drift into a cycle longer than 24 hours, and closer to 25 hours. In addition, when out-of-sync with their normal environment after isolation in a time-free environment, each participant's sleep–wake cycle quickly adjusts to match the 24-hour day–night cycle of the normal environment following re-exposure to environmental time cues, such as light–dark, clocks, meal times, noise, TV programs, jobs and social interaction (see Box 9.1 on pages 478–9).

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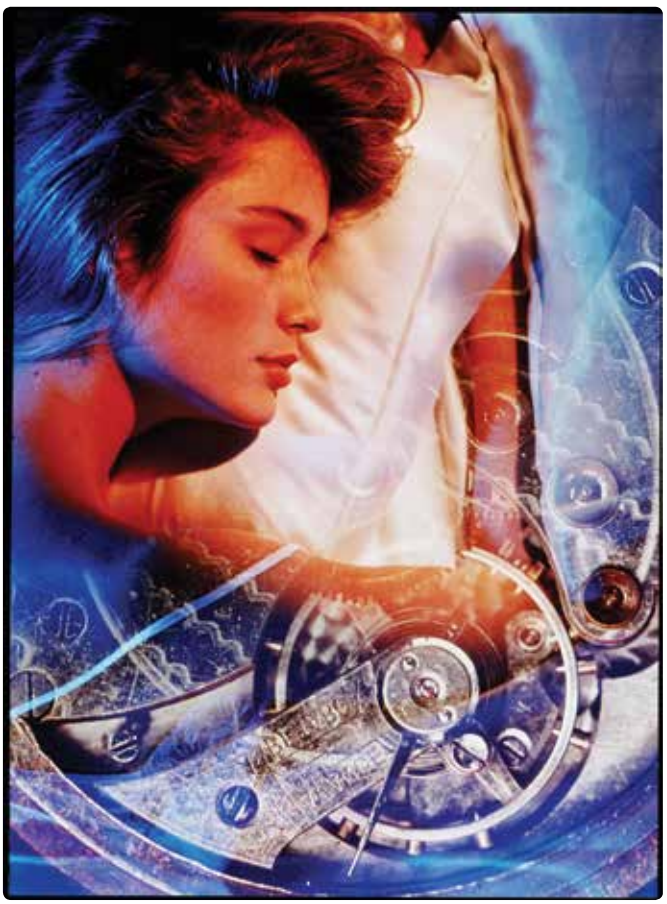

Figure 9.2 The human sleep–wake cycle is a naturally occurring 24-hour circadian rhythm regulated by a biological clock. This complex timekeeper is controlled by an area of the brain that primarily responds to light, which is why we are ordinarily most alert during the day, and less alert and more ready to sleep when it is dark outside.

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Practical activity
Self-report data on alertness cycle

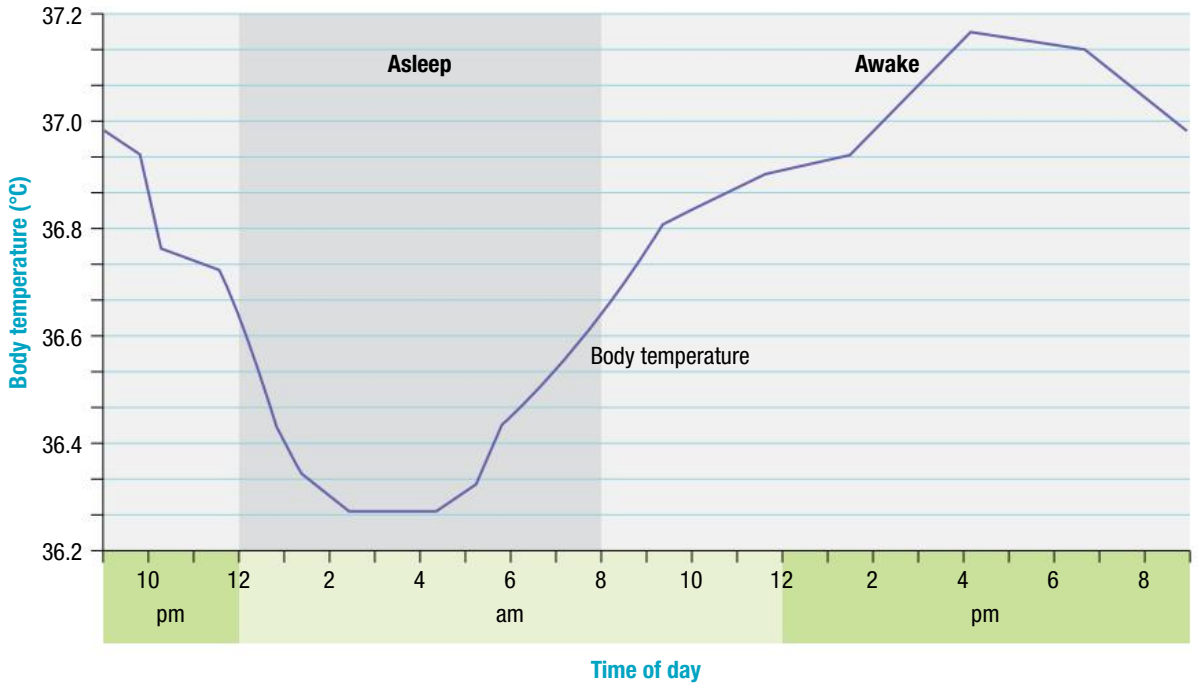

Figure 9.3 The 24-hour circadian core body temperature cycle in relation to sleep and awake times. Both of these circadian rhythms are regulated by the same brain structure. Note that drowsiness increases as core body temperature decreases (and vice-versa).

Environmental time cues are called *zeitgebers*, from the German meaning 'time givers'. Zeitgebers help to maintain the biological clock to a 24-hour day. When a clock (and thereby its associated biological rhythm) is reset and matched to an environmental cycle or changes through the influence of a zeitgeber, it is said to be *entrained* (and the process is called *entrainment*). For example, our circadian rhythms are typically entrained to the regular daily day–night cycle of our external environment. When a circadian rhythm is synchronised with the day–night cycle it may be referred to as a *diurnal rhythm*.

Light is the main environmental cue that influences the sleep–wake cycle. An area of the brain's hypothalamus called the **suprachiasmatic nucleus (SCN)** is considered to be the 'master' biological clock that regulates the timing and activity of the sleep–wake cycle (as well as body temperature and other circadian rhythms). The SCN is actually a pair of pinhead-sized structures that together contain about 20 000 neurons. It is named for its location just above ('supra') the optic chiasm, the point where the optic nerves that connect the eyes and brain cross.

The SCN receives information about the amount of incoming light from the eyes and adjusts our sleep–wake cycle accordingly. It does so by sending neuronal messages to the nearby pineal gland to secrete more or less of the hormone **melatonin** into the blood. This activity occurs deep inside the brain, as shown in Figure 9.4 opposite.

The amount of melatonin present in the blood is associated with alertness. A higher melatonin level is associated with greater drowsiness and vice versa. The amount that is secreted varies with the amount of light that is detected. When there is less light, such as after sunset, the SCN signals the pineal gland to produce and secrete more melatonin, which will make us drowsy and induce sleepiness. The melatonin level in the blood stays elevated all through the night, then falls back to a low daytime level before the light of a new day. When the SCN detects light in the morning, it inhibits the release of melatonin. That is why melatonin is sometimes called the 'Dracula of hormones' — it only comes out in the dark. Even if the pineal gland is switched 'on' by the SCN, it will not produce melatonin unless the person is in a dimly lit environment (National Sleep Foundation [NSF], 2018a).

In addition to sunlight, artificial lighting can be bright enough to impede the release of melatonin. This includes room lights and light emitted by laptops, tablets and mobile phones. When light is detected, the SCN also performs functions such as initiating an increase in body temperature and the release of stimulating hormones like cortisol to promote alertness and support other arousal activities (Sleep Health Foundation [SHF], 2018a). It is believed that feedback on the level of melatonin in the blood is used by the SCN to modify output of melatonin and help regulate the overall timing of the sleep-wake cycle. There is also internal communication between the SCN and other systems in regulating the cycle (Kolb & Whishaw, 2014; Rawashdeh & Maronde, 2012).

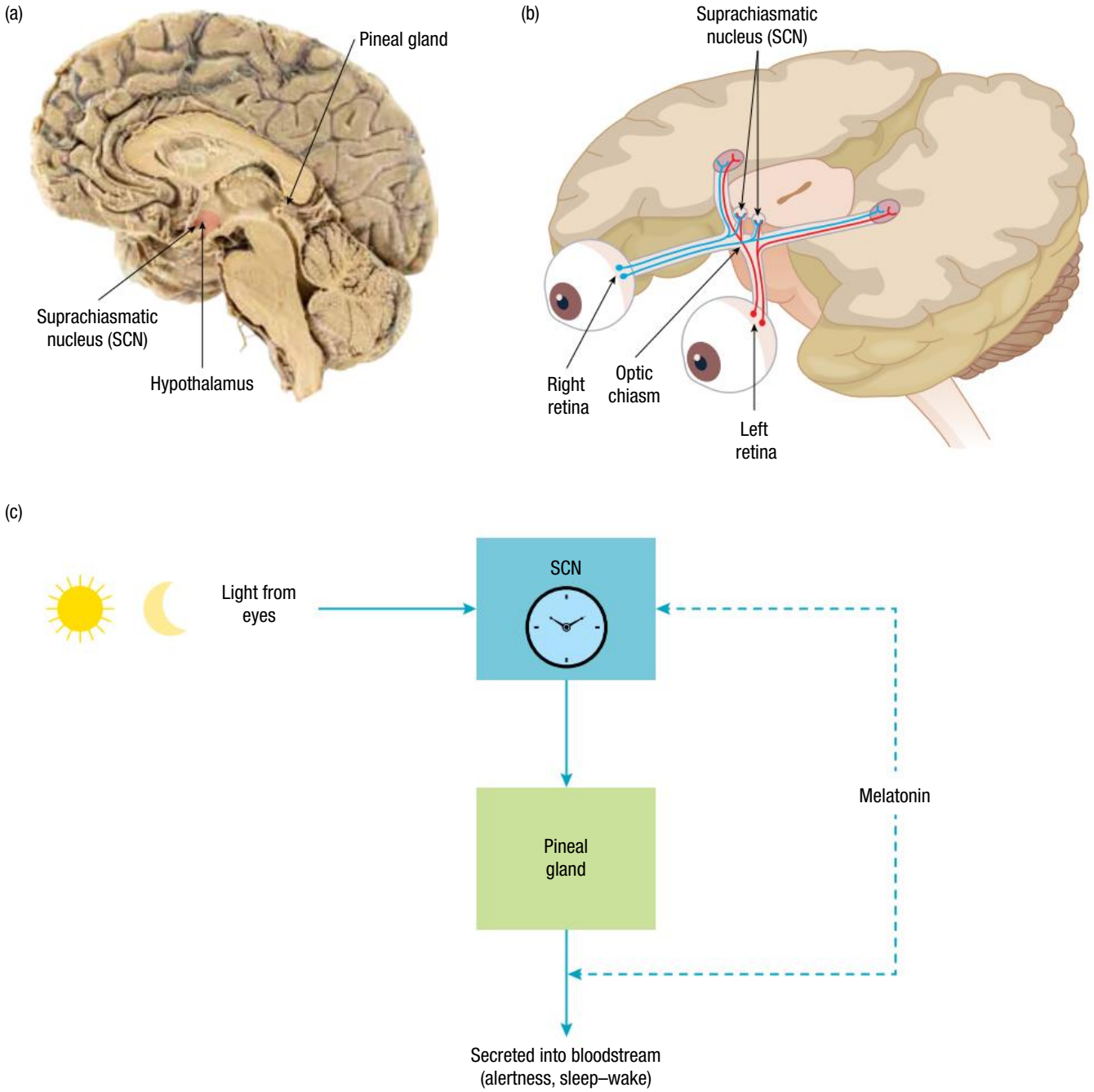

Figure 9.4 (a) Circadian rhythms are regulated by the suprachiasmatic nucleus (SCN) within the hypothalamus, which is considered to be the location of the 'master' biological clock. (b) The SCN receives information about the amount of light from the eyes and adjusts our sleep–wake cycle accordingly. It signals the nearby pineal gland to produce and secrete more or less melatonin in relation to light intensity. For clarity, the SCN is shown proportionally larger than other structures. (c) The amount of melatonin present in the blood is associated with alertness. A higher melatonin level is associated with greater drowsiness and vice versa. The amount that is secreted varies with the amount of light that is detected. Note the melatonin feedback loop enabling the SCN to detect the level of melatonin in the blood and modify the output from the pineal gland to maintain an optimum level.

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Video on circadian rhythms and the SCN 4m 9s

Ultradian rhythms

An **ultradian rhythm** is a biological rhythm that involves changes in bodily functions or activities that occur as part of a cycle shorter than 24 hours. The term ultradian originates from the Latin, meaning 'more often than daily'.

Many different ultradian rhythms that fluctuate in cycles and repeat throughout each day have been described. Some are interdependent and tied to a daily circadian rhythm. Ultradian rhythms include our heartbeat, which occurs thousands of times each day in a fairly regular and predictable rhythm. Respiration is another example of an ultradian rhythm occurring many times over the course of a day. Hunger and eating behaviour, secretion of different types of hormones, the activity of certain neurotransmitters in the brain (such as dopamine and noradrenaline), alertness and activity levels have also been described as ultradian rhythms that occur less frequently than heartbeat and respiration (Blum, et al., 2014; Wollnik, 1989).

The best-known ultradian rhythm is human sleep. When we go to sleep it is not a single constant activity like 'one long snooze'. Instead, it occurs as a sequence of distinctly different states and stages. There are also alternating periods of sleep with and without rapid eye movements and other physiological responses that are also considered ultradian rhythms. Generally, a complete sleep cycle lasts for about 90 minutes, but its duration and the number of cycles that occur are influenced by many variables such as age, health and environmental cues.

Figure 9.5 Eating behaviour is an ultradian rhythm that follows a much shorter cycle than our daily sleep–wake cycle. Generally, this cycle repeats itself about three times a day, as we eat three meals a day that are relatively evenly spaced across our daily wake period.

BOX 9.1 The sleep–wake cycle in a time-free environment

German physiologist Jurgen Aschoff was one of the earliest researchers to conduct experiments on the sleep–wake cycle in a time-free environment. He first experimented with isolating humans in the early 1960s.

Aschoff (1967, 1965) built a special underground laboratory (like a bunker) in which participants could live in complete isolation from the external environment for an extended period. Living quarters were custom-built for this purpose. These consisted of small apartments fully equipped for long stays underground. Each apartment could house a group of participants who could also be isolated from other groups to study social factors that could influence the sleep–wake cycle.

While living in the bunker, the participants had no environmental cues that would enable them to distinguish night from day. For example, they had no natural lighting or devices such as clocks and radios. Regular meals were provided and they were asked to lead as normal a life as possible in the restricted conditions. Participants could also select the periods when the lights were on or off, when they were active and when they slept. In sum, they selected the length of their own day and night and therefore exerted control over their environmental light–dark cycle.

The results showed that participants continued to experience a sleep–wake activity cycle. This indicated that the cycle is produced and regulated internally and independently of external cues (called *endogenous*). However, on each successive day, participants tended to go to sleep and awaken a little later as they naturally drifted into a 25-hour or longer sleep–wake cycle. Many were choosing to go to bed from 1 to 2 hours or so later every 'night'. Eventually, they were getting up at about the time the researchers outside the bunker were going to bed (see Figure 9.6).

Aschoff's experiments had found that our circadian sleep–wake cycle is 'free running' because it runs at a rate of the body's own devising when environmental cues are absent. However, our body maintains harmony with the external environment. Although out of sync with the environment after their isolation, participants quickly shifted back to their normal sleep–waking cycles after they were exposed to environmental time cues such as the natural day–night cycle.

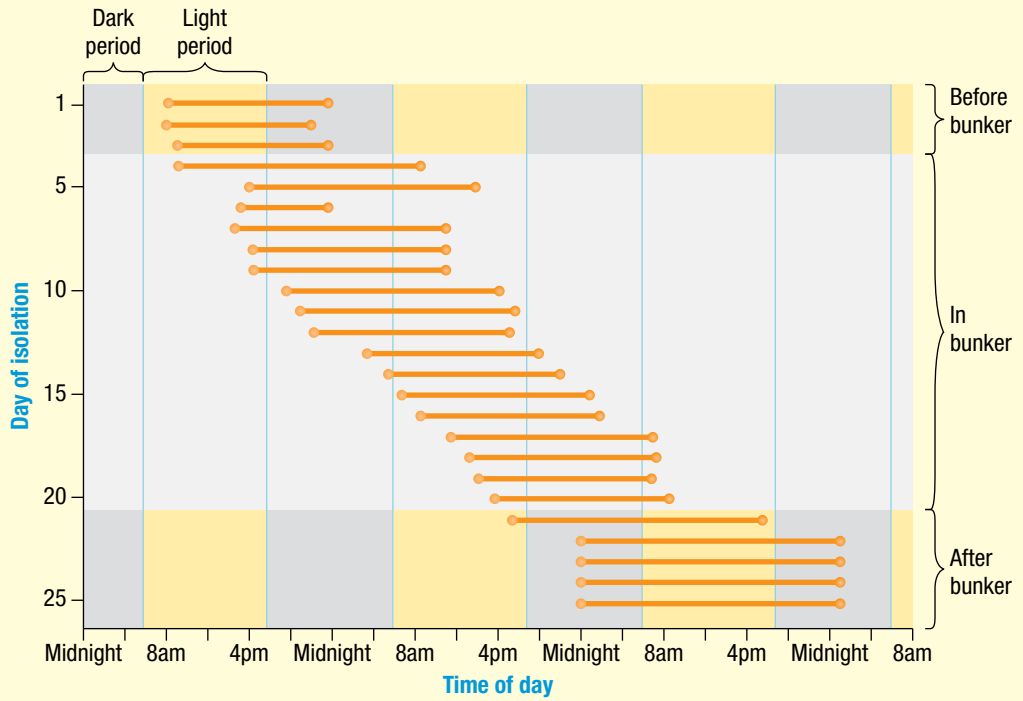

Figure 9.6 The sleep–wake cycle of a research participant who lived removed from all time cues for four weeks. The orange circles at the beginning (left) of the lines indicate when the participant went to bed, and the circles at the end (right) of the lines indicate when they woke. Days 1–3 shows the daily sleep period under normal day-night conditions. During days 4–20 when isolated from environmental cues the free running circadian rhythm developed and the participant shifted to a 25 hour sleep-wake cycle. During days 21–25 when the participant was once again exposed to normal day-night conditions the sleep-wake cycle returned to 24 hours.

Based on Hobson, A.J. (1989). *Sleep*. New York: Scientific American Library p. 33.

BOX 9.2 Infradian rhythms

Some rhythmic activities occur in cycles which extend longer than one day. These cycles are known as *infradian rhythms.* The term infradian comes from the Latin and means 'less often than daily'. One example of an infradian rhythm is the menstrual cycle. While the duration of the menstrual cycle varies from one individual to another and sometimes from one cycle to the next, for most females the range of the cycle is usually between 20 and 40 days, with 28 days being the average.

The menstrual cycle is regulated by changes in the levels of reproductive hormones. The hypothalamus and the pituitary gland in the brain control the release of *oestrogen* and *progesterone* by sending messages to the ovaries to release various quantities of these reproductive hormones according to what for most females is a monthly timetable. The level of oestrogen is at its highest about midway through the menstrual cycle at the time of ovulation. The level of progesterone reaches its peak a few days later. After the peaks, the levels of both hormones drop significantly (unless a pregnancy has occurred) until menstruation (bleeding) occurs and the cycle begins again (as shown in Figure 9.7).

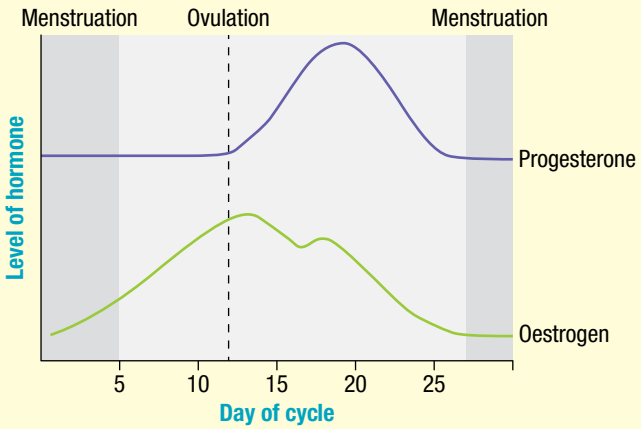

Figure 9.7 The menstrual cycle is controlled by variations in the body's level of the hormones oestrogen and progesterone.

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Distinguishing between circadian, ultradian and infradian rhythms 2m 17s

LEARNING ACTIVITY 9.1

Review questions

1. Define the meaning of sleep.
2. Why is sleep considered to be an altered state of consciousness?
3. Describe three key characteristics that collectively best distinguish sleep from other states of consciousness. Explain with reference to an animal in a hibernating ASC.
4. Comment on the suitability of a definition of sleep that mainly refers to a naturally occurring, temporary loss of consciousness.
5. (a) Define the term biological rhythm.
   (b) Describe the relationship between a biological rhythm and a biological clock.
   (c) Is a biological clock the same as a circadian rhythm? If so, why? If not, how are they related?
6. State two criteria that could be used to assess whether a biological rhythm could be called a circadian rhythm.
7. Distinguish between circadian and ultradian rhythms with reference to relevant examples.
8. Explain the meaning of entrainment in relation to a circadian sleep–wake cycle.
9. Explain the roles of the suprachiasmatic nucleus (SCN), pineal gland, melatonin, light and other environmental cues in regulating the human sleep–wake cycle. You may use a diagram to support your explanation.
10. Explain from a biological perspective why digital media use for a prolonged period when in bed just before sleep can adversely impact on the onset of sleep.

LEARNING ACTIVITY 9.2

The 2017 Nobel Prize for Physiology or Medicine was awarded to three scientists who discovered the genetic mechanism controlling circadian rhythms. It is considered that understanding the genetic basis of circadian cyclical activity has significant implications for our health and wellbeing.

Comment on whether you would choose to award the prize for this specific discovery ahead of a one that cures all forms of breast or prostate cancer.

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Nobel Prize 2017 press release

NREM AND REM SLEEP

Over the course of a typical night's sleep we experience two distinctly different states or types of sleep known as **NREM sleep**, or non-rapid eye movement sleep, and **REM sleep**, or rapid eye movement sleep. While both have characteristics in common, such as reversibility, perceptual disengagement and unresponsiveness, there are significant differences between the two.

REM and NREM sleep occur in virtually all mammals and birds, and they are as distinct from one another as each is from wakefulness. For example, Carskadon and Dement (2011) have described NREM sleep as a relatively inactive brain in a body that can move and REM sleep as an active brain in a paralysed body.

As shown in the *hypnogram* ('sleep graph') in Figure 9.8 opposite, NREM and REM sleep periods alternate throughout the night in a cyclical way, with one following the other. The biological purpose or function of the alternations between NREM and REM sleep is not yet understood, but irregular cycling and absence of either sleep state are associated with sleep disturbances and disorders.

A complete sleep cycle consists of a period of NREM sleep (but not necessarily all four stages) and a period of REM sleep. Generally, in the ideal case of a normal young adult who sleeps well, each cycle is repeated about five or six times each night, depending on the duration of the sleep. The lengths of individual cycles show considerable variability during an entire sleep episode. For example, the average length of the first NREM–REM sleep cycle, measured from sleep onset to the end of the first REM period, is about 70 to 100 minutes. The duration of the second and later sleep cycles, measured from the end of a REM sleep period to the end of the next, is generally longer lasting — about 90 to 120 minutes. Overall, however, the average length of each NREM–REM sleep cycle is commonly described as 'about 90 minutes' (Carskadon & Dement, 2011; Lavie, 1996; SHF, 2016a).

There are also other variations in the patterns and proportions of NREM and REM sleep. In younger adults, stages 3 and 4 sleep tend to predominate in NREM sleep during the first half of the sleep episode, particularly in the first two cycles. As the night progresses, stage 2 begins to account for the majority of NREM sleep, and stages 3 and 4 may disappear. Consequently, the first third of the night is the time when the deepest sleep usually occurs. REM sleep periods increase as the night progresses and is longest in the last third of the night. In addition, brief episodes of wakefulness tend to occur in later cycles, generally in association with transitions between stage 2 and REM sleep, but these brief arousals are usually not remembered in the morning. The wakeful periods are considered part of a sleep episode rather than waking time (Carskadon & Dement, 2011; Dement, 2006; Lavie, 1996).

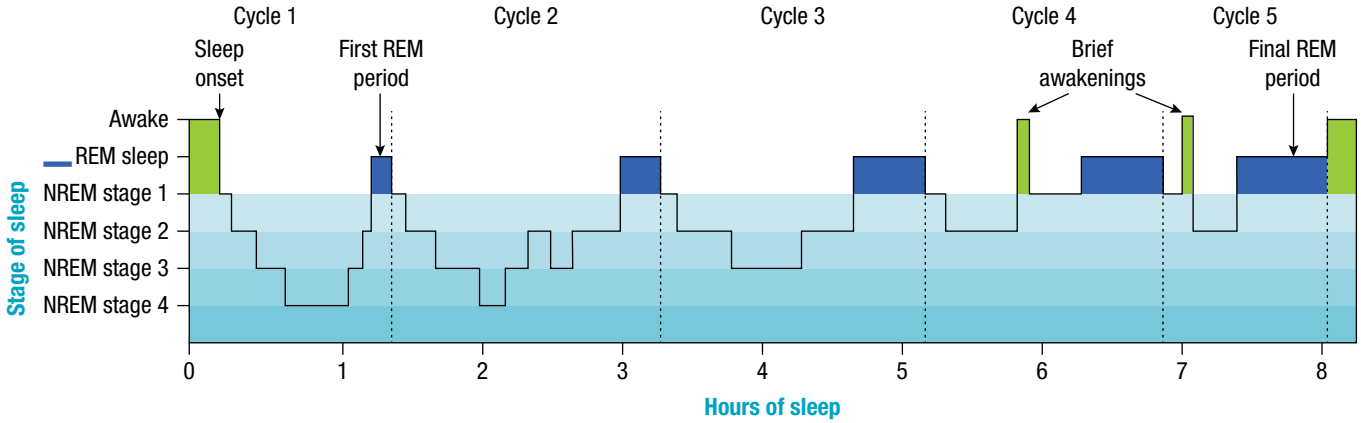

Figure 9.8 A typical sleep episode across a single night for a healthy young adult. The hypnogram shows alternating cycles of NREM and REM sleep and the relative amount of sleep spent in each of these. Note that as the sleep episode progresses, stages 3 and 4 (deepest sleep) may not be experienced and that REM sleep periods tend to get longer and be closer together. Stage 1 may be skipped at different times during the episode, most commonly just before the first REM period. There may also be brief awakenings during the episode.

Source: Based on Carskadon M., & Dement W.C. (2005). Normal human sleep: An overview. In M.H. Kryger, T. Roth & W.C. Dement (Eds.), *Principles and practice of sleep medicine* (4th ed., pp. 13–23). Philadelphia: Elsevier Saunders.

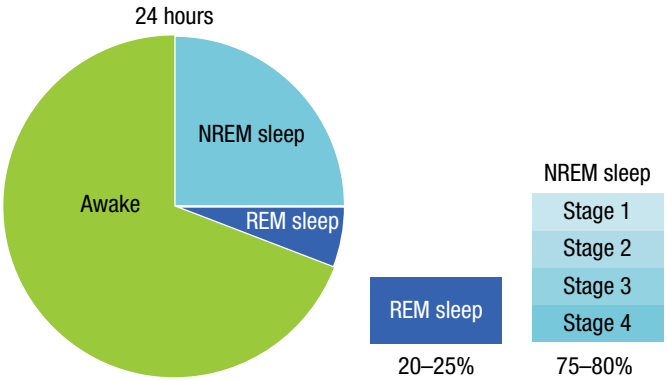

Figure 9.9 Average proportion of time younger adults spend daily in NREM and REM sleep

NREM sleep

NREM sleep is traditionally subdivided into four stages (although some researchers now describe only three stages by combining stages 3 and 4). Approximately 75–80% of our total sleep time is spent in NREM sleep. Typically the first half of the night has more NREM sleep than the second half of the night.

Each of the four NREM stages has a distinguishable pattern of physiological activity. Change in brain wave pattern is primarily used to identify an individual's stage of sleep and their transition between stages. Every stage is dominated by a particular brain wave pattern that is different from that of the other stages. Although the brain is active during NREM sleep, it is not as active as during REM sleep or during normal waking consciousness.

Overall, NREM sleep is characterised by a reduction in physiological activity. Each successive stage of NREM sleep is indicative of a deeper sleep, with stage 1 as the lightest and stage 4 as the deepest. As sleep gets deeper, the brain waves get slower and bigger, breathing and heart rate slow down, and blood pressure drops. We also transition back again from the deep sleep of stage 4. As shown in Figure 9.8 above, it is common to miss one or more of the NREM stages and have brief periods of awakening during a sleep episode.

The transition period from being awake to being asleep is usually called *sleep onset* and the length of time it takes to transition from being awake to being asleep is called *sleep latency*. This 'pre-sleep' period may last for a minute or two and is normally followed by stage 1 of NREM sleep. Consequently, NREM stage 1 is the entry point of sleep for most people (but in infancy and certain sleep disorders such as narcolepsy, sleep onset may occur into REM sleep).

Sleep onset is often called a *hypnagogic state* because of the unusual hallucinatory type perceptual experiences that may occur. These may include visual, tactile, auditory and movement sensations, such as flashes of light or colour, feelings of floating and weightlessness, dreamlike images that resemble vivid photographs or a sense of falling or slipping. A hypnagogic state is accompanied by a distinguishable brain wave pattern and may also be experienced when transitioning from being asleep to being awake.

The precise definition of when an individual can be said to have actually fallen asleep has been an ongoing topic of debate, primarily because there is no single measure that is 100% clear-cut 100% of the time. For example, in studies of sleep onset, some people report that they are still awake when their brain wave pattern and other physiological responses clearly indicate the presence of sleep (Carskadon & Dement, 2011).

Nonetheless, during sleep onset, our body is winding down. It is primarily characterised by the slowing, reduction and eventual disappearance of alpha brain activity. This is also a key characteristic

of NREM stage 1, so some sleep researchers describe sleep onset as occurring *through* NREM stage 1 rather than into stage 1 (American Academy of Sleep Medicine [AASM], 2014; Carskadon & Dement, 2011).

Stage 1

NREM stage 1 occurs as we drift into and out of a true sleep state. We tend to gradually lose awareness of ourselves and our surroundings, but some of the time we may be aware of faint sounds in our environment.

The point at which stage 1 is actually entered in the first sleep cycle is difficult to distinguish. Given the cyclical natural of NREM, stage 1 may also follow arousal from NREM stages 2, 3, 4, or REM sleep.

Physiological changes that indicate a lower level of bodily arousal — a decrease in heart rate, respiration, body temperature and muscle tension — are all evident in stage 1. Some slow, rolling eye movements may also be observed.

As a result of the muscles relaxing, we sometimes experience involuntary muscle twitches, as if our body, or a part of our body, seems to go into a spasm. In addition, there is an overall slowdown in the brain wave pattern (as irregular theta waves start to mix with then replace rhythmic alpha waves).

Stage 1 in the first NREM–REM cycle of a healthy young adult lasts for about 5 minutes after falling asleep, but for as little as 1 minute or so for some people or up to 7 or 8 minutes for others. In relation to an entire sleep episode, it amounts to about 4 or 5% of the total sleep time.

We can be easily awakened during stage 1 by a gentle nudge or sound such as a door closing, which means stage 1 has a *low* arousal threshold. If awoken during stage 1, we may feel as if we haven't been asleep at all. Sometimes, we may deny ever having been asleep, even after we have failed to respond to an external stimulus earlier in the stage. A common sign of severely disrupted sleep is an increase in the amount and percentage of stage 1 sleep (Carskadon & Dement, 2011).

Stage 2

NREM stage 2 is a period of light sleep, and during the first cycle some researchers identify this as the point at which someone can be said to be *truly asleep*. Although our sleep is less easily disturbed than it is in stage 1 and requires more intense stimuli than in stage 1 to awaken (which means it has a higher arousal threshold than stage 1), we can still be easily aroused from sleep during stage 2. When people are awakened during the first half of this stage in particular, about seven out of ten report that they really didn't think they were asleep, but were just dozing and thinking. About midway through stage 2, we are unlikely to respond to anything except extremely strong or loud stimuli, indicating that our sleep has become noticeably deeper (Coren, 1996).

Stage 2 in the first cycle lasts for about 10 to 25 minutes and lengthens with each successive cycle, eventually constituting about 45 to 55% of the total sleep episode, which is the bulk of an 'average' person's sleep each night.

As we transition from stage 1 to 2 in the first cycle, body movements lessen, breathing becomes more regular, blood pressure and temperature continue to fall, heart rate is slower and eye movements stop. The brain wave pattern is slower (predominantly theta waves). Brief bursts of rapid brain waves (called *sleep spindles*), lasting for about 1 or 2 seconds periodically appear, and their presence is used as an indicator by most researchers that the person is truly asleep.

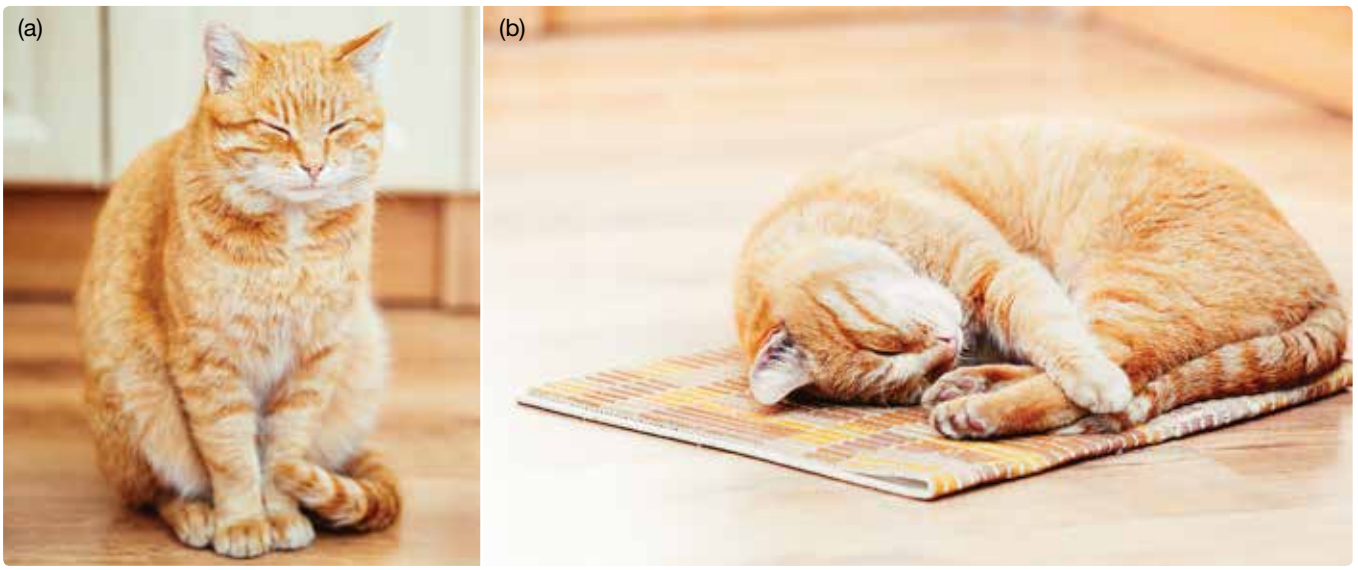

Figure 9.10 Cats experience both NREM and REM sleep periods. (a) A cat in NREM sleep can remain in an upright position. (b) With the onset of REM sleep, the muscles completely relax and the cat will usually lie down.

Stage 3

Stage 3 is the start of the deepest period of sleep. It has been described as *moderately deep sleep* (Coren, 1996) and as an interim or transitionary stage between the shallow sleep of stage 2 and the deep sleep of stage 4 (Lavie, 1996). Stage 3 typically lasts only a few minutes, sometimes up to 10 minutes, and constitutes about 3 to 8% of total sleep time. In sleep cycles in the latter half or so of a sleep episode there may be no stage 3 sleep at all (Carskadon & Dement, 2011)

During stage 3, heart rate, blood pressure and body temperature continue to drop, and the breathing rate continues to be slow and steady. Lack of eye movement also continues to be evident. The individual is extremely relaxed, and they become less and less responsive to external stimuli. In this stage, people are difficult to arouse, but if they are awoken they are often groggy and disoriented. The arousal threshold is higher than for stage 2.

EEG activity is also noticeably different from that of earlier NREM stages. Brain waves slow further, with delta waves becoming increasingly prominent and making up about 20–50% of the brain wave pattern recorded during the stage.

The presence of delta waves is used by researchers to define the beginning of *slow wave sleep (SWS)*, so called because of the slower frequency delta waves. When the EEG shows that delta waves comprise more than 50% of the brain wave activity, the person has entered stage 4, the deepest stage of sleep, and it will be very difficult to awaken them.

Stage 4

Stage 4 is the deepest stage of sleep with the highest arousal threshold. It might best be called *very deep sleep* (Coren, 1996). The physiological signs of stage 4 are very similar to those in stage 3. In stage 4, our muscles are completely relaxed and we barely move. There are no eye movements. Heart rate, blood pressure and body temperature are at their lowest and most regular.

Delta waves dominate the EEG pattern. They occur more than 50% of the time (which defines the commencement of the stage) and may become even slower and larger than those in stage 3. A person in stage 4 is very difficult to awaken — harder than in any other stage. It is at this point during a sleep episode that people are often said to be 'sleeping like a log' or 'out like a light'. When they are woken, especially if woken abruptly, they can feel groggy and take several minutes to orient themselves, and usually have a poor memory of sleep events. This is sometimes referred to as 'sleep drunkenness', although psychologists prefer the term *sleep inertia* when referring to the post-awakening 'mental lag'.

In the first sleep cycle, a person may spend between 20 to 40 minutes in stage 4, after which a series of body movements usually marks the transition to lighter NREM sleep stages. A brief, 1- or 2-minute period of stage 3 sleep might occur, followed by perhaps 5 to 10 minutes of stage 2 sleep interrupted by body movements preceding the initial REM period.

As the night progresses, less and less time is spent in stage 4 and stage 4 sleep may disappear altogether, as may occur with stage 3 sleep. Overall, stage 4 makes up about 10 to 15% of total sleep time (Carskadon & Dement, 2011).

Primarily because of their similarities in relation to physiological responses, stages 3 and 4 are now commonly combined and described as one stage called slow wave sleep, delta sleep or simply stage 3.

Figure 9.11 NREM stage 4 is the deepest stage of sleep with the highest arousal threshold. When awoken during this stage, a person often experiences a performance impairment called sleep inertia. This is examined in more detail in Chapter 10.

The progression through the first NREM sleep cycle from stage 1 to stage 4 takes about 45 to 60 minutes or so before we gradually move back up through stages 3 and 2. Having passed through one complete NREM sleep cycle, we are unlikely to awaken, although our brain and body begin to respond as if we are on the point of waking. These are signs that we are about to move into REM sleep.

REM sleep

Approximately 20–25% of our total sleep time is spent in REM sleep. As the term suggests, REM sleep is defined by spontaneous bursts of rapid eye movement during which the eyeballs quickly move beneath the closed eyelids, darting back and forth and up and down in jerky, but coordinated movements. The brain wave pattern associated with REM sleep generally consists of rapid, irregular, mixed frequency activity, like that produced during alert wakefulness. The body's internal functioning is more active during REM sleep than during NREM sleep. The heart rate is faster and more irregular. Blood pressure rises, and breathing is shallower, faster and more irregular when compared with NREM sleep. However, the sleeper looks totally relaxed (Carskadon & Dement, 2011; Colten & Altevogt, 2006).

Although there are occasional twitching movements in the small muscles of the face, fingers and toes, most of the skeletal muscles (those attached to bones) are limp, and the body shows few outward signs of movement. An observer might say the sleeper appears paralysed during REM sleep. Consequently, REM sleep is also called *paradoxical sleep* — internally, the brain and body are active, while, externally, the body appears calm and inactive. The purpose of the apparent body paralysis remains unclear.

Research indicates that most dreaming occurs during REM sleep. In sleep laboratories, if a research participant is woken during REM sleep, about 80% of the time they will report having been dreaming at the time of being woken. Although some people believe they do not dream at all, research findings suggest that we typically dream several times a night, even though we may not remember dreaming.

Dreams also occur during all NREM sleep stages and can be as bizarre as those in REM sleep, but these are less frequent, less structured, less likely to be recalled and less vivid than those of REM dreams. Typical REM dreams have a narrative structure and consist of storylines that can range from realistic to complete fantasy (Kennedy, 2011; Suzuki et al., 2004). NREM dreams may be better referred to as 'dream imagery' — more colours and abstract shapes than the storybook-type dreams that the active REM brain constructs (Morton, 2015). Given the nature of REM dreams and the simultaneous body paralysis, some psychologists have proposed that the loss of muscle tone inhibiting movement (sometimes called *sleep paralysis*) may serve an important function of preventing an individual from 'acting out' their dreams or nightmares while sleeping (Carskadon & Dement, 2005).

studyon

Figure 9.12 The eye muscles are exempt from the paralysis of REM sleep. These double-exposure photographs capture the rapid eye movements, during which vivid dreaming occurs, as do heightened levels of internal physiological responses such as heart rate, respiration rate and brain wave activity.

Some psychologists have hypothesised that the rapid eye movements characteristic of REM sleep correspond to activity in dreams; for example, that someone who is woken up when their eyes were moving from left to right would say they were dreaming about tennis. However, research studies have found that a dreamer's eye movements are unrelated to the content of their dreams (Kennedy, 2011). Moreover, people who have been blind since birth experience REM sleep, despite the fact that they've never experienced sight.

It is generally believed that eye movements are simply physiological activity that is occurring at the same time as random neural activity of the brain. Although many psychologists support this view, the specific reason for the rapid eye movements is unclear.

REM sleep periods lengthen and occur closer together as a sleep episode progresses. The first REM period that occurs earlier in the episode may last for only 1 to 5 minutes or so, the second about 12–15 minutes, the third about 20–25 minutes, while a later REM period towards the end of a sleep episode may last even longer. This may explain why you are often dreaming when you are woken by an alarm in the morning (Carskadon & Dement, 2011; Lavie, 1996).

Whether or not REM sleep is considered to be light or deep sleep when compared with NREM sleep depends on which criteria are used. REM sleep is clearly more like wakefulness than NREM sleep when brain wave activity is considered. However, if muscle tone is considered, then REM sleep can be called deep sleep due to muscle tone being at its lowest point. Therefore, psychologists tend to view REM sleep as sharing properties of both light and deep sleep.

The arousal threshold of REM sleep throughout the night is variable. It seems to depend on when during a REM period awakening is attempted. Generally, the arousal threshold may be like that of NREM stage 2 or NREM stage 4 (Ermis, Karsten & Voss, 2010). REM sleep is not a uniform state in relation to physiological responses. For example, a REM sleep period may comprise bursts of rapid eye movement activity accompanied by muscle twitches and breathing irregularities separated by episodes of relative inactivity. This has led some researchers to define REM stages or 'sub-states' called *tonic REM* and *phasic REM*, which are more similar to each other than to any of the NREM stages. However, the tonic–phasic distinction is primarily made for certain research purposes only. REM sleep usually is not divided into stages (Carskadon & Dement, 2011).

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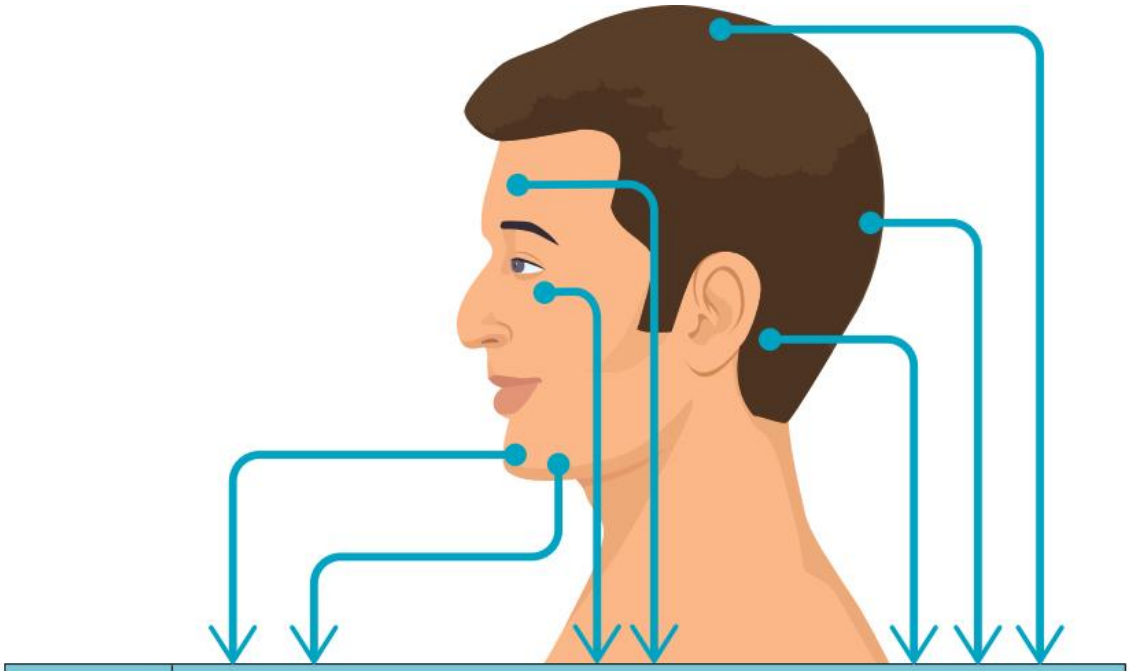
Articles
- Alan Hobson and the neuroscience of dreams
- How NREM dreams may be investigated



State of consciousness	EMG 10 seconds	EOG 10 seconds	EEG 1 second
Awake–alert			
NREM stage 1			
NREM stage 2			
NREM stage 3			
NREM stage 4			
REM			

Figure 9.13 Comparison of NREM and REM sleep on three physiological responses

BOX 9.3 Generalisations about sleep in the normal young adult

A number of general statements can be made regarding sleep in the 'normal' young adult who is living on a conventional sleep–wake schedule and who is without sleep complaints.

- Sleep is entered through NREM sleep.
- NREM sleep and REM sleep alternate with a period near 90 minutes.
- NREM stages 3 and 4 (SWS) predominates in the first third of the night.
- REM sleep predominates in the last third of the night.
- Wakefulness in sleep usually accounts for less than 5% of the night.
- NREM stage 1 sleep generally constitutes approximately 2% to 5% of sleep.
- NREM stage 2 sleep generally constitutes approximately 45% to 55% of sleep.
- NREM stage 3 sleep generally constitutes approximately 3% to 8% of sleep.
- NREM stage 4 sleep generally constitutes approximately 10% to 15% of sleep.
- NREM sleep, therefore, is usually 75% to 80% of sleep.
- REM sleep is usually 20% to 25% of sleep, occurring in four to six discrete episodes.

Source: Carskadon, M.A., & Dement, W.C. (2011). Monitoring and staging human sleep. In M.H. Kryger, T. Roth, & W.C. Dement (Eds.), *Principles and practice of sleep medicine* (5th edition, pp. 16–26). St Louis: Elsevier Saunders.

BOX 9.4 Posture movements happen during a typical night's sleep

Some people think they don't move at all during sleep. However, eminent American REM sleep and dream researcher Allan Hobson, with the assistance of a photographer, demonstrated that this is not true. According to Hobson (1988), everybody makes at least eight to 12 major posture shifts in a typical night's sleep. Poor sleepers may even double or triple this figure. Most people change their sleeping position twice per cycle. The first change usually occurs at the end of NREM stage 4 sleep, and the next major movement occurs just before commencing REM sleep.

To demonstrate the movements during a typical night's sleep, Hobson arranged for a photographer to set up a camera in a sleep laboratory so that a photograph was automatically taken of a sleeping person approximately every 4 minutes over the course of a night. The sleeper was also attached to an EEG and an EOG. The series of photos showed that in four sleep cycles, the person shifted posture nine times.

According to Hobson, if a person moves too frequently, the tossing and turning results in a disturbed sleep, and the person may awaken in the morning not feeling refreshed.

Figure 9.14 Couples who regularly sleep in the same bed tend to have synchronised NREM and REM sleep cycles and movements.

LEARNING ACTIVITY 9.3

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Word copy of table

Review questions

1. Copy and complete the table below to summarise distinguishing characteristics of NREM and REM sleep.

Type of sleep	Muscle tone; Bodily movements (EMG)	Eye movements (EOG)	Brain waves (EEG)	Heart rate; Respiration; Body temperature	Arousal threshold	Dreams	Change in duration across a sleep episode
NREM stage 1							
NREM stage 2							
NREM stage 3							
NREM stage 4							
REM							

2. Refer to the table and list three characteristics that best distinguish NREM and REM sleep. Explain why NREM and REM sleep are considered to be two different states of sleep.
3. Explain whether the NREM stages are four different states of consciousness.
4. Why are NREM stages 3 and 4 commonly referred to as slow wave sleep?
5. Why is REM sleep sometimes referred to as paradoxical sleep?
6. Explain whether REM sleep is best described as deep sleep or light sleep.
7. (a) Distinguish between a sleep cycle and a sleep episode.
(b) Explain whether sleep cycles and sleep episodes may occur voluntarily, involuntary or both.
8. Outline the pattern and proportions of NREM and REM sleep in a typical night's sleep by a young adult. You may use a diagram (such as a chart or hypnogram) to support your description.
9. (a) When could you experience a hypnagogic state?
(b) Explain whether this is an ASC distinguishable from sleep or dreaming.
10. In which half of a sleep episode is a person:
(a) more easily awakened?
(b) more likely to be harder to awaken?
(c) likely to be dreaming?
Explain each answer.
11. If you wanted to wake up mid-dream as soon as possible after falling asleep, how would you calculate when to set up your alarm?
12. Explain whether sleep is the same as being under anesthesia or in a coma.

LEARNING ACTIVITY 9.4

Reflection

NREM stages 3 and 4 are commonly combined and described as one stage called slow wave sleep, delta sleep or simply stage 3. If combined, which term do you believe is most appropriate and why?

LEARNING ACTIVITY 9.5

Comparing NREM and REM sleep as different states of consciousness

Create a poster that differentiates the characteristics of NREM and REM sleep. In your poster, ensure you refer to:

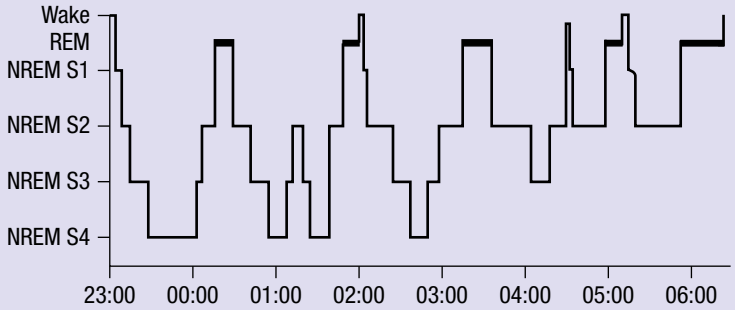
- the cyclical nature of sleep
- the pattern and proportions of NREM and REM sleep in a typical sleep episode of a young adult under normal circumstances
- physiological responses that distinguish each sleep state and the NREM stages, such as:
  - muscle tone and bodily movements
  - eye movements
  - brain wave activity
  - other physiological responses
  - dreams
  - responsiveness to external stimuli/ease of waking (arousal threshold).

LEARNING ACTIVITY 9.6

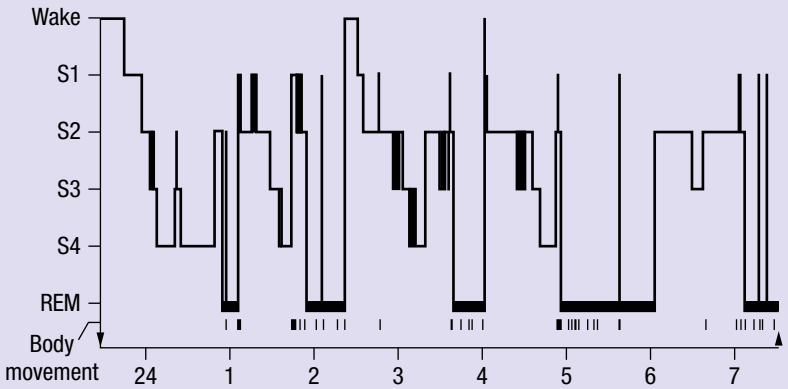
Analysis of data — interpreting hypnograms

1. Identify all the sleep cycles in each version of a hypnogram shown below, both of which show the progression of sleep stages during a single night in a normal young adult.

Hypnogram 1

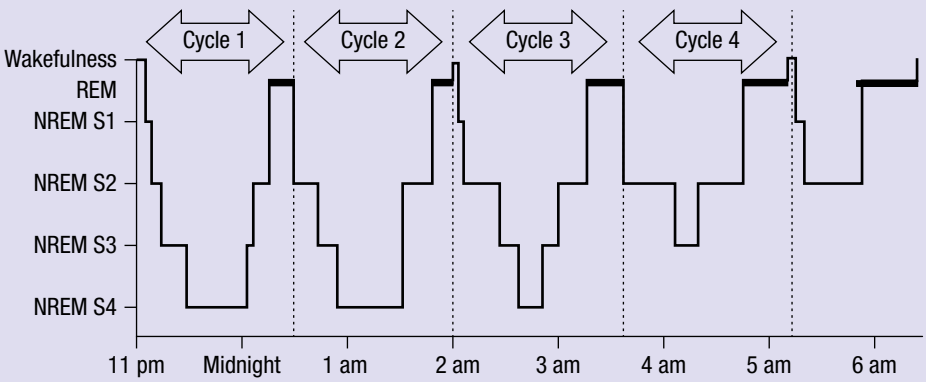


Hypnogram 2



Source: Reprinted from Kryger, M., Roth, T. & Dement, W.C. (2005). Principles and practice of sleep medicine. In M. Carskadon & W.C. Dement, *Normal human sleep: an overview* (4th ed., p. 18). St Louis: Elsevier Saunders.

2. Comment on the accuracy of the hypnogram below with reference to three characteristics of a typical sleep episode of a young adult.



LEARNING ACTIVITY 9.7

Analysis of data on physiological responses during sleep

A researcher obtained sleep data on three participants observed in a sleep laboratory. Extracts from the data are summarised below. Consider the data for each participant and identify the NREM stage during which the data were obtained or whether the data indicate REM sleep.

Participant 1
EOG pattern: no eye movement
EMG pattern: little muscle tension and movement
EEG pattern: brain wave activity quite slow (mainly medium amplitude, medium frequency theta waves)
Other physiological responses: breathing has settled into a more regular pattern; slight drop in blood pressure, temperature and heart rate
Observations:
- Participant reported that they were 'just dozing' during this time.
- Participant reported hearing something smash on the floor in the sleep researcher's office (low arousal threshold).

Participant 2
EOG pattern: frequent eye movements under closed eyelids
EMG pattern: no muscle tension or movement apart from occasional facial twitches
EEG pattern: irregular high frequency brain wave activity (periods of low amplitude beta-type brain waves and occasionally some alpha-type waves)
Other physiological responses: fast and irregular heart rate and breathing; relatively high blood pressure
Observations:
- Participant was difficult to awaken (high arousal threshold).
- Participant reported they had been dreaming and could describe the dream in vivid detail.

Participant 3
EOG pattern: no eye movement
EMG pattern: almost no muscle tension or movement
EEG pattern: only very slow brain waves (low frequency, high amplitude delta)
Other physiological responses: heart rate, blood pressure and temperature all low; slow and steady breathing
Observations:
- Participant was very difficult to awaken (high arousal threshold).
- Participant was disoriented on awakening.
- Participant reported they had been dreaming but had limited recall of the dream.

THEORIES OF THE PURPOSE AND FUNCTION OF SLEEP

We have all experienced the effects of going without sleep for varying periods of time so we know it is important for good physical and mental health. The impact of sleep loss has also been well researched and documented by psychologists. It is clear that we cannot avoid the need for sleep. Eventually our bodies shut down and we sleep whether we want to or not. Even though it is well-known that we need sleep, there is less certainty about *why* we sleep — the purpose and all the functions of sleep.

Research findings on biological processes influencing sleep, the differing needs for sleep between individuals and among people of different ages, and research findings on the effects of sleep deprivation, have led psychologists to propose various theories about why we sleep. Two of the more prominent theories are the restoration and evolutionary (circadian) theories.

Restoration theory

If someone asked you why you sleep, there is a good chance that your answer would refer to being tired and needing to rest and recover from the day's activities. This is essentially the purpose and function of sleep according to restoration theory.

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Practical activities on sleep and dreaming

Restoration theory, also called *recovery theory* and *repair theory*, proposes that sleep provides 'time out' to help us recover from depleting activities during waking time that use up the body's physical and mental resources.

According to the theory, sleep provides an opportunity for the body to recover by replenishing resources that have been used up during the day, including neurotransmitters that are vital to communication between neurons. It also allows any damaged cells to be repaired and various muscles to be detoxified or rid themselves of waste products. This view is supported by the experiences most people have of feeling tired before they sleep and feeling refreshed and more energetic upon waking. Furthermore, people usually sleep for a longer period of time during an illness, suggesting that sleep may have something to do with the recovery process.

The popular belief that sleep helps us ward off illness is supported by research. For example, studies have found that immune system cells that fight infection and disease are produced during sleep (Inoue, Honda & Komoda, 1995; Motivala & Irwin, 2007). However, an adequate amount of sleep in itself does not guarantee good health. For example, a team of Australian

researchers studied 326 children with parent-reported sleep problems at age 7 months and found little or no relationship between sleep duration and mental or physical health when they did a follow-up assessment 5 years later (Price, et al., 2012).

Research evidence supporting restoration theory includes findings from sleep laboratory studies that sleep is a period of physiological rest. For most of the time when we are asleep, large and small muscles throughout the body are relaxed, body functions such as heart and breathing rates slow down, and the rate of neural activity in various brain structures is slightly reduced. Growth hormone, which also promotes body repair, is secreted at a much higher rate when asleep than when awake. Its secretion typically takes place during the first few hours after falling asleep, especially during NREM deep sleep (Colten & Altevogt, 2006).

Figure 9.15 Restoration theory proposes that sleep provides an opportunity for recovery from daily, waking time activities that deplete bodily resources.

In one of the earliest studies to test restoration theory, researchers investigated the effects of strenuous physical exercise on sleep. Sleep recordings of ultramarathon runners who had participated in a 92-kilometre road race were conducted over four consecutive nights. As shown in Figure 9.16, the results indicated that when allowed to sleep for as long as they needed to, the runners slept significantly deeper and longer in the two nights following the race, suggesting a restorative need for sleep (Shapiro, et al., 1981). However, this study involved extreme physical activity over a prolonged period. Although there is considerable research evidence that physical activity can improve sleep quality and increase sleep duration, we do not necessarily need to sleep more than usual after a particularly active day (Breedlove, Watson & Rosenzweig, 2010; Horne & Minard, 1985).

Different people need different amounts of sleep and this is influenced by numerous biological and lifestyle factors such as age, genes, physical health, diet and tasks undertaken before going to bed. Overall, even after a series of physically demanding days, some people can cope very well with much less sleep and some need much more every night (NSF, 2018b).

Other research findings supporting restoration theory come from sleep deprivation studies. For example, experiments with rats have found that prolonged sleep deprivation results in the breakdown of various bodily tissues (e.g. skin sores fail to heal) and death within three weeks. Allowing them to sleep prevents their death. In humans, prolonged sleep deprivation has been found to suppress immune system functioning, resulting in heightened susceptibility to illness and disease. However, there is not necessarily a cause–effect relationship between sleep loss and health problems (Everson, 1997; Motivala & Irwin, 2007).

Restorative functions of NREM and REM sleep

It is also suggested that NREM and REM sleep tend to have different restorative effects. Generally, NREM sleep is considered to be important for restoring and repairing the body. For example, physical growth, tissue repair and recovery from the effects of fatigue may occur during slow wave, stages 3 and 4 of NREM sleep when the brain is least active. A different restorative role of REM sleep is suggested by the fact that REM sleep is much more abundant in the developing fetus and infant than in childhood and subsequent lifespan stages. This indicates that REM sleep may play an important part in the peak period of brain development that occurs in the early stages of the lifespan. For example, it may provide stimulation that is essential for developing the brain, doing so at a time when the brain is less preoccupied with the mental processes and other activities of everyday life (Breedlove, Watson & Rosenzweig, 2010; Hockenbury & Hockenbury, 2006).

It has also been proposed that REM sleep has a restorative role throughout the lifespan by providing regular 'exercise' to groups of neurons in the brain that form neural pathways, thereby promoting the maintenance of brain circuits. Synapses (where neighbouring neurons communicate) can deteriorate if they go too long without being active, so the increased brain activity observed during REM sleep may help strengthen and preserve important neural pathways (Hobson, 1988).

There is also evidence that REM sleep may assist in the consolidation of new memories. For example, experiments with laboratory bred rats have found that they performed better on a learning task (such as running a maze) several hours after learning if they were permitted REM sleep soon after learning, compared with rats deprived of REM sleep during that time (Kavanau, 2000; Smith, 1985).

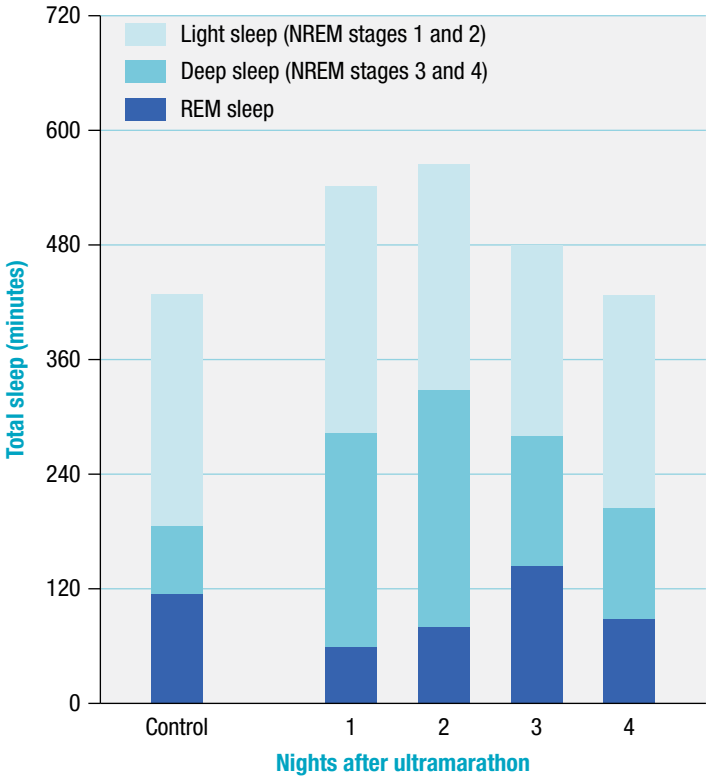

Figure 9.16 Effect on sleep of running an ultramarathon. This graph shows the average time spent in each sleep stage by athletes on each of four nights following a 92-kilometre ultramarathon, compared with control nights (two weeks before and two weeks after the marathon). Notice that the main effects were an increase in the time spent in deep sleep (stages 3 and 4) and a decrease in REM sleep in the first two nights after the marathon.

Source: Based on Shapiro, C.M., Bortz, R., Mitchell, D., Bartel, P., & Jooste, P. (1981). Slow wave sleep: A recovery period after exercise, *Science, 214*, 1253–1254.

study on

A similar experiment with people found improved performance when REM sleep occurred after learning a particular motor task, such as pressing a key on a keyboard after visually locating an object hidden in a textured background (Karni, et al., 1994). Learned motor skills, such as tapping one's fingers in a particular sequence as if playing notes on a piano, can also improve significantly when a period of REM sleep follows initial practice (Walker, et al., 2002). This suggests that REM sleep may have a role in the consolidation of procedural, implicit memories. There is no relationship, however, between time spent in REM sleep and learning capacity in general. Even if REM sleep aids learning, it is not absolutely essential for learning. Similarly, there is little evidence that lack of REM sleep (or NREM sleep) is detrimental to memory formation (Breedlove, Watson & Rosenzweig, 2010; Kolb & Whishaw, 2006; Smith, Nixon & Nader, 2004).

Psychologists generally agree that REM sleep probably serves an important biological need. In the controlled conditions of sleep laboratories, people have been woken up each time they lapsed into REM sleep with no obvious ill-effects. However, when they were allowed to sleep uninterrupted following periods of interrupted REM sleep, they spent more time than they normally would in REM sleep. It seemed that for some reason they needed to make up for lost REM sleep (Dement & Vaughan, 1999). Psychologists refer to this as REM rebound. **REM rebound** involves catching up on REM sleep immediately following a period of lost REM sleep by spending more time than usual in REM sleep when next asleep.

While some research findings suggest that NREM and REM sleep have restorative functions in relation to the body and the brain, it has not been conclusively established in a cause–effect way precisely what, if anything, is actually restored, repaired or revitalised during sleep and at no other time. More active people do not necessarily sleep longer and, for people in general, the amount of sleep we have does not necessarily decrease whenever our level of daytime activity decreases, and vice versa. Although sleep deprivation studies have found that even relatively little sleep loss can impair physiological and mental performance on certain tasks, these studies have not conclusively identified any function for which sleep is essential. Nor has research in general established that restoration is the only function of sleep. If restoration was the only function of sleep, we would expect that a physically disabled person confined to bed would sleep less than a physically active person. This, however, is not the case.

Figure 9.17 REM sleep is much more abundant in the infant than in childhood and subsequent lifespan stages, indicating it may play an important part in the peak period of brain development that occurs in the early stages of the lifespan.

Evolutionary (circadian) theory

Evolutionary (circadian) theory on the purpose and function of sleep emphasises the relationship of sleep to circadian rhythms and how sleep has adaptive value and has evolved to enhance our survival. More specifically, **evolutionary (circadian) theory**, also referred to more simply as *evolutionary theory, circadian theory*, *adaptive theory* or *survival theory*, proposes that sleep evolved to enhance survival by protecting an organism through making it inactive during the part of the day when it is most risky or dangerous to move about. The organism's circadian sleep–wake cycle helps ensure its lifestyle and specific activities are synchronised with the day–night cycle of its environment and at the safest times.

According to evolutionary (circadian) theory, once an organism has fulfilled all its survival functions such as eating, drinking, caring for its young and reproducing, it must spend the rest of its time conserving energy, hidden and protected from predators. While sleeping, an organism is not physically interacting with the environment and is less likely to attract the attention of potential predators. Thus, according to the theory, sleep serves the function of protecting the sleeper from harm or death, and therefore enhances survival of the species. Moreover, the sleep–wake cycle is regulated by circadian processes that are tied to light–dark changes and support the safer lifestyle by ensuring the scheduling of activities and biological functions at appropriate times in the daily environmental cycle.

Research evidence for evolutionary (circadian) theory comes mainly from studies on behaviour patterns and sleep–wake cycles of different animal species. An animal's typical amount of sleep depends to a significant extent on how much time it needs to obtain food, how easily it can hide, and how vulnerable it is to attack. Large animals that are vulnerable to attack tend to sleep little. Large predatory animals, which are generally not vulnerable, tend to sleep a lot. For example, animals with few natural predators, such as lions, tigers and gorillas, may sleep as much as 15 hours a day. Grazing animals such as cows, deer, horses, zebra and buffalo have many predators and struggle to escape from them, especially when isolated from their herd. They cannot hide easily, climb trees or burrow quickly to escape danger. Thus, they are safer awake, rely on vigilance and tend to sleep for short periods totalling about 4 hours per day. Smaller animals such as possums and bats eat less food and need less time to find and digest it. They are also able to sleep in safe places away from their natural predators. Consequently, they do not need to be awake for so long each day, nor to spend so much time safeguarding against attack from predators.

When considered from this perspective, humans sleep at night because we are highly visual animals who need light to find food and do other things necessary for survival. Consequently, we are not well adapted to searching for food in the dark or protecting ourselves from nocturnal predators. It may have been best for us during most of our evolution to be tucked away asleep

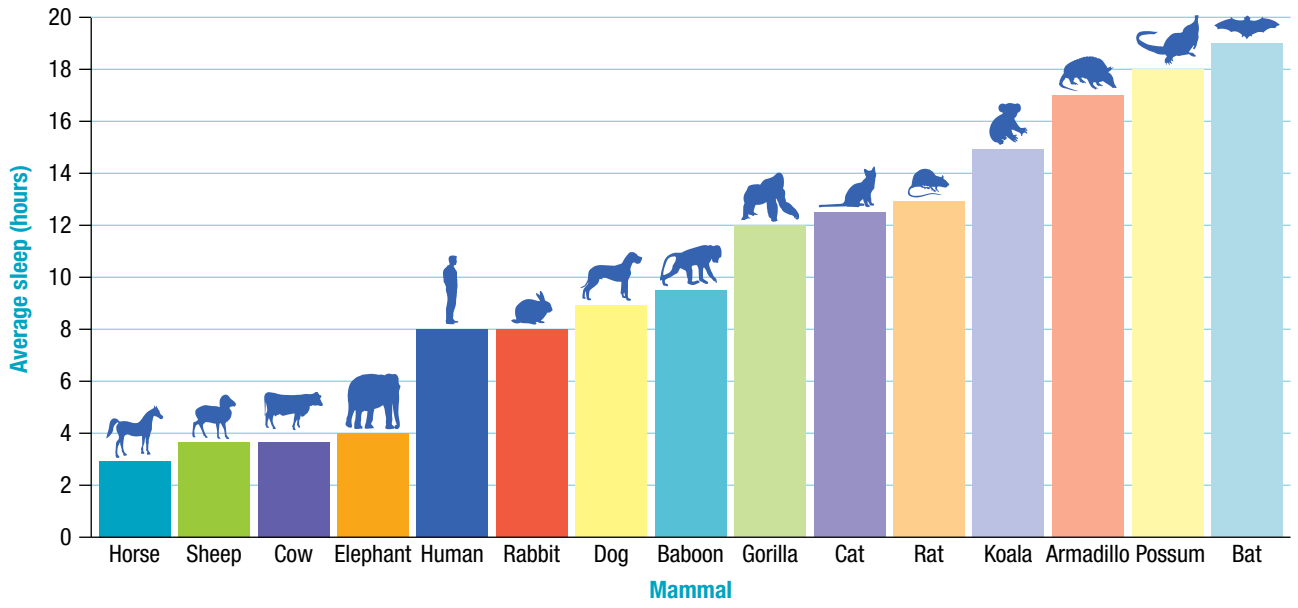

Figure 9.18 Average daily sleep time in a sample of mammals

Source: Zepelin, H., Siegel, J.M., & Tobler, I. (2005). Mammalian sleep. In M. H. Kryger, T. Roth & W. C. Dement. (Eds.). *Principles and Practice of Sleep Medicine* (4th Ed., p. 95). Philadelphia: Elsevier.

at night in a cave or other hiding place so as not to be tempted to walk about and risk falling off a cliff or being attacked by a nocturnal predator. Only during the past few centuries, which is an insignificant speck of time in the context of evolution, have lights and other technologies made the night relatively safe for us. Our pattern of sleep at night may simply be a carryover from a period when the night was a time of great danger. To the degree that night time is still more dangerous than day time our pattern of sleep may continue to serve an adaptive function (Gray, 2007; Grison, Heatherton & Gazzaniga, 2015).

Evolutionary (circadian) theory is useful in furthering understanding of the purpose and function of sleep, particularly how the circadian sleep–wake cycle accounts for why we sleep when we sleep. However, it does not actually explain our need for sleep — why we (and other mammals) must and will eventually sleep, regardless of the environmental circumstances and possibly the danger to which we may be exposed if we fall asleep.

Nor does the theory account for the loss of awareness and alertness during sleep, since their loss may place the organism at greater risk. When asleep, especially during deep sleep, the organism is perceptually disengaged from the external environment and its muscles are in a relaxed state. This means it is not very ready to respond to danger. Furthermore, it is actually always safer for the more vulnerable animals to remain in a state of heightened conscious awareness throughout the day in order to be able to react to an emergency (even if lying still in the dark at night).

While the restorative and evolutionary (circadian) theories of sleep provide insights into the possible reasons for sleep, there is only limited evidence for each of these perspectives. Both theories tend to overlook the benefits of sleep for our mental wellbeing and neither adequately accounts for the ultradian nature of sleep or the patterns and proportions of NREM and REM sleep.

Psychologists have no definite answers to the question of why we sleep. It seems sleep has multiple purposes and functions, two of which may involve restoration and survival. Although the two theories adopt different approaches in explaining the purpose and function of sleep, they are not necessarily mutually exclusive. Both have merit. Furthermore, sleep may serve other purposes as yet not considered. What is clear, however, is that we have little choice about sleeping after a certain period of time has elapsed, so sleep seems to be an automatic process over which we have only limited control.

Figure 9.19 What is the purpose of sleep? To restore the body and its functions after the usual efforts of daily life, or to enhance survival by protecting a species from potential danger when they are most vulnerable? Perhaps it is both, and/or something else that is still unknown.

BOX 9.5 The adaptive nature of the dolphin's sleep

A dolphin must be constantly on the move so it can voluntarily breathe oxygen or it will drown. It also needs to protect itself and its young from sharks and other ocean predators. Unlike humans, there is a survival need for constant movement. Yet the dolphin also has a powerful sleep need as humans do. So, it has adapted with a behaviour called unihemispheric sleep.

Unihemispheric sleep involves switching off and sleeping with one hemisphere of the brain at a time. The other hemisphere, which remains awake and entirely alert, controls breathing. If the left side of the brain is asleep, the right is awake with one eye open and vice versa. The two hemispheres alternate every one to three hours during sleep — first the left hemisphere sleeps, then the right, but never both at the same time. The duration of sleep in each hemisphere varies and sometimes lasts for two hours or more.

During sleep, dolphins kept in aquariums usually swim in circles, in the same direction, as though they were doing so automatically. Prevention of sleep in one hemisphere of the brain is compensated in that hemisphere only and does not change the sleep pattern of the second hemisphere. It remains unknown whether dolphins ever experience drowsiness.

Other marine mammals that need to surface regularly to breathe and some birds, especially birds that spend long periods in migration, are also believed to have unihemispheric sleep (Cvetkovic, 2011; Lavie 2006).

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Weblink
Article on how dolphins and whales sleep without drowning

Figure 9.20 The sleep–wake cycle and sleep behaviour of the dolphin have adapted to the dolphin's unusual respiratory requirements.

LEARNING ACTIVITY 9.8

Review questions

1. (a) Briefly describe the purpose and function of sleep with reference to restoration theory.
(b) Outline the differing restorative effects of NREM and REM sleep.
(i) What is REM rebound?
(ii) When does it occur?
(iii) What is its relevance to restoration theory?
(d) Outline empirical research in support of restoration theory.

2. (a) Briefly describe the purpose and function of sleep with reference to evolutionary (circadian) theory.
(b) Outline empirical research in support of evolutionary (circadian) theory.

3. What are the main limitations of each of the theories?

LEARNING ACTIVITY 9.9

Reflection

Which theoretical perspective do you believe better explains the purpose and function of sleep — restoration theory or evolutionary (circadian) theory? Give a reason for your answer.

DIFFERENCES IN SLEEP PATTERNS ACROSS THE LIFESPAN

Sleep patterns change considerably with age. From infancy to adulthood, there are marked changes in the proportions of REM and NREM sleep, including the percentage of time spent in each NREM stage. Virtually all age-related changes are predictable (Carskadon & Dement, 2011).

As shown in Figure 9.21 below, from birth onward, the total amount of time we spend sleeping gradually decreases as we get older. In addition, the proportion of time spent in REM sleep decreases markedly during the first two years and then remains relatively stable through to a very old age. As shown in Figure 9.22 on the next page, there is also an age-related decrease in the proportion of NREM sleep that persists through to a very old age.

Early in life, after birth, we sleep for about 16 hours a day, about 50% of which is REM sleep. By the end of infancy at about 2 years of age we have overall spent more time asleep than awake, however, total sleep time has declined to around 12–13 hours and REM sleep as a percentage of total sleep is about 20–25%. By the end of childhood and onset of adolescence, total sleep time drops to around 9 hours and about 2 hours or 20–25% is REM sleep. The gradual decrease in total sleep time continues through childhood, adolescence and adulthood, but the 20–25% proportion of REM sleep is maintained well into old age (except in people with a neurodegenerative brain disorder).

In later adulthood, at around 60 or so years of age, the total sleep time averages about 6 hours. Individuals in their sixties and older tend to report that their sleep is much lighter with increased awakenings than when they were younger. This coincides with research findings that NREM sleep of elderly people is mostly stage 2 light sleep. The age-related decrease and eventual disappearance of NREM stages 3 and 4 is also seen in other mammals. Furthermore, as shown in Figure 9.22, by age 85, NREM stages 3 and 4 sleep has significantly diminished (Breedlove, Watson & Rosenzweig, 2010; Lavie, 1996).

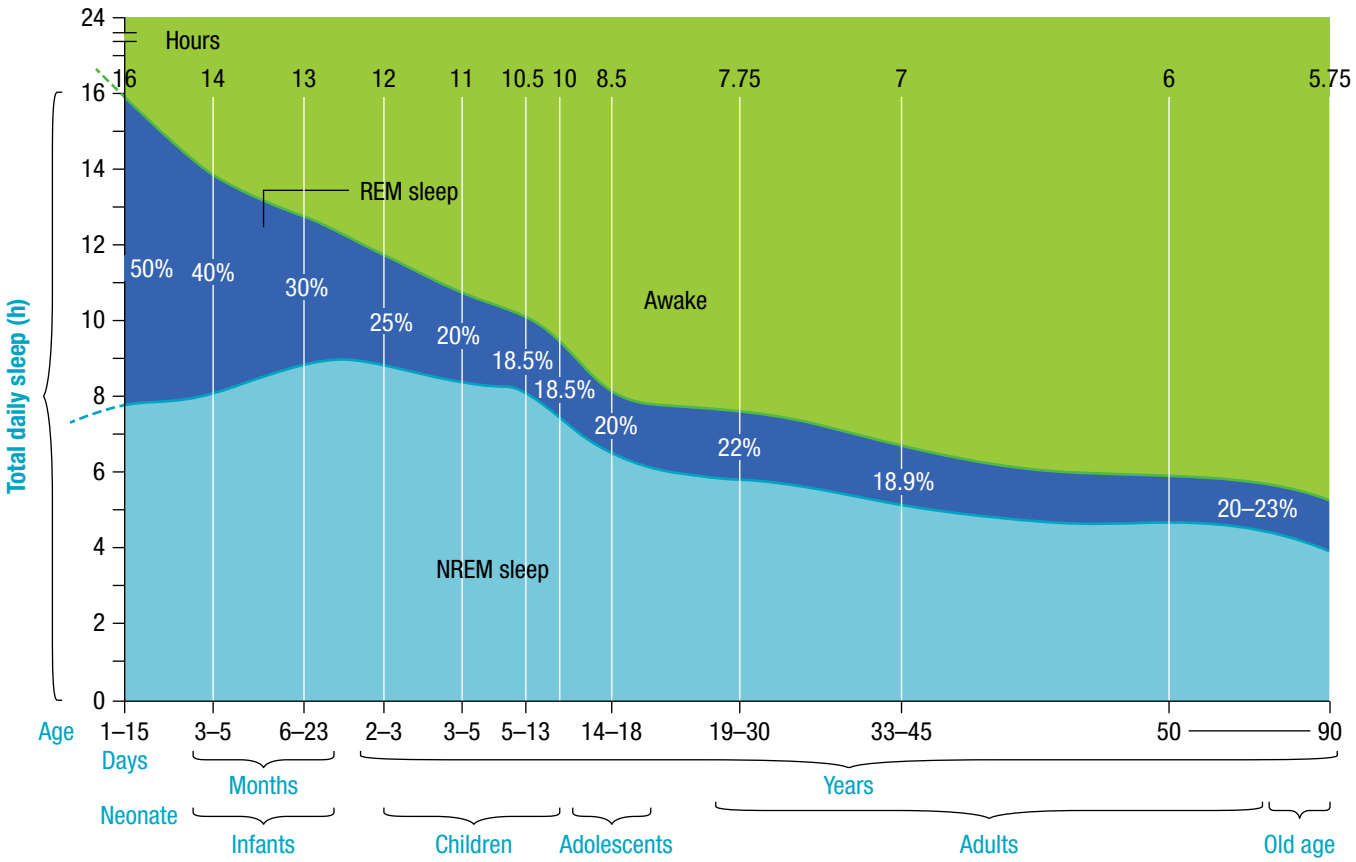

Figure 9.21 Proportions of REM and NREM sleep in humans across the life span

Source: Based on Roffwarg, H.P., Muzzio, J.N., & Dement, W.C. (1966). Ontogenetic development of the human sleep–dream cycle. *Science, 152*, 604–619.

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Practical activity
Survey on sleep patterns across the lifespan

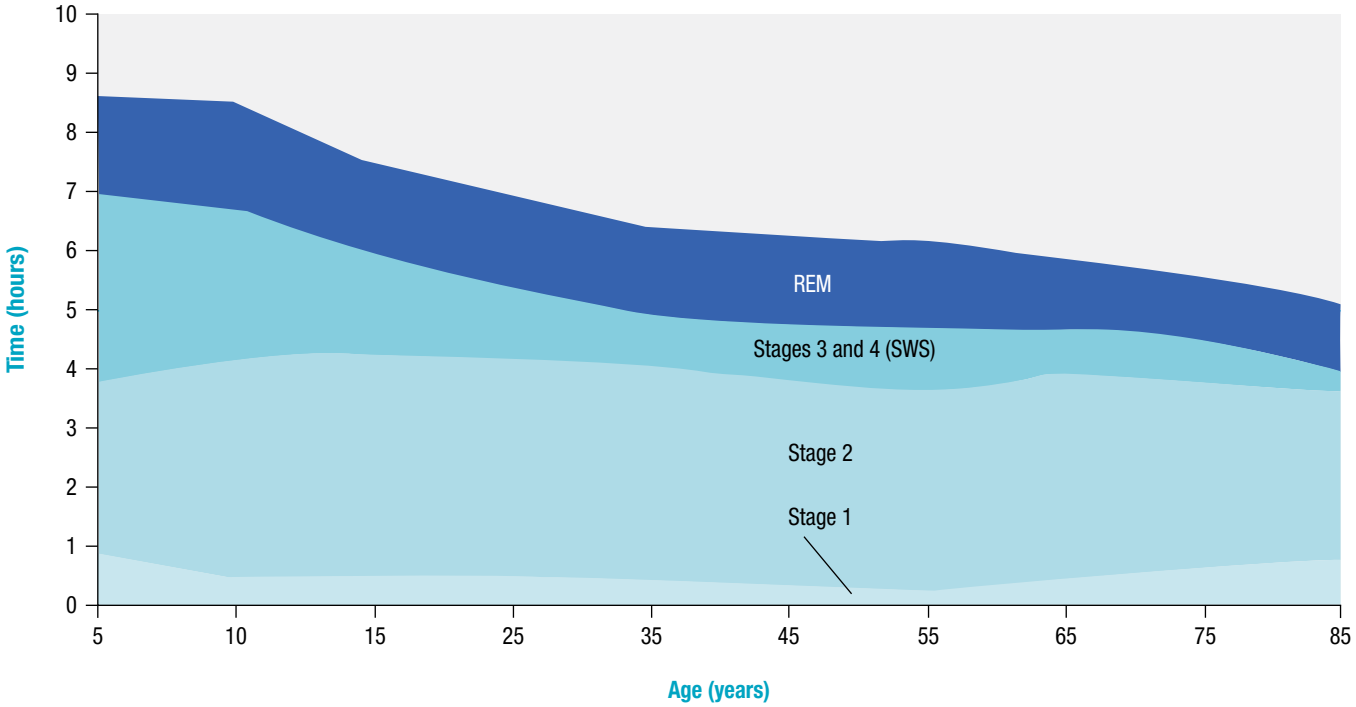

Figure 9.22 Age-related trends for REM sleep and NREM sleep stages.

Source: Based on Ohayon, M., Carskadon, M.A., Guilleminault, C., et al. (2004). Meta-analysis of quantitative sleep parameters from childhood to old age in healthy individuals: Developing normative sleep values across the human lifespan. *Sleep, 27*(7), 1255–1273.

Newborns and infants

From birth to about two months of age, sleep onset may occur at any time of the day or night, with no regular rhythm or concentration of sleeping and waking periods. Sleep duration also tends to be irregular, with the length of one episode lasting from 30 minutes to 3 or 4 hours. The cyclic alternation of NREM–REM sleep is present from birth, but there are fewer sleep cycles. Infants fed from the bottle tend to sleep for longer at a time than breastfed babies (3–4 hours versus 2–3 hours).

As shown in Figure 9.21 on the previous page, for the first few weeks at least, more than half of the infant's sleep is REM sleep or *active sleep* that is like REM sleep. For example, an infant's REM sleep is often restless with lots of facial movements and, unlike when older, arms and legs may move too. It is unclear as to why this occurs but various theories have been proposed, including REM sleep playing a role in neural processes involved in early brain development.

Sleep onset also occurs through REM sleep, not NREM stage 1, and each sleep episode consists of only one or two cycles, which is tied to the shorter duration of a sleep episode. This distinctive sleep pattern is believed to occur primarily because the young infant's circadian rhythms are not fully developed and have not yet been fully entrained to the daily day–night cycle of their external environment. At around 2 or 3 months when circadian rhythms start to exert their influence, particularly the cyclical production of melatonin, there are longer periods of wakefulness during the day and longer periods of sleep at night. Environmental cues influencing night sleep preference include a greater responsiveness to social cues, such as bedtime routines.

By 3 months of age, the NREM–REM sleep cycles become more regular. Sleep onset now begins with NREM stage 1, REM sleep decreases and shifts to the later part of the sleep cycle, and the total NREM–REM sleep cycle is typically 50 to 60 minutes.

By 6 months of age, total sleep time reduces slightly and the longest continuous sleep episode lengthens to about 5 to 8 hours at night. Sleep episodes therefore become less fragmented. In addition, a full NREM cycle comprising all stages is likely to have emerged. The muscle paralysis typical of REM sleep has also set in. These changes emerge between the ages of 2 and 6 months and are primarily attributed to the maturation of the brain and ultradian sleep cycle.

By about 12 months old, the infant sleeps 14 to 15 hours per day with the majority of sleep occurring as a single episode in the evening. This may be complemented by one or two naps during the daytime. There are full sleep cycles but the proportion of REM sleep is still relatively high compared with childhood, adolescence and adulthood (Carskadon & Dement, 2011; Colten & Altevogt, 2006; NSF, 2018c; SHF, 2016b).

Children

Total sleep time continues to decrease as the child gets older, from about 13 to 11 hours between 2 to 5 years of age. This has been attributed to maturation and other biological factors, as well as social factors such as decreased daytime napping, the introduction of preschool time routines and other changes that can influence sleep, including how, with whom, and where children sleep.

The proportion of REM sleep continues to decrease and the amount of NREM sleep increases, with a greater percentage of sleep time spent in stages 3 and 4. As shown in Figure 9.22, about half the NREM sleep of children is slow wave deep sleep and this decreases markedly from about age 10.

The slow wave deep sleep of young children is both qualitatively and quantitatively different from that of older adults. For example, it is extremely difficult to wake a 10 year old when delta brain waves are predominant in the night's first sleep cycle. In addition, children up to mid-adolescence often 'skip' their first REM sleep period, which may be due to the quantity and intensity of slow wave sleep activity early in the sleep episode (Carskadon & Dement, 2011; Colten & Altevogt, 2006).

Adolescents

With increasing age, the total time spent sleeping decreases, as does the amount of REM sleep. However, if bedtime is fixed, the duration of REM sleep tends to remain constant. By mid-adolescence, the first REM period is unlikely to be skipped, and a sleep episode resembles that of young adults.

Within NREM sleep, the amount of stages 3 and 4 sleep progressively declines and the time spent in stage 2 increases. By late adolescence, the amount of slow wave deep sleep has decreased by nearly 40% since early childhood. This occurs even when the length of a sleep episode remains constant (Carskadon & Dement, 2011).

Research findings indicate that adolescents tend to get less sleep than they need to function at their best. One reason is a biologically driven change in their sleep–wake cycle that changes the timing of sleep, delaying its onset for one to two hours. As explained in Chapter 10, it is quite natural for adolescents to want to go to sleep later at night and to sleep in. Many adolescents tend to have irregular sleep patterns across the week — they typically stay up late and sleep in late on the weekends, which can affect their biological clocks and impact on the quality of their sleep (NSF, 2018d).

Adults

Individuals vary in their sleep needs, particularly as they get older, but most people sleep appreciably less as they age. By adulthood, we average about 8 hours of sleep a night, 20–25% of which is REM sleep.

As shown in Figure 9.21 on page 495, the overall pattern of sleep shows a progressive decline in the duration of a typical sleep episode and in the proportions of time spent in REM and NREM sleep. There is also a gradual loss of stages 3 and 4 NREM sleep. As an individual ages (between the ages of 20 to 60), slow wave deep sleep declines at a rate of about 2% per decade. By age 60 or so, a severe reduction is evident. People at age 60 may spend only about half as much time in NREM stages 3 and 4 as they did at age 20, sometimes not at all. Eventually, stages 3 and 4 disappear altogether, particularly in males. Females appear to maintain slow wave deep sleep later into life than men (but no other significant sex differences in sleep have been established) (Bliwise, 1993; Carskadon & Dement, 2011; Colten & Altevogt, 2006).

Sleep also tends to become more fragmented as we age, with more night time awakenings among older adults. One reason for more frequent awakenings is the decline in NREM stages 3 and 4 sleep with age — we are harder to awaken during slow wave sleep. Younger adults may experience brief awakenings, but they are usually minor and occur close to when there is a transition from NREM to REM sleep, so their sleep remains relatively consolidated (Colten & Altevogt, 2006).

Older people also tend to become sleepier in the early evening and wake earlier in the morning compared to younger adults. This pattern is called *advanced sleep phase syndrome*. The sleep–wake cycle is shifted forward so that the usual total amount of sleep is still obtained, but the individuals will wake early because they have gone to sleep early. The reason for this change in the sleep–wake cycle is not clearly understood. It has been proposed that it may be due to an age-related deterioration in the biological clock (SCN) that drives the sleep–wake cycle and the decrease in melatonin levels that is evident among older people (Colten & Altevogt, 2006; SHF, 2016c).

The inability to maintain long sleep episodes and the bouts of wakefulness may also reflect the influence of other factors such as medical problems, decreased mobility leading to a reduction in exercise, irregular meal times and inconsistency of exposure to external cues that influence the sleep–wake cycle (Colten & Altevogt, 2006; Tractenberg, Singer & Kaye, 2005).

It is a common misconception that sleep *needs* decline with age. Research findings show that that our sleep needs remain constant throughout adulthood. The real issue is that, as people age, they tend to have a harder time falling asleep and more trouble staying asleep than when they were younger. The prevalence of sleep disorders also tends to increase with age (SHF, 2017).

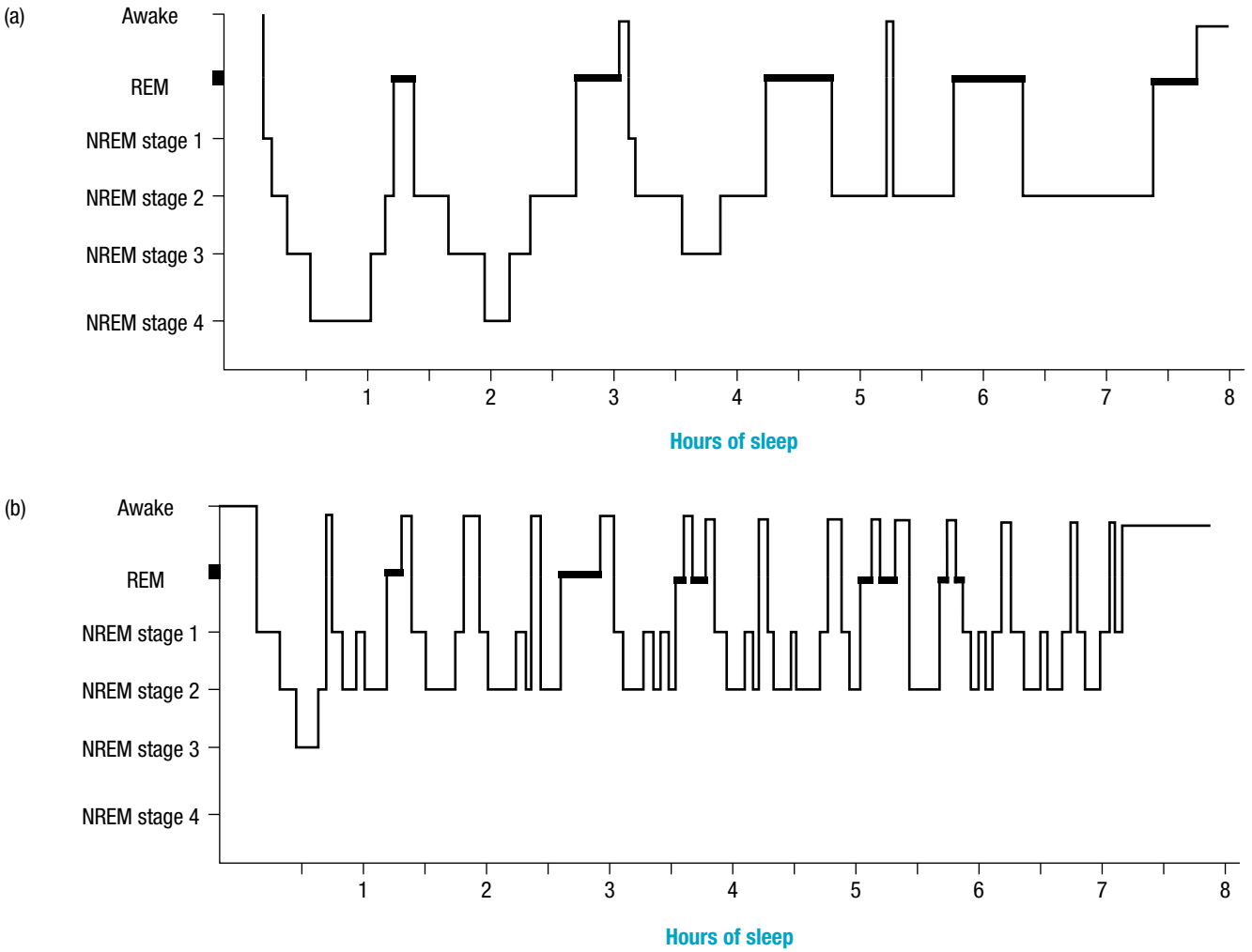

Figure 9.23 Hypnograms showing the typical sleep pattern of (a) young adults and (b) elderly persons.

Source: Neubauer, D. (1999). Sleep problems in the elderly. *American Family Physician, 59*(9), 2551–2558.

BOX 9.6 Are you a morning lark or a night owl?

A lark is a bird that rises early in the morning to satisfy its thirst with the morning dew. Once that is done, the lark will often begin singing a song that, in spring, serves as its mating call. People who are like larks, or who show the psychological tendency that some psychologists have called *morningness*, are early risers. More commonly known as a 'morning person', from the moment they get out of bed, they seem awake, alert and ready to begin daily activities. They tend to work busily through the morning but start to fade as the afternoon wears on. They usually become tired and sleepy early in the evening.

These morning larks can be contrasted with night owls — people who show the psychological tendency called *eveningness*. Getting up early is difficult for night owls. More commonly known as an 'evening person', they tend to drag themselves through the morning but begin to feel more alert and energetic as the day progresses. By evening they are alert and active, and they can often be found working late into the night or the early hours of the morning.

Larks and owls both have 24-hour sleep–wake cycles that are synchronised with the daytime and night-time of the 24-hour 'environmental day'. However, their sleep–wake cycles differ. The owl cycle peaks about 2 hours later than the lark cycle. Larks do their best work in the morning; owls do their best work late in the evening. Owls tend to find it difficult to be motivated in the morning, whereas larks are buzzing around enjoying the morning light and being awake. At night, owls feel energetic and ready to play, while larks are beginning to crash.

A number of questionnaires have been designed to determine whether someone is a morning lark (high score on morningness) or night owl (high score on eveningness). An example is presented below. To find out if you are a lark or an owl, respond to the statements by circling the answers that apply to you. Note that most people fall somewhere between these two types.

1	I am most alert during the	morning	evening
2	I feel that I have the most energy during the	morning	evening
3	I feel that I remember material better if I read it or hear it in the	morning	evening
4	I am the most productive during the	morning	evening
5	I come up with my best ideas during the	morning	evening
6	I feel that I am most intelligent during the	morning	evening
7	I prefer recreation during the	morning	evening
8	Considering what makes me feel best, if I were free to plan my day, I would get up	before 8 am	after 8 am
9	Considering what makes me feel best, if I were free to plan my day, I would go to sleep	before 11 pm	after 11 pm
10	During the first hour after I wake up in the morning I would judge my alertness and energy as	fairly high	fairly low

To score this questionnaire, count the number of responses you circled in the right-hand column. If you have circled seven or more, you are clearly an owl. If you have circled three or fewer, you are clearly a lark. If your responses are between four and six you have no clear larkish or owlish tendencies.

Note that it is difficult for someone to change from being a lark to being an owl, and vice versa. Morning people tend to be more rigid in their circadian sleep-wake cycle. Evening people tend to find adjustment to new schedules somewhat easier. As we age, we all develop a bit more of a tendency towards morningness. Owls, however, show the greatest changes, becoming much more larkish with age.

Source: Adapted from Coren, S. (1996). *Sleep thieves*. New York: The Free Press. p. 92.

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Digital document
Morning lark or night owl questionnaire

LEARNING ACTIVITY 9.10

Review questions

1. Construct a table to summarise sleep–wake patterns of newborns and infants, children, adolescents, adults and elderly people with reference to two distinguishing features of each lifespan stage.
2. Briefly describe five general trends in the pattern and proportions of NREM and REM sleep across the lifespan.
3. (a) Explain age-related changes in sleep in three lifespan stages with reference to circadian rhythm changes.
(b) Give two examples of psychological or social factors that may influence age-related changes.

LEARNING ACTIVITY 9.11

Reflection

Comment on whether changes in the pattern and proportions of NREM and REM sleep across the lifespan are best explained from a biopsychosocial perspective.

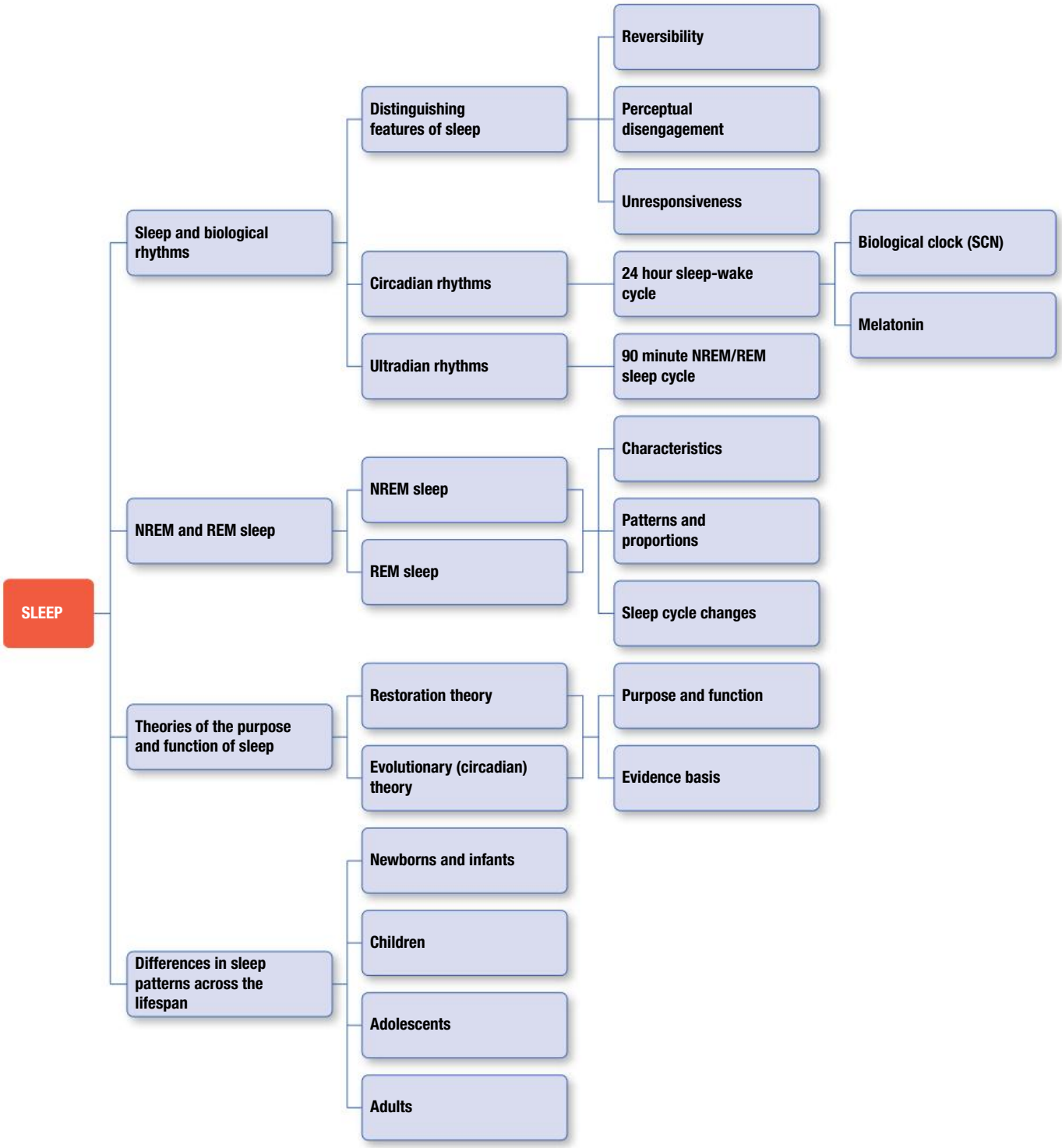
LEARNING ACTIVITY 9.12

Analysis of data — interpreting hypnograms

1. Compare and contrast the typical sleep patterns of young adults and elderly people shown in Figure 9.23 on page 498. Ensure that you refer to:
- sleep onset
- time in REM sleep
- time in NREM sleep and its stages
- awakenings — fragmented vs consolidated sleep across an episode.

2. Suggest a possible limitation of the data.
3. Write a conclusion on the typical sleep pattern of young adults and elderly persons based on the data.

CHAPTER SUMMARY



KEY TERMS

arousal threshold p. 482
biological clock p. 475
biological rhythm p. 475
circadian rhythm p. 475
deep sleep p. 483
entrainment p. 476
evolutionary (circadian) theory p. 492
hypnagogic state p. 481
hypnogram p. 480
hypothalamus pp. 476, 477
melatonin p. 476
non-rapid eye movement (NREM) sleep p. 480
paradoxical sleep p. 484
perceptual disengagement (of sleep) p. 474
pineal gland p. 476
REM rebound p. 491
rapid eye movement (REM) sleep p. 480
restoration theory p. 489
reversibility (of sleep) p. 474
sleep p. 474
sleep cycle p. 480
sleep episode p. 481
sleep latency p. 481
sleep onset p. 481
sleep paralysis p. 484
sleep-wake cycle p. 475
slow wave sleep p. 483
suprachiasmatic nucleus (SCN) p. 476
ultradian rhythm p. 478
unresponsiveness (of sleep) p. 474

LEARNING CHECKLIST

Complete the self-assessment checklist below, using ticks and crosses to indicate your understanding of this chapter's key knowledge (a) before and (b) after you attempt the chapter test. Use the 'Comments' column to add notes about your understanding.

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Word copy of checklist

Key knowledge I need to know about sleep	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
Sleep			
characteristics			
distinction from NWC			
biological clock (SCN)			
role of light			
role of melatonin			
Biological rhythms			
circadian rhythms			
• sleep-wake cycle			
ultradian rhythms			
• NREM-REM sleep cycle			
NREM sleep			
characteristics			
pattern and proportions			
sleep cycle changes			
REM sleep			
characteristics			
pattern and proportions			
sleep cycle changes			
Theories of the purpose and function of sleep			

(continued)

Key knowledge I need to know about sleep	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
Restoration theory			
• purpose and function			
• restorative functions of NREM and REM sleep			
• evidence			
Evolutionary (circadian) theory			
• purpose and function			
• evidence			
Differences in sleep patterns across the lifespan			
newborns and infants			
children			
adolescents			
adults			

studyon

Unit 4 > Area of study 1 > Topic 3

Concept screens and practice questions

CHAPTER 9 TEST

SECTION A — Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Question 1

As we drift in and out of sleep at the start of a typical night's sleep, we normally enter a sleep period known as _____ sleep.

A. REM
B. NREM
C. slow wave
D. delta sleep

Question 2

EOG records of a young adult during NREM stage 3 are likely to indicate

A. coordinated eye movements.
B. uncoordinated eye movements.
C. rapid eye movements.
D. no eye movements.

Question 3

With each complete sleep cycle throughout a typical night's sleep by older adolescents, the

A. duration of REM sleep increases.
B. duration of slow wave sleep increases.
C. duration of REM sleep decreases.
D. brain becomes less active.

Question 4

Which two NREM stages are most alike in terms of commonly measured physiological responses?

A. 1 and 2
B. 1 and 4
C. 2 and 3
D. 3 and 4

Question 5

Which of the following is true of REM sleep?

A. Muscle tone decreases appreciably during REM sleep.
B. The first REM period in the first sleep cycle of a young adult has a duration of about 50 minutes.
C. Brain wave activity decreases appreciably during REM sleep.
D. The first REM period in the first sleep cycle of a newborn infant occurs after an NREM sleep cycle.

Question 6

The most accurate physiological measure for distinguishing between the different stages of NREM sleep is

A. sudden changes in heart rate or muscle tone.
B. the pattern of brain wave activity.
C. the presence or absence of rapid eye movements.
D. gradual changes in body temperature.

Question 7

Which of the following would usually be excluded when calculating total sleep time for an individual?

A. brief awakenings
B. sleep onset period
C. REM sleep periods
D. NREM dream periods

Question 8

Muscle tone, eye movements and other physiological responses commonly measured during NREM sleep tend to be at their highest activity level in stage

A. 1.
B. 2.
C. 3.
D. 4.

Question 9

Which NREM stage has the highest arousal threshold?

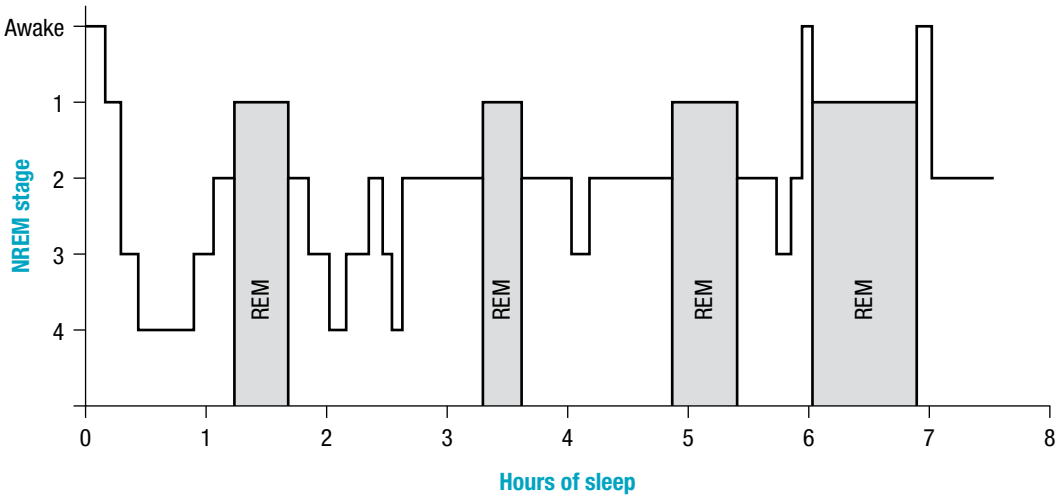
A. 1
B. 2
C. 3
D. 4

Question 10

You are a volunteer research participant isolated from all time cues for over two weeks. What change is most likely to occur to your sleep-wake cycle?

A. cycle becomes longer
B. cycle becomes shorter
C. tend to go to sleep a little earlier each day
D. no change at all due to synchronisation with new environmental cues

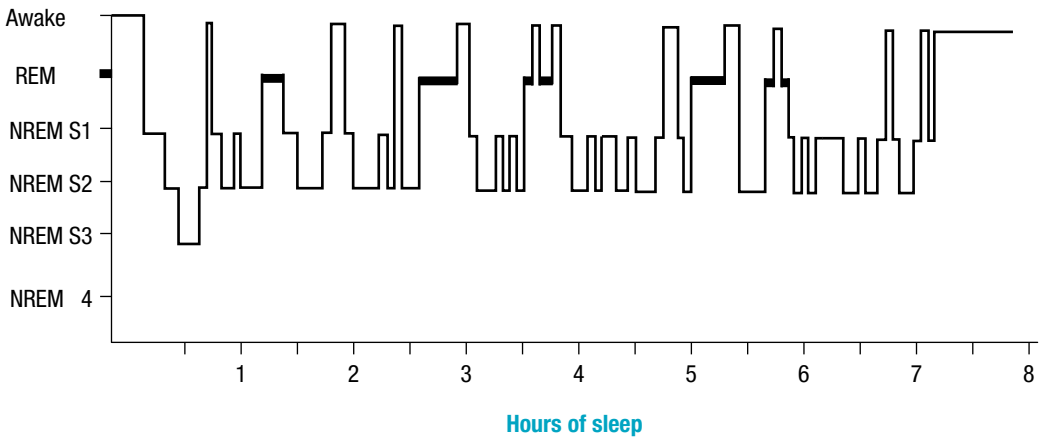
Question 11



The hypnogram above shows the sleep of a/an healthy

A. infant.
B. child.
C. young adult.
D. very old person.

Use the following hypnogram to answer questions 12–15.



Question 12

Approximately how old is the person whose hypnogram is shown?

A. 0–2 weeks
B. 14–19 years
C. 30–50 years
D. 70 years+

Question 13

The hypnogram shows that the person experienced

A. consolidated sleep.
B. mostly light sleep.
C. mostly deep sleep.
D. a prolonged period of NREM stage 4 sleep.

Question 14

About how many times did the person awaken after falling asleep?

A. 1
B. 2
C. 12
D. 21

Question 15

The person spent _____ in NREM stage 3 sleep.

A. 15 minutes
B. 30 minutes
C. 1 hour
D. no time

Question 16

A researcher conducted an experiment to test whether sleeping immediately after learning improves memory of that learning. On the first evening of the experiment, volunteer non-Spanish-speaking participants were required to learn a list of Spanish words. They were then allowed to sleep for an hour. On awakening, they were asked to recall as many of the words as they could. On the second evening, the same participants learnt a new list of Spanish words. They then watched a television program for an hour, after which they were asked to recall as many of the words as they could.

This experimental design is best described as

A. repeated measures.
B. independent groups.
C. mixed participants.
D. matched participants.

Question 17

Which of the following statements about the sleep of a healthy young adult is correct?

A. REM sleep is usually about 75% to 80% of total sleep time.
B. Slow wave sleep is rarely experienced.
C. REM sleep periods tend to occur closer together during a normal night's sleep.
D. Cyclic alternation of non-REM sleep and REM sleep occurs less frequently than in childhood.

Question 18

How soon after a healthy young adult falls asleep are they normally likely to experience REM sleep in a typical sleep episode?

A. immediately
B. about 1–5 minutes
C. after the first sleep cycle
D. about 80–90 minutes

Question 19

The sleep-wake cycle is entrainable because it

A. follows a single pathway across a period of about 24 hours in a clock-like way.
B. has a genetic basis and is therefore internally produced.
C. can be adjusted to match time cues in different environments.
D. repeats once a day regardless of external cues.

Question 20

In a typical sleep night's sleep, _____ tend to predominate during the first half, whereas _____ tend to predominate in the last half.

A. NREM stages 3 and 4; REM and NREM Stage 2
B. NREM stages 1 and 2; REM and NREM Stage 2
C. REM and NREM Stage 2; NREM stages 3 and 4
D. NREM stages 1 and 2; NREM stages 3 and 4

SECTION B

Answer **all** questions in the spaces provided. Write using black or blue pen.

Question 1 (1 mark)

Define the meaning of REM rebound.

Question 2 (2 marks)

Deep sleep may be defined as starting during NREM stage _____when a pattern of_____ brain waves is established.

Question 3 (2 marks)

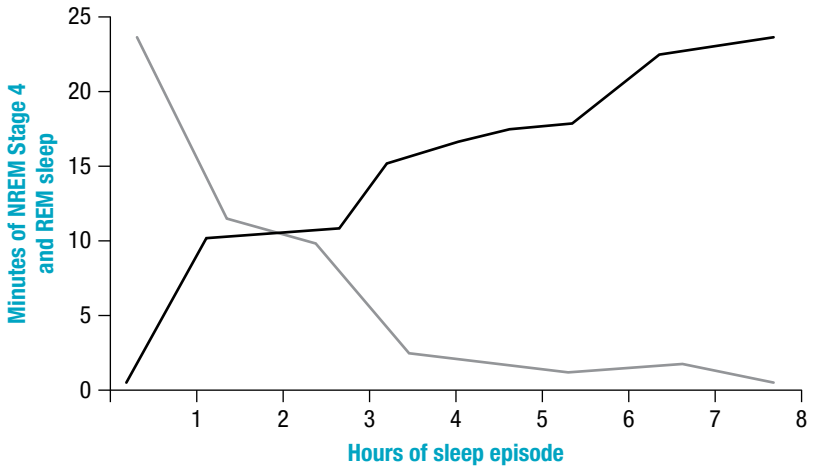
Distinguish between a sleep cycle and a sleep episode.

Question 4 (3 marks)

Describe how eye movements are likely to change across the sleep cycle of a healthy young adult under normal circumstances.

Question 5 (2 marks)

Label the two plot lines in the graph below to show which line represents NREM stage 4 sleep and which line represents REM sleep.



Question 6 (4 marks)

List four differences in sleep across the lifespan with reference to the total amount of sleep and changes in the pattern and proportions of REM and NREM sleep (including NREM stages).

Question 7 (4 marks)

Describe two characteristics that best distinguish sleep from any other state of consciousness. Explain with reference to a person in a drug-induced state after having used a potent depressant.

Question 8 (2 marks)

If a person's eyelids are taped open and they fall asleep, explain whether they would stop seeing.

Question 9 (4 marks)

(a) Describe two criteria that could be used to assess whether a biological rhythm could be called a circadian rhythm. 2 marks

(b) Distinguish between a circadian and an ultradian rhythm. 2 marks

Question 10 (6 marks)

Explain how light influences the human sleep–wake cycle with reference to biological structures and processes that regulate the cycle and why sleepiness is highest at night and lowest in the day.

Question 11 (5 marks)

(a) Name and describe two different theories on the purpose and function of sleep. 3 marks

(b) What is a limitation of each theory? 2 marks

Question 12 (15 marks)

To test the effectiveness of a new sleeping pill, a researcher conducts an experiment at the participants' homes rather than in a sleep laboratory.

Eighteen volunteer adult participants, who reported that they have been suffering from sleep-onset insomnia (i.e. difficulty falling asleep) for more than a year, are each given a packet of 14 pills and asked to take one each night for 14 consecutive nights, 15 minutes before their usual sleeping time. They are also given a special apparatus to record the time they fall asleep. The apparatus, worn on the body, measures various physiological responses associated with sleep–awake states, has a timing device and has been reported by participants in previous studies as not being uncomfortable in any way. Researchers have also found it to be far more valid and reliable than similar measures devised as smart phone apps.

The participants do not know that they have been randomly allocated to either of two groups. The researcher's assistant is also unaware of the group to which each participant has been allocated. Group 1 has 9 participants whose pills are arranged in the pack so that pills 1 to 7 are the new sleeping pills, and pills 8 to 14 look and taste like the sleeping pills but do not contain the sleep-inducing ingredient. Group 2 also has 9 participants, but their pills are arranged so that pills 1 to 7 are the fake pills and pills 8 to 14 are the new sleeping pills.

The results are shown in the following table.

TABLE 1 Time taken to fall asleep

Group	Mean time (minutes)	
	Sleeping pills	Non-sleeping pills
1	37	64
2	78	31

(a) Identify the operationalised independent and dependent variables. 2 marks

(b) Name the experimental design. 1 mark

(c) Explain the meaning of the term counterbalancing with reference to how it was used in this particular experiment. 2 marks

(d) What was counterbalancing used to control in this experiment? 1 mark

(e) Identify the experimental and control groups, if any. 2 marks

(f) Explain the difference between a placebo effect and an experimenter effect in relation to this particular experiment. 2 marks

(g) Name and describe the procedure(s) used to control placebo and experimenter effects in this experiment. 2 marks

(**h**) What conclusion can be drawn from the results? 1 mark

(i) Identify a relevant extraneous or confounding variable that may have affected the results of the experiment. 1 mark

(j) Explain a way in which this variable may have been minimised or controlled in the experiment. 1 mark

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The answers to the Section A multiple-choice questions are in the answer section at the end of this book and in eBookPLUS. The answers to the Section B questions are in eBookPLUS.

10 SLEEP DISTURBANCES

KEY KNOWLEDGE

- changes to a person's sleep–wake cycle and susceptibility to experiencing a circadian phase disorder, including sleep–wake shifts in adolescence, shift work and jet lag
- the effects of partial sleep deprivation (inadequate sleep either in quantity or quality) on a person's affective (amplified emotional responses), behavioural and cognitive functioning
- the distinction between dyssomnias (including sleep-onset insomnia) and parasomnias (including sleep walking) with reference to the effects on a person's sleep–wake cycle
- the interventions to treat sleep disorders including cognitive behavioural therapy (with reference to insomnia) and bright light therapy (with reference to circadian phase disorders).

Source: ©VCAA, VCE Psychology Study Design (June 2017 update), p. 29.

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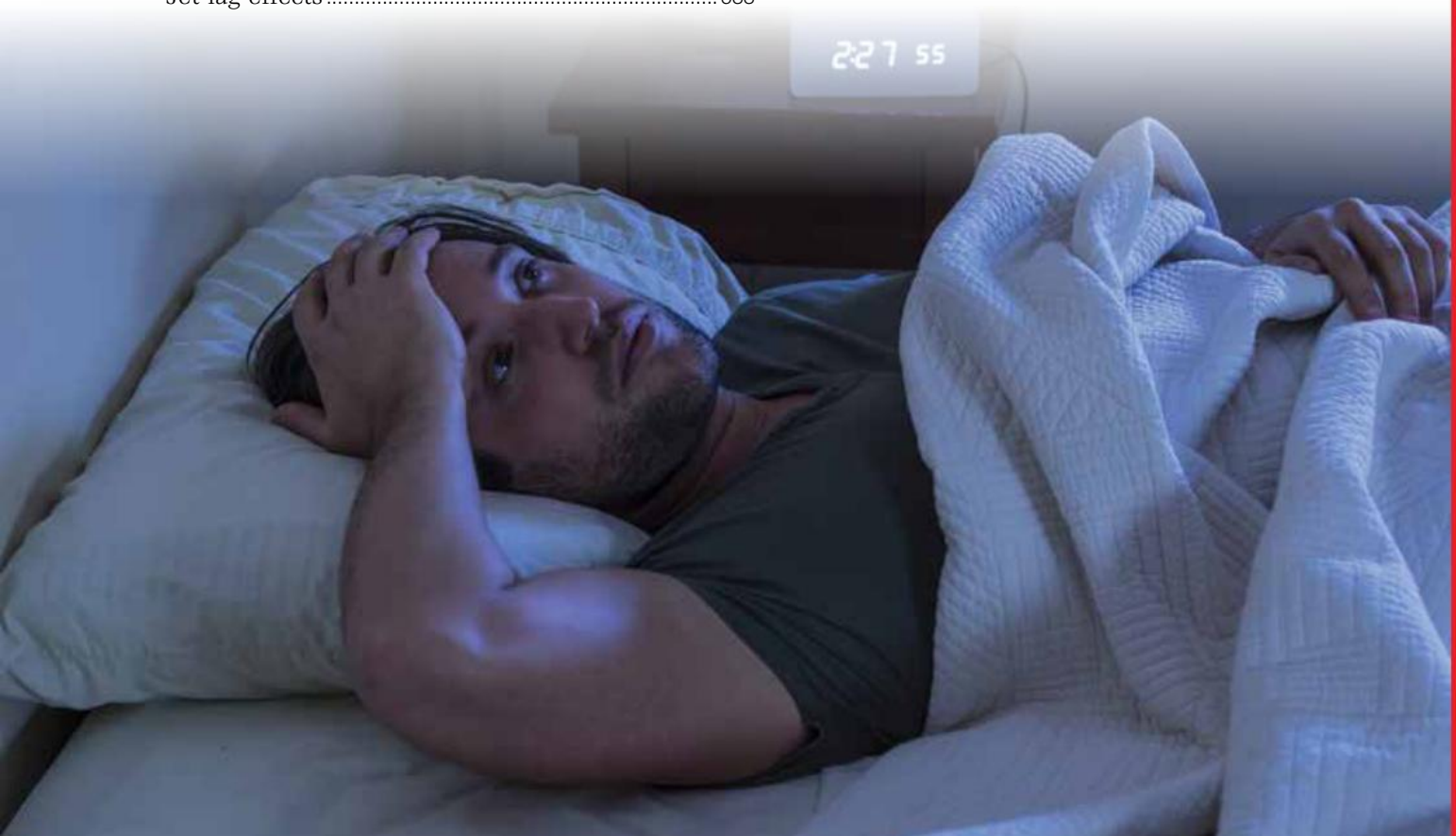
- Parasomnias 518

Circadian rhythm phase disorders 525
- Sleep–wake cycle shift in adolescence 526
- Shift work 529
- Jet lag 532
- Jet lag effects 533

Effects of partial sleep deprivation 535
- Affective functioning 536
- Behavioural functioning 537
- Cognitive functioning 538

Interventions to treat sleep disorders 542
- Cognitive behavioural therapy 542
- Bright light therapy 547



Some nights, we fall asleep easily and the night passes with little or no interruption to our sleep. When we awaken after a good night's sleep we feel terrific — refreshed, energised and ready to take on the world. Other nights, onset of sleep is slow, perhaps not until well into the early morning hours. Or we may fall asleep quite quickly but awaken too many times throughout the night. We usually don't feel so great after these types of 'bad' sleep experiences. Merely getting out of bed when the alarm goes off can be a huge effort. We may snap at the first person we see over something that is really quite trivial. At school or work we may lack motivation, find it hard to concentrate for too long and react more slowly than usual. However, we generally recover quite quickly from isolated 'bad' sleep experiences, especially if we follow it up with a 'good' night's sleep at the next available opportunity (Epstein & Mardon, 2007).

Some people, however, don't sleep as much or as well as they would like to on a regular basis. They may have trouble with the timing of their sleep, falling asleep, staying asleep, waking up, staying awake and/or a problem with the quality of their sleep after they manage to fall asleep. Their problem with sleep quantity or quality occurs because their sleep–wake cycle is disturbed in some way.

The term **sleep disturbance** is used to refer to any sleep-related problem that disrupts an individual's normal sleep–wake cycle, including problems with sleep onset, waking from sleep and abnormal behaviour occurring during sleep. The disruption may be temporary, occasional or persistent. If a sleep disturbance regularly disrupts sleep, causing distress or impairment in important areas of everyday life during normal waking hours, then it is usually referred to as a **sleep disorder**. This means that sleep disorders are generally considered serious disturbances to the normal sleep–wake cycle (American Academy of Sleep Medicine [AASM], 2014a; APA, 2013).

Sleep disorders are often classified as either primary or secondary, depending on their root cause. This classification assists understanding of the symptoms and helps with the planning of treatment.

A *primary sleep disorder* is a sleep disorder that cannot be attributed to another condition, such as another sleep disorder, a mental disorder or medical problem, or use of a substance such as a legal or illegal drug. The sleep disorder is the main, or 'primary', cause of the sleep problem. It occurs in its own right and cannot be explained by another condition. For example, someone may experience regular awakenings throughout their major sleep episode because they have the primary sleep disorder called insomnia.

A *secondary sleep disorder* involves a prominent sleep problem that is a by-product of or results from another condition, or use of a substance. For example, someone may experience regular awakenings whenever they sleep because of their back pain, a bladder problem, a breathing irregularity, stress, an anxiety disorder or depression. In this case, the sleep problem is 'secondary' to something else — another underlying condition. It is believed to improve with treatment of the underlying condition so the target of treatment would be the underlying secondary condition (AASM, 2001, 2014a).

Figure 10.1 If you regularly feel drowsy during the day, you may have a sleep-related problem.

Distinguishing between primary and secondary sleep disorders depends on whether the sleep problem is considered a sleep disorder or a symptom of another condition. Although primary sleep disorders do not arise from other conditions, they can often contribute or lead to other conditions. For example, the ongoing experience of poor sleep quantity or quality due to insomnia or an irregular sleep–wake pattern, both of which are primary sleep disorders, may contribute to an anxiety disorder or depression.

Disturbed sleep, whether because of timing, quantity, quality or some other problem, can adversely impact on our health and wellbeing. Common effects are daytime sleepiness, tiredness, lack of energy, difficulty concentrating, slower reaction times and mood change. A range of other impairments to various aspects of our emotional, behavioural and cognitive functioning have also been identified. Some sleep disturbances or disorders are a risk factor for the presence or subsequent development of a serious physical or mental health problem. Some sleep disorders, such as those that are breathing-related or involve seizures, can even be life threatening.

Sleep disturbances and disorders are very common, affecting virtually everyone at some point in their lives. However, they are largely under-reported, under-recognised and under-diagnosed, and often left untreated. While ongoing sleep problems typically cause some degree of personal distress and interfere to some extent with an individual's behaviour and everyday functioning, virtually all of them can be successfully treated or managed.

In this chapter we examine the effects of a range of sleep disorders and possible treatments. We also revisit sleep deprivation to examine the effects of inadequate sleep quantity or quality in a more substantial way than in chapter 9.

DYSSOMNIAS AND PARASOMNIAS

More than 80 different types of sleep disorders are described in the various classification systems that are used for diagnostic purposes by sleep disorder specialists and mental health professionals. The disorders are usually grouped in categories and sub-categories. Two traditionally used categories are dyssomnias and parasomnias.

Generally, *dyssomnias* involve problems with sleep–wake cycle processes, such as difficulty falling or staying asleep, inability to prevent sleep onset, or a disruption to the timing of the circadian sleep–wake cycle. In contrast, *parasomnias* involve inappropriate disruptions of sleep by some abnormal sleep-related event, such as sleep walking, teeth grinding and terrifying dreams. Unlike dyssomnias, parasomnias do not involve a dysfunction in any process or mechanism that generates or times sleep (Kennedy, 2002; Thorpy, 2012).

In some cases, symptoms of a dyssomnia (such as excessive daytime sleepiness) may result from awakenings caused by the disruptive behaviour of a parasomnia during sleep or by another dyssomnia. Similarly, someone who regularly experiences nightmares (a parasomnia) may also experience insomnia (a dyssomnia) because of an inability to sleep soundly.

Most individuals suffering from a parasomnia express concern about the unusual behaviour or experiences they have during sleep, rather than insomnia or excessive daytime sleepiness. In contrast, dyssomnias are not usually associated with abnormal behaviour or experiences and primarily produce a complaint of insomnia or excessive sleepiness.

All dyssomnias and parasomnias are primary sleep disorders. This means the specific disorders within each category are independent of any other condition or disorder and the main cause of the sleep disturbance.

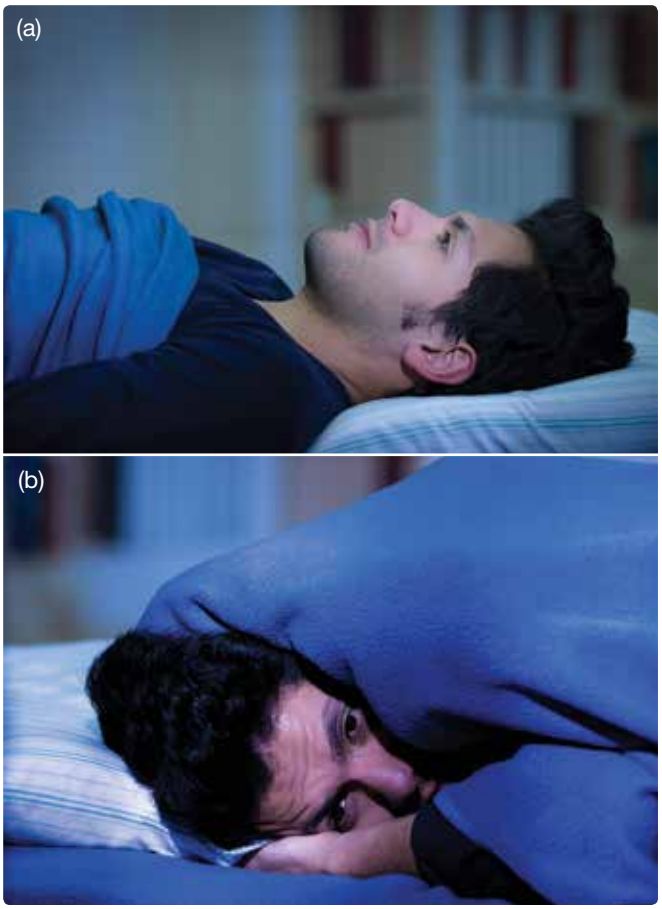


Figure 10.2 (a) A dyssomnia involves a problem with a sleep–wake cycle process (such as difficulty falling or staying asleep), whereas (b) a parasomnia involves disruption of sleep by an abnormal event (such as a frightening dream that awakens the sleeper).

LEARNING ACTIVITY 10.1

Review questions

1. Explain the meaning of sleep disturbance.
2. Under what conditions is a sleep disturbance likely to be considered a sleep disorder?
3. (a) Distinguish between a primary and secondary sleep disorder.
   (b) Explain how primary and secondary sleep disorders can contribute to each other's symptoms.
4. (a) What are dyssomnias and parasomnias?
   (b) Give two examples of dyssomnias and parasomnias.
   (c) Distinguish between dyssomnias and parasomnias with reference to two key characteristics.

LEARNING ACTIVITY 10.2

Reflection

Consider the comment in the chapter introduction that sleep disorders are largely under-reported, under-recognised and under-diagnosed and often untreated. What is a possible explanation?

Dyssomnias

Dyssomnias are sleep disorders that produce difficulty initiating, maintaining and/or timing sleep. This results in a problem either falling asleep, staying asleep and/or excessive sleepiness. As a consequence, the person suffers from changes in the quantity (amount) or quality (restfulness) of their sleep (AASM, 2014a).

Among the more common dyssomnias are different types of *insomnia* (when it is hard to fall asleep or stay asleep) and various *circadian rhythm phase disorders* such as the sleep–wake cycle shift that occurs in adolescence or a disturbance to the sleep–wake cycle that may be due to shift work or when we fly across time zones and experience jet lag.

Although many dyssomnias can originate or develop from causes outside of the body, such as lifestyle factors or sleep environment conditions, they are primarily attributable to some kind of change to the mechanisms and processes that generate or time sleep, including naturally occurring changes and abnormalities (AASM, 2014a; Kennedy, 2002; Thorpy, 2012).

In this section we examine one of the best-known and commonly occurring example of a dyssomnia, with reference to its effects on a person's sleep–wake cycle — sleep-onset insomnia.

Sleep-onset insomnia

Everyone has an occasional night of bad sleep from which they usually recover within a day or so. There are some people, however, who struggle nightly with their sleep. They take a long time to fall asleep, they may awaken many times during the night, or their sleep may even end in the middle of the night well before they want it to. Some may fall asleep quickly only to wake up during the night, wide awake and then have trouble falling asleep again. When it is time to get out of bed, they typically feel tired, their head can feel heavy, it is a struggle to focus or think clearly and their senses can feel dull. Often, a few minutes are needed to 'recover' from sleep. These are all symptoms of insomnia.

Insomnia is a sleep disorder that typically involves *persistent* difficulty initiating or maintaining sleep. This means that a person regularly experiences a problem falling asleep and/or staying asleep, despite having adequate time and opportunity for sleep. As a consequence, there is dissatisfaction with the quantity or quality of sleep. Sleep is perceived as insufficient or non-refreshing. In addition, the sleep complaints are accompanied by a significant degree of personal distress or functional impairment when awake. Persistent insomnia is sometimes called *chronic insomnia* because of its ongoing, long-term nature (APA, 2013; SHF, 2018c).

As with other dyssomnias, insomnia is a primary sleep disorder — it may occur in the absence of any other disorder or condition. Insomnia may also be secondary to another sleep disorder; for example, it is commonly associated with sleep-related breathing disorders (e.g., obstructive sleep apnoea), movement disorders (e.g. restless legs or periodic limb movements during sleep) and circadian rhythm sleep disorders. The difficulty initiating or maintaining sleep may also occur with a mental or physical health condition such as stress, anxiety, pain, an illness, disease or effects of a substance (Schutte-Rodin, et al., 2008).

Generally, insomnia can be situational or recurrent. *Situational insomnia* lasts a few days or weeks and is often associated with life events that may include a sudden change to the sleeper's environment or sleep–wake cycle. It usually resolves once the initial causal event passes. *Recurrent insomnia* occurs irregularly and involves episodes of sleep difficulty interspersed with occasional nights of restful sleep. The insomnia bouts tend to be associated with the occurrence of stressful events (APA, 2013).

The term **sleep-onset insomnia** (also called *initial insomnia*) is used to refer specifically to the sleep disorder involving persistent difficulty falling asleep at the usual sleep time. It takes a long time to fall asleep, but the person can usually sleep through the night once sleep starts (or through the day if they are a shiftworker). Sleep-onset insomnia is distinguished from *sleep maintenance insomnia* which involves difficulty staying asleep (called *middle insomnia*) and/or awakening prematurely from sleep with an inability to fall asleep again (called *late insomnia*). Many people experience a combination of these types of insomnia, sometimes all three (APA, 2013).

Key symptoms

The experience of sleep-onset insomnia is a unique one for each individual with the disorder. There are, however, a number of key symptoms and criteria that are commonly used as part of the diagnostic process. Along with the pattern of sleep disturbance, these may include:

- regular failure to fall asleep within about 20–30 minutes after intending to go to sleep
- complaint of poor quality sleep that does not leave the individual feeling rested upon awakening (called *nonrestorative sleep*) or a consistently reduced amount of total sleep, either of which is associated with difficulty falling asleep
- the sleep difficulty occurs at least three nights a week
- the sleep difficulty is experienced for at least three months (but if less than three months may be described as *recurrent* or *episodic* sleep-onset insomnia)
- the sleep difficulty occurs despite adequate opportunity to sleep (which helps distinguish insomnia from insufficient sleep due to behaviour and lifestyle factors)
- the sleep difficulty does not occur in the course of another sleep disorder and is not due to another disorder or the effects of a substance
- difficulty falling asleep causes significant impairment in behaviour or important areas of everyday functioning, such as at school, work and in social or recreational situations (APA, 2013; Schutte-Rodin, et al., 2008).

Insomnia is the most prevalent of all sleep disorders and most frequently occurs together with another condition of some type, either another sleep disorder and/or a physical or mental health disorder. It is estimated that about 30% of adults have symptoms of insomnia at some time, and about 5–10% of adults have a persistent insomnia disorder. The onset of symptoms can occur at any time in life, although insomnia complaints are more prevalent among older adults. Like most other sleep disorders, the symptoms can be treated and it is a manageable condition (APA, 2013; NSF, 2018e; SHF, 2018c).

Figure 10.3 Sleep-onset insomnia involves persistent difficulty falling asleep at the usual sleep time.

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Weblink
Video on chronic insomnia 2m 30s

Effects on sleep–wake cycle

As with any other sleep disorder, sleep-onset insomnia can significantly disrupt the sleep–wake cycle and its regulation. Generally, the individual experiences changes in the amount, restfulness and the timing of their sleep. Common complaints are sleep onset occurring much later than desired, sleep is nonrestorative (not restful) and/or total sleep time is less than desired (Schutte-Rodin, et al., 2008).

Many people who experience sleep-onset insomnia are often frustrated, anxious or stressed about not being able to fall asleep when they want to and therefore not getting enough sleep to properly fulfil their daily commitments, which can make the problem worse. The preoccupation with sleep and distress due to the inability to sleep may lead to a vicious cycle — the more the person tries to sleep, the more frustration and anxiety build up and impair sleep onset. Consequently, excessive attention and efforts to sleep can override and inhibit the normal sleep-onset mechanisms (APA, 2013).

In some cases of persistent sleep-onset insomnia, when the person also starts to regularly experience difficulty waking up in the morning, the continually delayed sleep onset may disrupt the circadian sleep–wake cycle to the extent that a delayed sleep phase ('timing') disorder develops. When this occurs, the times when they naturally feel sleepier and awaken occur later, so their paired sleep–wake times are later than desired. This may partly solve their problems of sleep quantity and/or quality, but their sleep–wake cycle can be out-of-sync with time dependent requirements of the rest of society which may create new problems.

In sum, the effects of sleep onset insomnia on the sleep-wake cycle may include:

- changes in the amount, restfulness and timing of sleep
- sleep onset tends to occur much later than desired
- sleep tends to be nonrestorative (not restful)
- total sleep time may be less than desired
- excessive daytime sleepiness (i.e. during the waking state of the circadian cycle)
- difficulty waking up in the morning
- continually delayed sleep onset may disrupt the circadian sleep–wake cycle to the extent that a delayed sleep phase disorder develops e.g. the reset sleep–wake cycle is out of sync with time-dependent requirements of the rest of society.

BOX 10.1 Narcolepsy

Narcolepsy is a sleep disorder involving excessive sleepiness during normal waking hours. A person with this type of dyssomnia will usually feel extremely tired and sleepy throughout the day. This will happen even though they believe that they are getting enough sleep at night. The sleepiness can occur regardless of the time, what they are doing or where they are. They will want to go to sleep, rather than just feel tired or weary without a strong need for sleep, as tends to happen in people without narcolepsy (Bruck, 2006; NSF, 2018f).

In some cases, they may also experience an urge to sleep that will be hard to control unless they have had a nap. This involuntary lapse into sleep is commonly called a *sleep attack*. There is a tendency to fall asleep quickly and move directly into REM sleep. A sleep attack usually occurs suddenly, without warning. Some attacks may last for only a few seconds. Typically, the individual sleeps for 10 to 20 minutes and awakens refreshed, but within the next two to three hours begins to feel sleepy again, and the pattern repeats itself. Sleepiness can often be tolerated for a while with much effort and attention focussed on staying awake. Eventually, however, it is impossible to resist the urge to sleep.

Figure 10.4 Narcolepsy is primarily characterised by excessive sleepiness during normal waking hours. A person may feel sleepy anywhere, at any time when awake. In some cases, they may have a sleep attack and fall directly into REM sleep regardless of what they are doing.

Sleep attacks are more likely to occur in passive situations when sufferers are inactive or situations in which tiredness is common, such as when travelling on public transport, attending a meeting that requires no active participation, listening to a long lecture, or when at the movies or theatre. However, sleep attacks may also occur in situations where sleep normally never occurs, including dangerous situations. For example, they may occur when eating a meal, engaged in a conversation, during an exam, while actively participating in a meeting, when standing or walking, or when riding a bike or driving a car (AASM, 2014a).

Everyone with narcolepsy experiences excessive sleepiness when awake and it is usually the first symptom to appear and indicate presence of the disorder. There are also three other major symptoms:

- *cataplexy* involving sudden loss of muscle tone while conscious, resulting in weakening of muscles and loss of voluntary control of affected muscles
- *hallucinations* during sleep onset or when awakening
- *sleep paralysis* involving temporary inability to move and speak during sleep onset or when waking up (resembles a cataplectic episode that affects the entire body)

These symptoms are less common than excessive sleepiness and not necessarily experienced by all people with narcolepsy.

Narcolepsy is a rare sleep disorder which effects about 1 in 2000 people (less than 0.05% of the general population). Age of onset is most common during puberty and adolescence. The actual cause remains unclear. It is considered to be a neurological disorder, specifically a central nervous system disorder involving the brain's inability to regulate sleep–wake cycles normally. There is no cure but symptoms can be treated and it is a manageable condition. Sometimes people confuse narcolepsy with a tropical disease called *sleeping sickness* which is caused by the bite of an infected tsetse fly, an insect native to Africa (NSF, 2018f, Scammel, 2013).

Figure 10.5 Cataplexy — a sudden loss of muscle tone — is one of the symptoms of narcolepsy. These narcoleptic Doberman Pinschers are awake but limp from a cataplectic attack provoked by the excitement of playing together. Moments earlier the dogs appeared normal. For humans, the most common trigger for cataplexy is laughter.

LEARNING ACTIVITY 10.3

Review questions

1. What is insomnia?
2. Explain the meaning of sleep-onset insomnia with reference to three symptoms relating to the sleep–wake cycle.
3. Under what conditions would sleep-onset insomnia be considered acute or chronic?
4. Give three examples of how sleep-onset insomnia can affect a person's circadian sleep–wake cycle.
5. Explain how someone can perpetuate their sleep-onset insomnia through their thoughts, feelings or behaviour.

LEARNING ACTIVITY 10.4

Reflection

Suppose you were diagnosed as having sleep-onset insomnia. Write a couple of paragraphs to give a snapshot of your experience during a break at school or work, ensuring you refer to several key symptoms.

Parasomnias

Parasomnias are sleep disorders characterised by the occurrence of inappropriate physiological and/or psychological activity during sleep or sleep-to-wake transitions (Kennedy, 2016b). This activity may occur in association with specific sleep states or stages (such as REM sleep or a specific NREM sleep stage) and/or during the transitional stages of sleep (such as wake-to-sleep and sleep-to-wake). Essentially, they may occur while falling asleep, sleeping, between sleep stages, or during arousal from sleep.

Unlike dyssomnias, parasomnias are not abnormalities of processes underlying the sleep–wake cycle, sleep states, or in the quantity or timing of sleep or wakefulness. They are specific *events* that occur predominantly during a sleep episode, such as abnormal sleep-related motor activity, behaviours, emotions, perceptions, dreaming and autonomic nervous system functioning. Many of the parasomnias result from inappropriate activation of the central nervous system (usually transmitted through the autonomic nervous system or skeletal muscles) during various states or stages of sleep. Some result from a failure of neural processes, as can occur when respiration is impaired in breathing-related sleep disorders (AASM, 2014a; Kennedy, 2002; Thorpy, 2012).

Sleep walking is the parasomnia specified for study in VCE Psychology. In this section we examine this disorder, with reference to its effects on a person's sleep–wake cycle.

studyon

Figure 10.6 Parasomnias are sleep disorders characterised by the occurrence of inappropriate physiological and/or psychological activity during sleep or sleep-to-wake transitions.

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Weblink
Parasomnias — sleep lab video recordings 8m 36s

BOX 10.2 Classification of sleep parasomnias

The table below shows a classification system for sleep disorders that organises some of the parasomnias in categories based on whether they are *primary* (occurring in their own right) or *secondary* (occur because of another condition). Primary parasomnias are also classified in subcategories based on whether events occur during NREM sleep, REM sleep or neither of these. Secondary sleep parasomnias are undesirable or troublesome motor, behavioural or physiological events that occur during sleep. Generally, the secondary sleep parasomnias result from the activity of one of the bodily systems and are classified according to the system with which they are associated (Kennedy, 2002).

PRIMARY SLEEP PARASOMNIAS

A. NREM parasomnias

1. Disorders of arousal (called Sleep terrors and Sleep walking in the DSM-5)
2. Sleep starts (e.g. brief body jerks just after sleep onset)
3. Sleep drunkenness (e.g. prolonged transition from sleep to waking)

B. REM parasomnias

1. Dream anxiety attacks (called Nightmare Disorder in the DSM-5)
2. Hypnogogic hallucinations and/or sleep paralysis
3. REM sleep behaviour disorder (e.g. abnormal movements during REM sleep instead of the expected loss of muscle tone)

C. Non-sleep state specific parasomnias

1. Bruxism (e.g. repeated grinding or crunching of teeth during sleep)
2. Enuresis (e.g. involuntary urination during sleep after the age at which bladder control usually occurs)
3. Rhythmic movement disorder (e.g. body movements such as body rocking while on hands and knees or head banging on the pillow repeated regularly over an extended period)
4. Periodic movements of sleep (e.g. episodes of simple, repetitive, involuntary muscle movements during sleep such as the tightening or flexing of a leg muscle)
5. Sleep talking (also called somniloquy)

SECONDARY SLEEP PARASOMNIAS

A. Central nervous system

1. Seizures
2. Headaches

B. Cardiopulmonary

1. Sleep-related arrhythmias (e.g. heart beats irregularly, too fast, or too slow)
2. Nocturnal asthma (e.g. asthma symptoms disturb sleep)
3. Sleep apnoea (e.g. sleep-related breathing disorder)

C. Gastrointestinal (e.g. acid reflux or symptoms like heartburn; painful contractions within oesophagus — the muscular tube connecting mouth and stomach)

Source: Based on Mahowald & Rosen's (1990) Classification of sleep parasomnias. Cited in Kennedy, G. A. (2002). A review of hypnosis in the treatment of parasomnias: Nightmares, sleep walking and sleep terror disorders. *Australian Journal of Clinical and Experimental Hypnosis, 30*(2), 99–155.

Note: Other classification systems have more or less sleep disorders, sometimes with different names. They may also use more categories and classify disorders differently. For example, the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5) has a Parasomnias category but not Dyssomnias. In addition, sleep apnoea is categorised as a Breathing-Related Sleep Disorder, not a Parasomnia.

Sleep walking

Sleep walking, sometimes called *somnambulism*, involves getting up from bed and walking about or performing other behaviours while asleep. A sleep walking episode may involve activities that vary in type, degree of complexity and duration. The level of activity may be calm, moderate or vigorous. For example, a sleep walker may arise from bed calmly and quietly walk around for a couple of minutes then return to bed. At another time, the sleep walker may bolt from the bed and move vigorously as if agitated or making a frantic attempt to escape from a fearful stimulus (AASM, 2014a; APA, 2013).

Most sleep walkers typically engage in activities that are of low complexity. The episode usually ends spontaneously if the sleep walker is left alone. For example, they will return to bed, lie down and continue to sleep without awakening.

The sleep walker's eyes are usually open but their eyes have a 'blank stare' or glassy 'look right through you' appearance. Movements often occur in a confused and clumsy manner. During a calm episode, however, the sleep walker tends to maintain coordination and is often able to successfully walk up or down stairs and navigate around large obstacles. When they arise from bed, they may immediately walk towards a stimulus such as a light or noise, or they may walk aimlessly around a room or from room to room. Children usually walk to their parents' bedroom (Kennedy, 2002). Sleep walkers do not walk with their arms extended in front of them as is sometimes inaccurately depicted in movies.

Sometimes, the sleep walker may perform routine, well-learnt activities, such as opening doors, dressing, cleaning, eating or packing a bag to go to school or work. They may even leave the house. More complex behaviours such as driving a car are possible, but rare. Occasionally, the sleep walker may perform socially inappropriate behaviours, such as urinating in a bin or cupboard, especially if a child. Sleep talking may also occur during an episode. For example, they may say or mumble a few words. However, the sleep walker is typically unresponsive to any attempt to

communicate with them (AASM, 2014a; APA, 2013; Mason & Pack, 2007; NSF, 2018g).

A major concern about sleep walking is the risk of self-injury. It can result in falls and injuries. In most cases sleep walkers do not suffer any harm, but occasionally they may injure themselves and have also been known to injure others. Painful injuries sustained during sleep walking are often not perceived until the individual awakens (APA, 2013; Kennedy, 2002; Mason & Pack, 2007).

Sleep walking episodes may occur up to 3 or 4 times a week. They generally last only a few minutes, rarely beyond 15 minutes (but have been known to last as long as one hour or so). More than one episode a night is rare. There is little awareness of what is going on during an episode. When an episode is over, most people are able to remember very little of what they did, if anything at all. The frequency of sleep walking may be underestimated because the episodes are often unremembered and generally unobserved by someone else (APA, 2013; Bruck, 2006; Kennedy, 2002; Mason & Pack, 2007).

Sleep walking usually occurs during the deep sleep of NREM stages 3 and 4 when we have no sleep paralysis and are therefore able to move around. This means that it is also more likely to take place during the first third of a sleep episode. It is most commonly initiated at the end of the first or second episode of slow wave sleep. Sleep walking can also be initiated in the lighter stages of NREM sleep, and the sleep walker may be partially aroused during the episode (AASM, 2001; APA, 2013; NSF, 2018g).

Figure 10.7 Sleep walking involves getting up from bed and walking about or performing other behaviours while asleep. Such behaviours are typically of low complexity.

Many people mistakenly believe that it is dangerous to waken sleep walkers. It can, however, be quite dangerous not to wake a sleep walker in case they harm themselves. While sleep walkers can be awakened, it is usually with great difficulty because of their tendency to be in a deep sleep state. When awakened, they may not recognise family or friends and it can take up to 20 minutes to calm them. If the sleep walker wakes suddenly during an episode, they are often confused and disoriented (Bruck, 2006; NSF, 2018g).

Sleep walking is very common in childhood. It is estimated that between 10–30% of children have had at least one sleep walking episode, and that 2–3% walk often (APA, 2013). Sleep walking episodes can occur as soon as a child is able to walk, but sleep walking typically begins at about age seven, generally before age 10, and ends before age 15 or so (Kennedy, 2002). For some people, however, sleep walking may continue for most of their life. The longer a child keeps sleep walking into their adolescent years, the greater the chance that it will go on into early adulthood. It is estimated to occur among 8% of secondary school students and about 1–5% of adults (APA, 2013; Bruck, 2006; NSF, 2018g).

The cause of sleep walking remains unclear, especially the neurological basis of the disorder. One reason is that the objective study of sleep walking is often difficult because episodes rarely occur in sleep laboratories. It is an unusual disorder, especially as the brain is partially aroused as if in a waking state, which enables often complex behavioural activities, and partially in deep NREM sleep, with no conscious awareness of these actions (Lopez, et al., 2013).

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Weblink
Video — Brainstuff video on sleepwalking 4m 20s

Sleep walking may happen for no obvious reason. The more common triggers include stress, anxiety and the use of particular medications, especially those that reduce or suppress REM sleep. Several studies have demonstrated a significant family history of sleep walking. The chance of having the disorder can greatly increase if one or both parents had sleep walking episodes as a child or adult. In addition, medical conditions such as seizures and fever can increase the likelihood of sleep walking, and episodes have also been associated with other sleep disorders, particularly sleep terror disorder (see Box 10.3 on page 522) and sleep apnoea (see Box 10.4 on page 523).

Generally, sleep walking is not considered to be a serious sleep disorder. Although it can disrupt sleep if the sleep walker awakens and can be unsettling for parents of child sleep walkers, sleep walking is not associated with any significant physical or mental health condition or any long-term complications. Common advice is that action should be taken only if sleep walking happens too often, if there is a major risk of harm to the sleep walker or someone else, or if the sleep walking is adversely impacting on the individual's everyday functioning.

There is no specific treatment for sleep walking, but basic changes that improve sleep habits can reduce or eliminate episodes. For example, simply getting the amount of sleep needed each night can prevent episodes for some people. Hypnosis has been found to be very effective in some cases, and the use of relaxation techniques and certain medications have also been found to be helpful in reducing the incidence of sleep walking in some people (APA, 2013; Kennedy, 2002; NSF, 2018g).

Figure 10.8 Sleep walkers do not walk with their arms extended in front of them as is sometimes inaccurately depicted in movies.

Effects on sleep–wake cycle

Sleep walking typically occurs in the first third of a sleep episode and is most commonly initiated during NREM stages 3 or 4 when the individual is in deep sleep. It is primarily distinguished by mobility and activity during sleep, which are abnormal for sleep. There is also considerable difficulty in arousing the individual during a sleep walking episode. However, this is not abnormal given it is also expected of the non-sleep walker in a deep sleep state.

If sleep walkers wake up suddenly, they are often confused and can take a while to get a sense of what's happening and where they are, which is what usually occurs with anyone who is abruptly awoken from deep sleep. Sometimes, the sleep walker may not be able to quickly go back to sleep after a sudden awakening. This sleep disturbance means there is a loss of deep sleep and that the sleep episode will be fragmented (but not as fragmented as often occurs with sleep apnoea). Loss of deep sleep in particular is likely to result in a sleep episode that is not as restful as normal, which will probably make the individual more tired than usual during the day.

It is widely believed that the effects of sleep walking tend to be confined to the night time episodes, but some researchers have found that sleep walkers do experience daytime effects from the disorder. For example, Canadian psychologist Antonio Zadra and his colleagues (2013) have reported that nearly 45% of sleep walkers experience daytime sleepiness and tend to do so more often than non-sleep walkers. In addition, adolescent sleep walkers experienced daytime fatigue but tended to more easily mask their tiredness and sleepiness. However, if they were given the opportunity to have a nap, they went to sleep faster than non-sleep walkers. Furthermore, they performed worse on concentration tasks than non-sleep walkers.

A French study that compared 100 adult sleep walkers with a control group of 100 non-sleep walkers also found a significant link between sleep walking and daytime impairments. The sleep walkers used in the study had a median age of 30 years. All had been diagnosed with the disorder at the sleep disorder clinic where the researchers worked and were subsequently asked to participate in the study. 22% reported daily episodes of sleep walking and 43% had weekly episodes.

TABLE 10.1 Daytime functioning and night time sleep problems in sleep walkers and controls

	Sleepwalkers (%) (n = 100)	Controls (%) (n = 100)
Daytime sleepiness		
Epworth sleepiness scale score (median)	10.00	6.50
Daytime fatigue		
Chalder Fatigue Scale score (median)	6.00	3.00
Insomnia		
Total Insomnia Severity Index score (median)	14.00	4.00
Score on Insomnia Severity Index subcategories		
Difficulty initiating sleep		
Never/rarely	63.22	84.29
Moderate	21.84	12.86
Frequently/often	14.94	2.86
Difficulty maintaining sleep		
Never/rarely	36.78	77.14
Moderate	32.18	17.14
Frequently/often	31.03	5.71
Early morning awakenings		
Never/rarely	51.72	74.29
Moderate	18.39	17.14
Frequently/often	29.89	8.57
Satisfaction		
Very satisfied/satisfied	12.64	50.00
Moderately satisfied	21.84	28.57
Dissatisfied/very dissatisfied	65.52	21.43
Interference		
Never/rarely	24.14	81.16
Moderate	21.84	13.04
Frequently/often	54.02	5.80
Noticeability		
Moderate/frequently/often versus never/rarely	32.18	7.14
Distress		
Moderate/frequently/often versus never/rarely	77.01	7.14

Source: Based on Lopez, R., et al. (2013). Functional impairment in adult sleep walkers: a case-control study. *Sleep, 36*(3), p. 348.

Table 10.1 shows some of the results from the French study. On the basis of their results, the researchers concluded that there were significant associations between sleep walking and daytime sleepiness, fatigue and insomnia. However, the researchers noted that these sleep walkers had found their condition debilitating enough to seek professional assistance, so they may not be representative of sleep walkers in the general population (Lopez, at al., 2013).

In sum, the effects of sleep walking on the sleep-wake cycle may include:

- loss of deep sleep (i.e. sleep walking is most commonly initiated during NREM 3 and 4)
- interruption to the natural progression of the sleep cycle during the disturbed sleep episode
- fragmented sleep episode due to cycle disturbance
- less than the normal number of sleep cycles if a prolonged episode
- daytime sleepiness following an episode (i.e. during the waking state of the circadian cycle).

LEARNING ACTIVITY 10.5

Reflection

Some researchers have found that sleep walkers engage in many more violent behaviours during sleep walking episodes than is commonly reported. For example, the person attempting to awaken the sleep walker can be violently attacked. Rarely, homicide during an apparent sleep walking episode has also been reported (Lopez, R., et. al., 2013).

Comment on whether sleep walking should be a legitimate murder or manslaughter defence with reference to sleep walking as an altered state of consciousness.

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Weblinks
Media and legal reports on sleep walking homicide cases

BOX 10.3 Nightmares and sleep terrors

Sleep can be an awful time for some people who experience parasomnias. The symptoms of these disorders range from the mundane to the horrifying, and worrying about what might happen during a night of sleep can cause some people who experience parasomnias to want to avoid sleep (Epstein & Mardon, 2007).

Nightmares and sleep terrors are among the most easily identifiable parasomnias. Both involve disturbing dreams but they have a number of distinguishable features.

Nightmares (also called *dream anxiety attacks*) are frightening dreams that occur during REM sleep. These are typically experienced in the last third of a sleep episode. Dream content is usually recalled in vivid detail if the person wakes up, but sometimes at a later time.

A common theme is the dreamer's experience of helplessness in undesirable circumstances. The dreams have visual images that are frightening enough or negative emotions that are strong enough to cause the dreamer to wake up scared or anxious. This feature differentiates a nightmare from a 'bad' dream that doesn't cause awakening.

The nightmare is almost always a long, complicated dream that becomes increasingly frightening toward the end. Fear of death is often present but the element of fright or anxiety is an essential feature. A child will

often dream of frightening imaginary creatures, such as monsters or ghosts. An adult may also dream about imaginary events that are threatening or harmful in some way, but this is less common when compared with childhood nightmares. The longer duration of nightmares is one of the many features that distinguish them from sleep terrors (AASM, 2014a; SHF, 2016d).

Nightmares are more likely to occur during times of stress, anxiety, fatigue or personal trauma. Illness, medications, illegal drugs or even watching a scary film can also set them off. They usually start at ages three to six years but can occur at any age. They are experienced more commonly by children than adults, and decrease in frequency with age. It is estimated that 10% to 50% of children have them, with the number of adults much less at about 2.5% to 10%. They are more common among women than men, but this may be due to their willingness to discuss or report them more than men do (SHFg 2016d).

Many nightmares occur for no particular reason, although being sleep deprived makes them more likely. In some cases, recurring, intense nightmares can follow a traumatic experience (Bruck, 2006).

Sleep terrors (once called *night terrors*) are characterised by sudden awakening from NREM stage 3 or 4 sleep in a terrified state. These are typically experienced during the first third of a sleep episode, most often during the first sleep cycle. The person often sits upright in bed, is unresponsive to external stimuli, and is confused and disoriented. There is little or no recall of the dream on awakening (SHF, 2016e).

Sleep terrors typically last only a few minutes, but are generally more distressing than nightmares. There is usually much more fear or anxiety than with a nightmare than nightmares. A person may awaken screaming or crying, sweating profusely, with wide eyes and dilated pupils and with a terrified expression on their face. They may speak incoherently and appear in a state of confusion or panic. Their breathing is usually rapid and their heart rate is often double or treble its normal rate. While in this distressed state, they are usually unresponsive and difficult to comfort. The terrified reactions may last for several minutes until they eventually relax or return to sleep.

In contrast, nightmares usually do not involve major motor activity. There is also considerably less anxiety, vocalisation and autonomic nervous system activity during a nightmare than during a sleep terror (AASM, 2014a).

Sleep terrors are far less common than nightmares. It is estimated that they occur in 1–5% of children. In adults it is even less, about 1% to 2% (SHF, 2016e). Sleep terrors are much more common in pre-school children (aged 3–5 years), especially in boys. Children's experiences of sleep terrors are usually temporary and they normally stop having them as they get older. One explanation for this is that the amount of NREM stages 3 and 4 sleep experienced is greater in childhood and diminishes with age. Triggers for sleep terror episodes include sleep deprivation, anxiety, a sudden noise, fever and depressant medications. People who have sleep terrors often sleep walk as well (AASM, 2014a; Hartmann et al., 1987).

Figure 10.9 Nightmares are frightening dreams that typically occur during REM sleep and can be recalled on awakening. Sleep terrors are terrifying dreams that typically occur during NREM deep sleep and there is little or no recall of the dream on awakening. They are more distressing than nightmares.

BOX 10.4 Sleep apnoea

Sleep apnoea is an involuntary cessation of breathing that occurs during asleep. The term apnoea (sometimes spelled apnea) literarily means 'without breath'. The duration of the stoppage is usually short (about 10 seconds) but can last for a minute or longer. Eventually, the brain detects the lack of breathing or a drop in oxygen level and triggers an arousal from sleep so that breathing can be renewed. The arousal disrupts sleep and sleep quality, but restores muscle tone, thus opening the airway, and normal breathing resumes.

People with untreated sleep apnoea stop breathing repeatedly during their sleep, sometimes hundreds of times. An apnoea usually ends with a loud snore as the sleeper renews their breathing. This is sometimes accompanied by vocalisations that consist of gasps, choking sounds, moans, or mumblings. There may also be a body jerk or arm flinging, or the individual may even sit upright momentarily. Awakenings tend to be short and abrupt. Often, the sleeper will awaken long enough for their breathing pattern to become regular again before they go back to sleep. In most cases, the sleeper is unaware of these breathing stoppages because they don't always trigger an awakening involving full arousal (APA, 2013; AASM, 2014a).

The severity of sleep apnoea varies considerably and generally depends on the number of apnoeas per hour of sleep, their duration and the extent to which they impair everyday functioning. Major symptoms include loud snoring; frequent awakenings; being out of breath,

(continued)

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with a dry mouth or a headache; unrefreshing sleep regardless of duration; and daytime sleepiness, tiredness or fatigue. Given apnoea involves involuntary cessation of breathing, it is a potentially life-threatening sleep disorder.

Three types of sleep apnoea are commonly described: obstructive, central and mixed. Of the three, obstructive sleep apnoea is the most common and is often referred to simply as sleep apnoea. *Obstructive sleep apnoea* is caused by an upper airway obstruction during sleep. This usually occurs when the soft tissue in the back of the throat relaxes during sleep, thereby narrowing the airway. Large tonsils and adenoids (spongy tissue between the back of the nose and throat), being overweight or having a minor or major facial abnormality that may change the size of airways can also cause an obstruction and result in snoring.

Obstructive sleep apnoea involves a struggle to breathe against a blocked airway. With *central sleep apnoea*, the airway is not blocked but breathing stops because the brain fails to maintain breathing for reasons that remain unclear. There is no effort to breathe during a stoppage, the apnoeas occur more frequently, last longer and snoring is not as prominent as in obstructive sleep apnoea.

Mixed sleep apnoea involves a combination of obstructive and central sleep apnoea. The suspensions of breathing typically begin as central apnoeas but conclude as airway blockages (Lavie, 1996). With each apnoea, the brain arouses the sleeper so that breathing can resume. As a result, sleep is extremely fragmented and of poor quality.

Sleep apnoea is extremely common. It is estimated that about 5% of adult Australians suffer from this sleep disorder (especially if overweight), with around one in four men over the age of 30 years experiencing it to some degree (Better Health Channel, 2018). However, there are many people with the disorder who have not been diagnosed or received treatment. For example, despite dozens or even hundreds of awakenings per night, most individuals with obstructive sleep apnoea have no recollection of the arousals. In fact, often the only evidence of this disorder is daytime fatigue and reports of loud snoring from bed partners.

As with other sleep disorders, there are various treatment options. Generally, treatment depends on the type of disorder, its symptoms and their severity for the individual involved (AASM, 2001; NSF, 2018h; SHF, 2016f).

Figure 10.10 An effective treatment for sleep apnoea is the use of nasal CPAP (Continuous Positive Airway Pressure) device developed by Australian doctor Colin Sullivan in the 1980s. CPAP consists of a portable machine that gently pumps pressurised air through a mask that is worn over the nose. The pressure acts like an 'air splint' that holds the upper airway open and thereby prevents apnoeas. It also stops the snoring (and the machine noise is much quieter than the snoring).

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Video on sleep apnoea 3m 3s

LEARNING ACTIVITY 10.6

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Word copy of table

Review questions

1. What is sleep walking?
2. (a) When in a sleep episode is sleep walking most likely to occur?
   (b) Why is sleep walking unlikely to occur during REM sleep?
3. List four distinguishing features of sleep walking.
4. Give three examples of how sleep walking can affect a person's circadian sleep–wake cycle.
5. Explain why sleep walking is classified as a parasomnia rather than a dyssomnia.
6. Complete the table below to summarise key features of the two sleep disorders examined in this section. Ensure you also complete details for the dyssomnia and parasomnia concepts.

Sleep disorder	What is it?	Key symptoms/ features	When most likely to occur in a sleep episode	Effects on circadian sleep–wake cycle
Dyssomnia				
Sleep-onset insomnia				
Parasomnia				
Sleep walking				

CIRCADIAN RHYTHM PHASE DISORDERS

Under normal conditions, our internally programmed circadian sleep–wake cycle and the sleep–wake schedule we maintain are closely aligned. This is essential to our ability to keep sleep and wakefulness in-sync with our environment and to undertake our daily activities as best we can. The importance of synchronisation becomes apparent when our sleep–wake cycle and sleep–wake schedule get out of phase, or 'out of sync'.

Circadian rhythm phase disorders (also called *circadian rhythm sleep–wake disorders*) are a group of sleep disorders involving sleep disruption that is primarily due to a mismatch between an individual's sleep–wake pattern and the pattern that is desired or required. The disruption may be caused by:

- a naturally occurring change or a malfunction of biological mechanisms or processes regulating the sleep–wake cycle
- a mismatch between an individual's sleep–wake cycle and the sleep–wake schedule required by their school, work or social schedule
- a mismatch between an individual's sleep–wake cycle and the day–night cycle of their physical environment (APA, 2013).

Circadian rhythm phase disorders essentially involve a problem with the timing of the sleep and wake states. The individual cannot sleep when sleep is desired, needed, or expected. As a result of sleep episodes occurring at the least preferable or inappropriate times, the corresponding wake periods may also occur at undesired times. Therefore, the individual usually complains of insomnia and/or excessive sleepiness. For most circadian rhythm phase disorders, once sleep is initiated, the sleep episode will tend to have its natural duration, with NREM-REM sleep cycles occurring as they normally do (AASM, 2014a).

Circadian rhythm phase disorders are primarily attributable to mechanisms and processes that generate and time sleep, and produce difficulty initiating, maintaining and/or timing sleep, so they are commonly classified as dyssomnias.

In this section, we examine three circadian rhythm phase disorders: the sleep–wake cycle shift in adolescence and disturbance of the cycle through shift work or by air travel across time zones. All three can result in a mismatch between our circadian sleep–wake cycle and our desired sleep–wake schedule. When this happens, our sleep–wake cycle can also become misaligned with our daily activity pattern.

studyon

Figure 10.11 The sleep–wake cycle shift in adolescence, shift work and rapid travel across multiple time zones are associated with circadian rhythm phase disorders.

Sleep–wake cycle shift in adolescence

Numerous research studies have found that adolescents need about 9.25 hours sleep a night to function at their best when awake, yet many males and females between the ages of 13 and 19 years sleep considerably less than this every night. Studies of adolescent sleep patterns also indicate that this is a period of high sleep disturbance. The time around puberty is associated with the onset of a characteristic pattern of sleep problems. Furthermore, these problems are associated with the tendency to stay up longer in the evenings and include feeling sleepy at a much later time, insufficient nighttime sleep on weekdays and considerable difficulty waking in the morning (Bruck, 2006; Carskadon, 2002; Short, et al., 2013).

Insufficient sleep can have significant effects on daytime alertness and normal daytime functioning. For adolescents at school, it can affect the ability to concentrate, think and learn. Daytime impairments can include excessive sleepiness; inattention and mentally 'drifting off' in class; problems with staying motivated to complete class work; lethargy; and difficulties with mood regulation and behaviour control (Blunden, 2013; Bruck, 2006; NSF, 2018i).

Psychologists explain adolescent sleep patterns and problems in terms of biologically driven changes and psychological and social factors that interact to exert considerable pressure towards going to sleep at a later time than would naturally occur.

Biological influences

Biological influences on an adolescent's sleep primarily involve the biological clock regulating the circadian sleep–wake cycle through melatonin secretions. During adolescence, there is a hormonally induced shift of the sleep–wake cycle forward by about 1 to 2 hours. More specifically, the timing of melatonin secretion that induces sleep onset peaks later in the 24-hour cycle and makes the adolescent sleepier 1 to 2 hours later. Their bodies are not ready to sleep when their real-world clock shows that it is time to sleep.

This change in the timing of the major sleep episode is known as a **sleep–wake cycle shift** and affects an adolescent's ability to fall asleep at the earlier times they did as a child. So a 10 year old may have been sleepy and ready for bed at 9 pm every night but at, say, 15, doesn't feel at all sleepy at 9 pm. The naturally occurring delay in the timing of sleep onset also means that there is a biologically driven need to sleep one to two hours longer given the changed sleep onset timing. That's not a problem if the time of getting up in the morning can be chosen. However, most adolescents do not have that luxury on most days of the week. School or work starts at a set time even if their biological clock makes them feel like it's one or two hours too early. This means that early school (or work) starts don't allow the adolescent to sleep in and get the additional sleep that would otherwise naturally occur (Blunden, 2013; Bruck, 2006).

In sum, the entire sleep–wake cycle is delayed by 1–2 hours in relation to the desired sleep and wake-up time. This type of sleep–wake cycle shift is called a *delayed sleep phase* disorder. Efforts to advance the timing of sleep onset, such as early bedtime, dimming the lights earlier, restricting the use of digital technologies when in bed to earlier times and relaxation techniques can be helpful at times, but generally result in little permanent success (AASM, 2014a; APA, 2013).

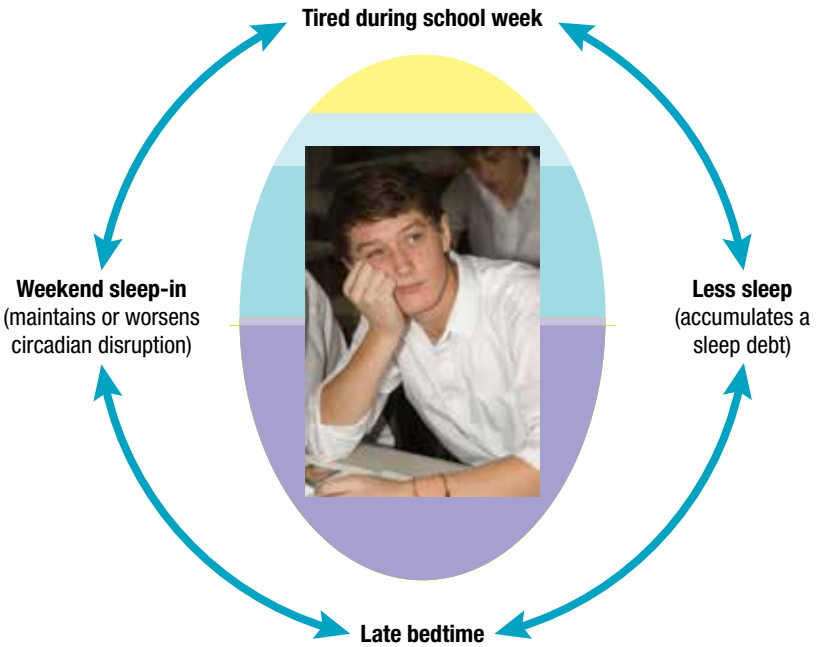

Figure 10.12 The cycle of activity in an adolescent student's world can perpetuate or worsen the biologically driven sleep–wake cycle shift.

Some people are more affected by melatonin delaying their evening wave of sleepiness than others. Many cope with the change in their hours of sleep but some do not. A significant problem is that nightly sleep loss due to having to wake up earlier than the body wants to can accumulate as a sleep debt.

Sleep debt is sleep that is owed and needs to be made up because daily sleep requirements have not been met. It is sometimes described as the difference between the amount of sleep that is needed to function at an optimal level and the amount a person

actually gets. For example, a nightly sleep debt of 90 minutes between Monday and Friday would add up to a total sleep debt of 7.5 hours. On the weekends, adolescents will often sleep in to make up their sleep loss. However, this usually results in going to bed even later, which can temporarily shift the major sleep episode further forward so that by Monday morning, getting out of bed to go to school (or work) is harder than on any other day.

Sleep debt does not continue to build up until repaid. For example, if you slept for one hour less than you needed to for 28 days, this does not mean that you need to sleep for 28 extra hours to function at an optimal level again. Generally, after a period of sleep deprivation, only some of the sleep debt needs to be recovered. If the sleep–wake cycle is allowed to take its natural course without interruption from an external cue, we will tend to sleep longer on the first night and possibly the second, by which time the hours of sleep will have reduced back to the optimal amount required.

Psychological and social influences

Psychological and social factors also influence an adolescent's sleep habits, often in ways that contribute to their sleep–wake cycle shift and associated sleep problems. Adolescents typically like to exert their growing need for independence, which can include making decisions about when to go to bed or sleep. Many usually decide to go to bed or sleep later, particularly as early sleep times are associated with childhood. Adolescents also experience increased demands on their time for socialising and increased academic or work demands compared to when they were children. Many have casual or part-time jobs. Adolescents who work long hours or who stay up late doing homework, studying, texting, catching up with others on social media, watching movies, playing with phone apps and listening to loud music are more likely to experience greater difficulty waking up in the morning than those who do not (Blunden, 2013).

Essentially, sleep seems to be a low priority for many adolescents. Research suggests that the 'typical' adolescent's natural time to fall asleep may be 11 pm or later (NSF, 2018i). Despite this, many stay awake long after their biological clock has promoted sleep onset. This typically results in erratic sleep habits that compound sleep problems, build up an excessive sleep debt and result in sleep deprivation to an extent that functioning during waking time is significantly impaired.

If puberty is considered as marking the onset of adolescence, with its associated delay in evening sleepiness, a relevant question that arises involves when adolescence ends. More specifically, when does the delay in sleepiness start to wear off and the adolescent feels like going to bed a bit earlier, more like the time of their parents? Research suggests that there is an abrupt change in the timing of sleep at around the age of 20 years, suggesting that this may be a biological marker of the end of adolescence (Bruck, 2006).

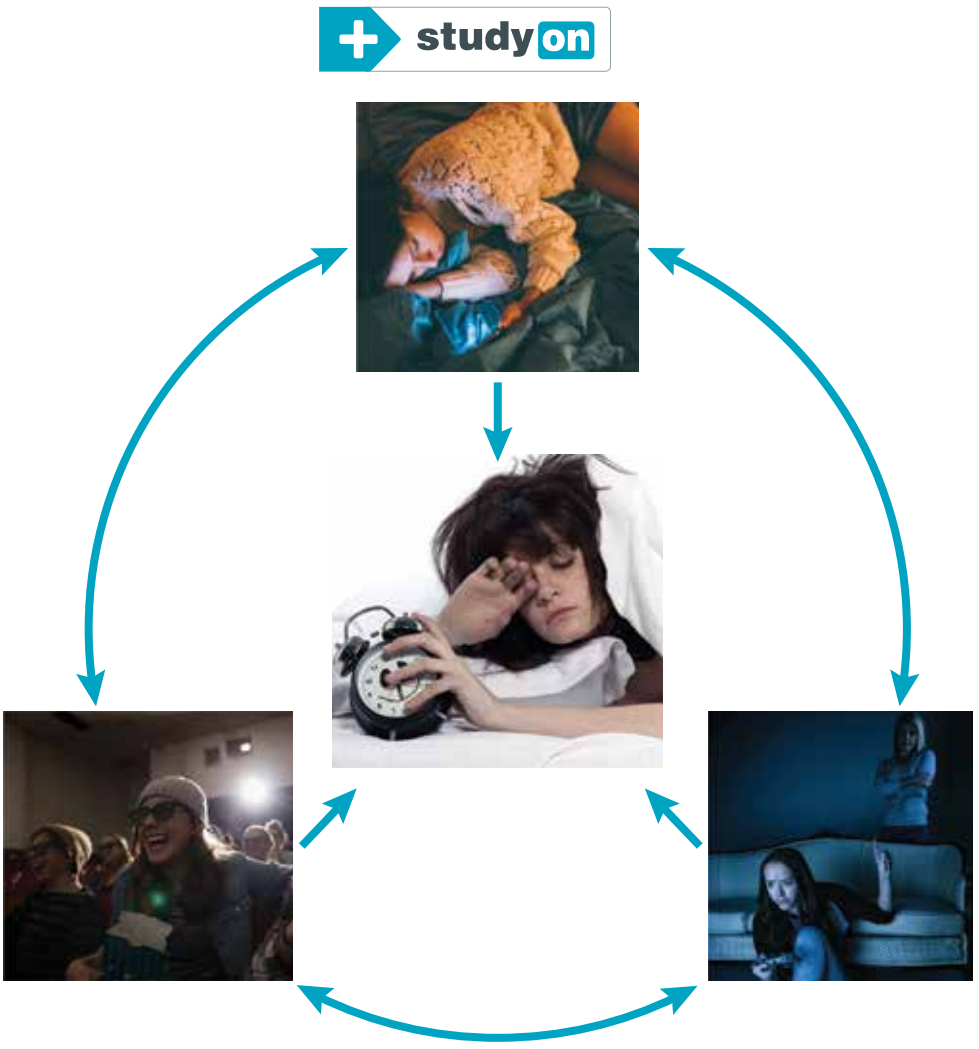

Figure 10.13 Biological, psychological and social (biopsychosocial) factors combine to influence the sleep–wake cycle during adolescence in a way that leads to the accumulation of a sleep debt.

BOX 10.5 Sleep tips for adolescents

- Make sleep a priority. Decide what you need to change to get enough sleep to stay healthy, happy and smart!
- Naps can help pick you up and make you work more efficiently, if you plan them right. Naps that are too long or too close to bedtime can interfere with your regular sleep.
- Make your room a sleep haven. Keep it cool, quiet and dark. If you need to, get eyeshades or blackout curtains. Let in bright light in the morning to signal your body to wake up.
- No pills, vitamins or drinks can replace good sleep. Consuming caffeine close to bedtime can impair sleep onset because it is a stimulant, so avoid coffee, tea, energy drinks, soft drinks and chocolate late in the day so you can get to sleep at night. Nicotine and alcohol will also interfere with your sleep.
- Establish a bed and wake-time and stick to it, coming as close as you can on the weekends. A consistent sleep schedule will help you feel less tired since it allows your body to get in sync with its natural patterns. You will find that it's easier to fall asleep at bedtime with this type of routine.
- Don't eat, drink, or exercise within a few hours of your bedtime. Don't leave your homework for the last minute. Try to avoid the TV, computer and mobile phone in the hour before you go to bed. Stick to quiet, calm activities, and you'll fall asleep much more easily!
- If you do the same things every night before you go to sleep, you teach your body the signals that it's time for bed. Try taking a bath or shower as this will leave you extra time in the morning, or reading a book.
- Try keeping a diary or to-do lists. If you jot notes down before you go to sleep, you'll be less likely to stay awake worrying or stressing.
- When you hear your friends talking about their all-nighters, tell them how good you feel after getting enough sleep.
- You can't change your sleep–wake cycle shift, but activities at night that are calming can help counteract heightened alertness.

Source: Adapted from National Sleep Foundation (2018j). *Teens and sleep* [Sleep topics > Children, teens and sleep > Teens and sleep]. Retrieved from https://sleepfoundation.org/sleep-topics /teens-and-sleep

LEARNING ACTIVITY 10.7

Review questions

1. Explain the meaning of the term sleep–wake cycle shift.
2. Briefly describe the sleep–wake cycle shift that occurs during adolescence.
3. (a) Why is the sleep–wake cycle shift classified as a circadian rhythm phase disorder?
   (b) Explain why this type of shift could also be classified as a dyssomnia rather than a parasomnia.
4. Explain why there is a sleep–wake cycle shift during adolescence, ensuring you adopt a biopsychosocial perspective.
5. (a) What is sleep debt?
   (b) How is it calculated? Show nightly sleep debt as a formula.
   (c) Use the formula to calculate total sleep debt after 5 week nights based on optimal nightly sleep of 9.25 hrs and a mean nightly sleep loss of 45 minutes.
   (d) How can sleep debt adversely impact on the sleep–wake cycle?
6. What are two potential consequences of the adolescent sleep–wake shift on sleep patterns or activity, other than sleep debt?
7. To what extent may it be possible to readjust or compensate for the adolescent sleep–wake shift? Explain your answer.

LEARNING ACTIVITY 10.8

Reflection

Comment on whether there should be a later start to the school day to accommodate the sleep–wake cycle shift in adolescence and whether this would be an effective means of addressing sleep-related problems of adolescents at school.

Shift work

We live in a globalised world that operates 24 hours a day, 7 days a week ('24/7'). Shift work is a type of work schedule designed to meet the demands of a 24/7 society. The practice typically divides the 24 hour day into shifts — set periods of time of about 8 hours or so during which employees perform their duties.

In Australia, three traditional shifts are the day, afternoon and night shifts. Day shifts typically start and end during the daytime, afternoon shifts start mid-afternoon and end in the evenings, and night shifts start late in the evening and end during the daytime. These may be on a *fixed* schedule and require employees to work the same shift on a regular, ongoing basis, or they may be on a *rotating* schedule and require employees to change shifts every so often to work a mix of day and/or afternoon and/or night shifts.

Numerous jobs within our society involve shift work. For example, shift work is common for police, paramedics and fire fighters; doctors and nurses; pilots and airline staff; customs, border protection and immigration officers; hospitality staff; transport drivers; security staff; mail sorters; miners, cleaners and factory workers. Many of these jobs involve some degree of danger to the individual involved or carry significant responsibility for the safety and wellbeing of others. It is estimated that at least 1.5 million Australian employees (16%) follow a shift work schedule in their main job, with the most common type of shift being the rotating shift (45% of those who work shift work) (ABS, 2013).

Psychologists are particularly concerned about sleep disturbances associated with shift work that takes place outside the times of the normal '9 to 5' work day, especially at night when the work is scheduled during the habitual hours of sleep. We are not nocturnal beings. Our body has a sleep–wake cycle that is biologically programmed to sleep best at night and to be awake and most alert during the day and early evening. Night shift work in particular disrupts this cycle and can cause sleep-related problems.

People who work on permanent night shift tend to experience problems with sleep quantity and quality more than people who do not do shift work. They often complain of being tired, both on and off the job. It is often not easy to sleep enough or to sleep well during the day. Many sleep less when they go to bed in the morning after a night shift. The reduction in sleep amount may be between 1 to 4 hours less a day than someone who doesn't work shifts. The sleep loss and circadian cycle disruption represent the main causes of sleepiness among shift workers. Many accumulate a sleep debt as they struggle to adjust to the disruption while juggling work and lifestyle demands (AASM, 2014a).

Night shift workers also have a greater tendency to sleep twice during the day — a major episode in the morning after work and then a nap of an hour or so before going to work. However, they often find it difficult to fall asleep and/or maintain sleep during the day despite attempts to optimise environmental conditions for sleep. For example, during the day, there is more light, the phone rings more frequently and visitors may arrive. All these can interfere with daytime sleeping, fragmenting the major sleep episode and thereby compromising the quality of the sleep episode. Difficulties with sleep onset or maintenance may lead to a difficulty in awakening. Overall, the major sleep episode of the night shift worker is reported by a significant number as unsatisfactory and unrefreshing. In addition, it is common for night shift workers to revert to daytime routines for a day or two during days off, which tends to make their circadian rhythm for the sleep–wake cycle unstable (AASM, 2014a; Dawson, 2017).

Figure 10.14 One in six Australian employees follow a shift work schedule in their main job.

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Weblinks

- Safework Australia videos on managing shift work and workplace fatigue
- ABS shift work statistics

Excessive sleepiness is often experienced during the night and may impair performance because of reduced alertness. This has consequences for safety. For example, it is believed to contribute to the significant number of on-the-job accidents in the middle of the night or in the early hours of the morning, when employee performance also tends to be significantly lower. There is also a higher risk of accidents on the road, driving to and from work (AASM, 2014a; Dement & Vaughan, 1999; SHF, 2016g).

Figure 10.15 Excessive sleepiness associated with shift work is believed to contribute to the significant number of on-the-job accidents and accidents on the road, driving to and from work.

Work rosters with rotating shift work schedules are associated with a higher frequency of sleep disturbances than rosters with fixed schedules. In particular, the most difficult rotating schedules to adjust to are those that change too quickly from one shift type to another because of the lack of time for the sleep–wake cycle to adjust and align with the day-night cycle of the individual's environment and other external sleep–wake cues.

Generally, if rotating shifts have to be used, the longer a person works on a particular shift, the more likely it is that their sleep–wake cycle will make at least some adjustments, and the better for the individual. A work roster for which the individual has longer periods on each shift before rotating to the next shift also tends to be better because it allows the individual to have a longer period off between one shift rotation and the next. This gives the body more time to reset its sleep–wake cycle to get in-sync with the external environment. A schedule with three-week shifts is generally considered preferable to one-week or three-day rotations.

We also tend to adapt more quickly when assigned to successively later shifts rather than to successively earlier shifts. It therefore tends to be best when the move from one shift to the next is a forward move so the new shift begins later in the day. For example, if a person has been working a day shift from 7 am to 3 pm, their next shift should be the afternoon shift, say from 3 pm until 11 pm, rather than moving backwards to an 11 pm to 7 am shift. Because our natural sleep–wake cycle is closer to 25 hours (see Box 9.1), by moving forwards through the shift rotation, the cycle is disrupted less than if a worker moved backwards through a shift rotation. Thus, workers will tend to adapt better and experience less disruption to their physiological and psychological functioning with a forward move than a backward move (Czeisler, Moore-Ede & Coleman, 1982; SHF, 2016g).

Some shift workers complain of excessive sleepiness at work and impaired sleep at home on a persistent basis to the extent that they may be diagnosed as having *shift work sleep disorder*. The two primary symptoms of shift work disorder are insomnia when a person is trying to sleep, and excessive sleepiness when a person needs to be awake and alert. Complaints tend to be more common and severe in relation to night shift work and inappropriately scheduled rotating rosters that can include double shifts and quick shift changes (AASM, 2014a).

Relatively few people seem to fully adapt to the night shift even after many years of night shift work, in part because of resumption of full daytime activities and nighttime sleep during weekends and vacations. For example, a person may work the night shift for five consecutive nights, followed by two days and two nights off. During this 'weekend', the person may revert to a typical nighttime–sleep/daytime–awake schedule in order to spend time with family and friends. This causes their internal sleep–wake cycle to shift again, thus requiring another adjustment when the night shift work week begins. Without a constant sleep–wake schedule during the entire week, the body's internal circadian rhythm may always remain out of sync with the external environment (Czeisler, 2007; Safework Australia, 2018).

Figure 10.16 The body tends to adapt more quickly when shift workers are assigned to successively later shifts.

BOX 10.6 Epworth Sleepiness Scale

The Epworth Sleepiness Scale (ESS) was first published in 1991 by Dr Murray Johns of the Sleep Disorders Unit at Melbourne's Epworth Hospital. It was designed as a simple assessment of a person's general level of daytime sleepiness. In 1997 it was slightly revised to add an extra sentence of instructions.

The ESS is widely used throughout the world for sleep research and diagnostic purposes. It is a subjective, self-administered questionnaire that lists eight situations or activities for which individuals rate their sleepiness on a 4-point scale (0–3). An overall score is then calculated to indicate a level of daytime sleepiness. When used for diagnostic purposes, it is one of a number of assessments that would be conducted by the sleep specialist.

THE EPWORTH SLEEPINESS SCALE

Name: _____

Today's date: _____ Your age (years): _____

Your sex (male = M; female = F): _____

How likely are you to doze off or fall asleep in the following situations, in contrast to just feeling tired? This refers to your usual way of life in recent times. Even if you have not done some of these things recently try to work out how they would have affected you.

Use the following scale to choose the *most appropriate number* for each situation:

0 = would *never* doze
1 = *slight* chance of dozing
2 = *moderate* chance of dozing
3 = *high* chance of dozing

It is important that you answer each question as best you can.

Situation	Chance of dozing
Sitting and reading	_____
Watching TV	_____
Sitting, inactive in a public place (e.g. a theatre or a meeting)	_____
As a passenger in a car for an hour without a break	_____
Lying down to rest in the afternoon when circumstances permit	_____
Sitting and talking to someone	_____
Sitting quietly after a lunch without alcohol	_____
In a car, while stopped for a few minutes in the traffic	_____

Thank you for your cooperation.

Interpretation

The 8 scores are added to find a total. The higher the score, the higher the person's level of daytime sleepiness. The following score ranges indicate different levels of sleepiness. The 0–10 range is widely considered to be the 'normal' range, but scores for other categories may vary. For example, some sleep specialists do not distinguish between mild or moderate sleepiness, while others may estimate severe sleepiness as a score of 16 or even lower.

Normal range in healthy adults	0–10
Mild sleepiness	11–14
Moderate sleepiness	15–17
Severe sleepiness	18 or higher

Source: Johns, M.W. (1991). A new method for measuring daytime sleepiness: The Epworth Sleepiness Scale. *Sleep, 14*(6), 540–545.

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Weblinks
- Official ESS website
- Online ESS

LEARNING ACTIVITY 10.9

Review questions

1. Explain how shift work can disrupt a person's sleep–wake cycle and make them susceptible to a circadian phase disorder.
2. What are the two major symptoms of shift work disorder?
3. Give an example of a change to sleep timing, quantity and quality that may be caused by shift work, ensuring you explain each change.
4. In what ways can psychological and social factors contribute to the development or maintenance of a circadian phase disorder due to shift work?
5. (a) What two features of a 'shift-friendly' roster may minimise sleep–wake cycle disruption and shift work effects?
   (b) Explain the rationale underlying each desirable roster feature.
6. Explain whether it would be worthwhile to manipulate lighting conditions in a night shift workplace to minimise sleepiness.
7. Draw hypnograms showing a possible sleep–wake cycle of a night shift worker and that of a day shift worker.

Jet lag

If you have travelled by aeroplane across two or more time zones in one trip, then there is a good chance that you have experienced jet lag, especially if you went in an easterly direction.

Jet lag, also called *time zone change syndrome*, is a sleep disorder due to a disturbance to the circadian sleep–wake cycle caused by rapid travel across multiple time zones. Shifting to a new time zone in this way results in a mismatch between our internal circadian biological clock and the external environment — our biological clock is out of sync with the actual time in the time zone of the new environment. For example, our body feels that it is time to go to sleep when others are having breakfast or it is in the middle of the afternoon in the new time zone, and we feel wide awake when it is late at night and everyone else is in bed, fast asleep.

Because jet travel is quick, our sleep–wake cycle remains aligned to the environmental time cues of the home time as there has been insufficient time to adjust to the new time cues. Consequently, our natural sleep–wake cycle (along with other circadian rhythms) is out of sync and in conflict with the light–dark and other time cues of the external environment. The desynchronisation is temporary and our brain and body need to adjust to the new environmental conditions, including re-setting of the sleep–wake cycle. In the interim, we experience the effects of jet lag during the adjustment process.

Figure 10.17 Long-distance aeroplane passengers who rapidly travel across multiple time zones experience jet lag because their circadian sleep–wake cycle remains aligned to the environmental time cues of their home time zone.

Jet lag effects

Jet lag effects include both physical and psychological symptoms that may leave us with sleep problems, feeling unwell and having more difficulty functioning than normal. We tend to experience varying degrees of difficulties in initiating or maintaining sleep (e.g. when trying to sleep at a time that is out-of-sync with our home time), excessive sleepiness (e.g. during the period when our biological clock is set for sleep), reduced daytime alertness, impaired concentration and cognitive performance, and digestive problems. A vague feeling of bodily discomfort or 'not feeling right', as may be experienced when starting to feel ill, is also common. Called 'malaise', this feeling is believed to primarily result from the loss of harmony among the various biological rhythms governed by the circadian system, some of which adjust to the new time zone more rapidly than others. Problems that can occur solely or largely as a result of cabin conditions in the aeroplane, such as a headache, a blocked nose, nausea and muscle cramps, are not considered jet lag symptoms (AASM, 2014a).

Research studies have found that jet lag tends to be associated with a greater number of arousals and a greater percentage of NREM stage 1 sleep during the first two to three sleep episodes after arrival compared to home-based sleep. Most often, the second half of the sleep episode is the more severely disrupted, regardless of the direction of the travel (AASM, 2014a).

The severity and duration of jet lag symptoms vary considerably, depending on the number of time zones crossed in one journey, the direction (east or west) of the travel, the timing of takeoff and arrival, sleep timing, duration and quality on the flight, and personal characteristics of the individual involved (e.g. older adults usually have more difficulty adjusting to time differences than younger adults and children). Generally, the further you travel and more time zones you cross in one journey, the longer it is likely to take to adjust. In addition, most people find it less disruptive and symptoms do not last as long when they travel in a westerly direction (which lengthens their day), in contrast to travelling in an easterly direction (which shortens their day). Jet lag following north–south travel does not occur if there is no more than a 1- or 2-hour change in time zone (AASM, 2014a).

The sleep–wake cycle disturbances generally reduce after two to three days at the destination. Adaptation of the timing of biological functions other than sleep and waking may take up to eight or more days. Overall, adaptation is an entrainment process requiring our biological clock to be reset through the influence of environmental time cues in the new location. Our biological clock readjusts itself a little bit each day until it is aligned with the external environment. The environmental cues that influence the entrainment process include exposure to light in the first few days following travel, being active, and eating meals and sleeping at appropriate times in the new time zone.

For most people, jet lag symptoms are temporary and the overall experience of jet lag is an occasional minor inconvenience, especially when considered in relation to the excitement of the new destination. Symptoms can sometimes be severe and limit what we do, but there are usually very few symptoms by the third day after the flight. However, individuals who routinely travel back and forth across multiple time zones (e.g. flight crew, diplomats, business executives) may experience chronic, longer-term sleep disturbances, daytime performance impairments and other symptoms similar to those experienced by shift workers (AASM, 2014a).

Figure 10.18 Excessive sleepiness at a time when we do not normally sleep is a common symptom of jet lag.

Travelling west is best

Jet lag is less disruptive when we travel in a westerly direction. Travelling west is best because when we travel in a westerly direction we follow the apparent pathway of the sun. This results in less of a mismatch between our biological clock and the day-night cycle of the external environment. For example, London time is 10 hours behind Melbourne time. Therefore, if you left Melbourne at 8 am to fly to London, despite the flying time being approximately 22 hours, you would arrive in London at 8 pm on the same day (London time).

While most people would experience jet lag after a flight of this nature, the effects are less in the case of westerly travel than on a return trip because the creation of a longer day is more in tune with the

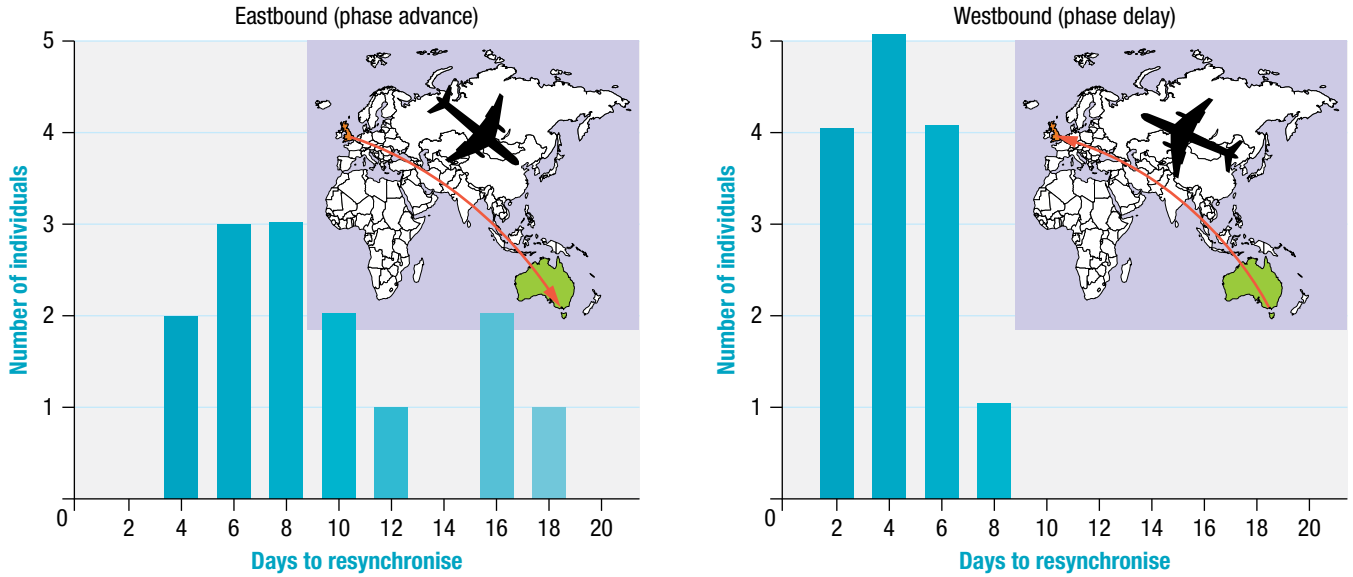

Figure 10.19 Travelling west is best. Most people have a natural circadian sleep–wake cycle that is longer than 24 hours, so the effects of jet lag tend to be more noticeable and last longer after travelling east (which shortens the day) than after travelling west (which lengthens the day).

Source: Moore-Ede, M.C., Sulzman, F.M., & Fuller, C.A. (1982). *The clocks that time us: Physiology of the circadian timing system*. Cambridge: Harvard University Press.

inclination of the body's biological clock to extend the day. When flying east, we travel in the opposite direction to the sun's apparent movement, so the day becomes 'shortened'. This runs counter to the natural tendency of our biological clock. The result is a greater mismatch between the internal and external rhythms and so the effects of jet lag are heightened.

On the return flight from London to Melbourne, travel is in an easterly direction. If your departure time from London is 8 am, the 22 hour flight and 10 hour time difference will mean that you arrive in Melbourne at 4 pm the next day (Melbourne time, which is 6 am London time). On your arrival in Melbourne your biological clock will be functioning on London time (i.e. 6 am) while the actual time is 4 pm, which results in a disruptive mismatch between internal and external rhythms.

Studies of jet lag have led researchers to identify two types of interruptions to circadian rhythms. Easterly travel, which shortens the sleep–wake cycle, is called *phase-advance* and this runs counter to the cycle's natural tendency to drift towards 25 hours and lengthen the day. Travel in a westerly direction results in *phase-delay* when the day is lengthened in accordance with our body's natural tendency towards a 25-hour day. Phase-advance requires more adjustment by the traveller than phase-delay.

Until the sleep–wake biological clock is reset and in sync with the environment, the individual is likely to continue to feel the effects of jet lag. This may create problems if, for example, soon after arrival, an individual has to perform a task that requires concentration, such as attending an important meeting or playing in a golf or tennis tournament.

Overcoming jet lag

Resetting the biological clock for the sleep–wake cycle to the destination time as quickly as possible is the key to overcoming jet lag and minimising its effects. To begin the adjustment process to a 'new' time, travellers should start to change their eating, sleeping and other behaviour patterns to accord with the 'destination time' sleep-wake cycle routines. Generally, 'working with the sun' is best.

While in transit, environmental cues can be manufactured to be in harmony with the destination time, minimising the effects of jet lag on arrival. For example, upon boarding the plane, changing watches to the destination time zone is a good starter. Depending on the destination time, turning on the light to simulate daytime or sitting in a window seat and opening the shades to take in more light may be appropriate. Trying to sleep in-sync with the likely sleep time at the destination may also help. Nighttime could be simulated by wearing sunglasses or an eye mask. If on arrival it is daytime, spending time outside can also speed up the adjustment to the new time zone by helping the biological clock to reset (SHF, 2016h).

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National Sleep Foundation — How to get over jet lag

LEARNING ACTIVITY 10.10

Review questions

1. What is jet lag?
2. Explain why jet lag occurs with reference to the circadian sleep–wake cycle.
3. Explain whether jet lag is likely to occur under each of the following conditions:
   (a) one time zone (rather than multiple time zones)
   (b) slow travel (rather than rapid travel)
   (c) rapid travel in a north or south direction (rather than east or west).
4. Give three examples of circadian sleep-wake cycle disturbances associated with jet lag.
5. Why is travelling east worse for jet lag?
6. Give two examples of behaviours that can minimise jet lag on a Melbourne to London direct flight and explain why these could be effective.

EFFECTS OF PARTIAL SLEEP DEPRIVATION

Research shows that inadequate sleep is a common problem in Australia. People in all age groups report not getting enough good quality sleep. The sleep experiences of numerous adolescents and shift workers illustrate the nature and extent of this issue. Our ability to function and feel well while we are awake significantly depends on whether we are getting enough total sleep and enough of each type of sleep. It also depends on whether we are sleeping at a time when our body is prepared and ready to sleep.

There are no rules on how much sleep we need but it is clear that we each need a certain amount of total sleep at different ages or stages of development to help ensure that we function at our best and maintain good health. Our major sleep episode of the day needs to be of the correct quantity and quality and occur when we are ready for sleep. It is best that this episode occurs as one consolidated block. Fragmented sleep is not good quality sleep. We also need to have the correct amounts of the different sleep types to be considered normal sleep. This includes NREM and REM sleep. Normal sleep consists of the correct quantity and quality of both NREM and REM sleep. As humans we are capable of adapting in ways that enables us to survive on less sleep than we actually need. However, when we aren't getting enough sleep, it is important to consider how well our bodies and our minds are functioning and the impact on our quality of life (Blunden, 2008).

When we fail to get enough sleep or have a 'good' sleep, we experience sleep deprivation. **Sleep deprivation** is a general term used to describe a state caused by inadequate quantity or quality of sleep, either voluntarily or involuntarily. This means that sleep deprivation may occur because we choose to go without sleep, such as when we stay up all night with friends or to watch a sports match. It may also occur due to reasons outside our control, such as when we work a night shift roster, travel rapidly across multiple time zones or have a sleep disorder.

Sleep *quantity* refers to the amount of sleep. This can be measured objectively using time. Sleep *quality* refers to how well we feel we have slept. This primarily relies on subjective self-report measures. We tend to judge sleep quality on the basis of how rested or recovered we feel on waking and throughout the day, so psychologists often use the terms 'restfulness' and 'restorative' when describing sleep quality. Sleep quantity influences our perception of sleep quality. The number of interruptions or arousals (partial or full) during a sleep episode are also commonly considered when we judge sleep quality because these influence whether our sleep episode is consolidated or fragmented (Harvey, et al., 2008).

Researchers often distinguish between partial and total sleep deprivation. **Partial sleep deprivation** involves having less sleep (either quantity or quality) than what is normally required. This may occur periodically or persistently over the short-term or long-term. For example, someone may have too little sleep for one or more days, weeks, months and so on. Most sleep disorders are associated with partial sleep deprivation that occur routinely over a prolonged period. In contrast, **total sleep deprivation** involves not having any sleep at all over a short-term or long-term period. The person stays awake for one or more days or weeks. This usually takes place under extreme conditions, such as when people try to break records. The longest period of total sleep deprivation that is widely recognised is 18.7 days (see Box 10.7 on page 540).

Psychologists have researched both types of sleep deprivation, investigating the effects of partial and total deprivation across short and prolonged periods.

In studying sleep deprivation, researchers investigate psychological and/or physiological effects. They may study inadequate sleep in relation to total sleep time, NREM sleep, REM sleep or some other feature of a sleep episode or the entire sleep–wake cycle. In many cases, they study sleep recovery patterns following sleep loss as this provides insights on sleep patterns, sleep functions and other aspects of sleep.

In this section we examine the effects of partial sleep deprivation on a person's affective, behavioural and cognitive functioning. These are often interrelated and overlap, so it can be difficult to draw a neat line between sleep deprivation effects in relation to such broad categories of human functioning.

You have undoubtedly experienced partial sleep deprivation. It often results in a range of uncomfortable side effects. The severity and extent of the effects depend on a range of factors, including the amount of total sleep loss, the nature of the sleep loss, when sleep loss occurs, why it occurs, its frequency, the period of time over which the sleep deprivation occurs and the personal characteristics of the individual involved.

Generally, the effects of partial sleep deprivation tend to be minor and temporary when they occur occasionally or on a short-term basis. When the accrued sleep debt is repaid, the person will quickly recover from the sleep loss effects. But with successive nights of inadequate sleep, the sleep debt can accumulate and sleep deprivation effects can multiply. Although we do not need to fully compensate for lost hours of sleep to recover from sleep deprivation effects, there is considerable research evidence that long-term sleep deprivation places the individual at a greater risk for a range of diseases and health problems, including obesity, diabetes and various cardiovascular diseases. It is also associated with an increased risk of accident and injury in people of all age groups.

Figure 10.20 Many parents of young infants experience partial sleep deprivation involving loss of both sleep quantity and quality.

studyon

There are many reasons why a person may not get enough sleep or experience poor sleep quality at any given time. However, the most common causes of partial sleep deprivation (without the presence of a sleep disorder) are lifestyle factors, including school or work-related factors. Consequently, most people are affected. Sleep-disrupting lifestyle factors, if not changed, can also lead to the development of a sleep disorder. For example, habitually staying up late or drinking caffeinated beverages before the major sleep episode can cause sleep-onset insomnia. Sleep deprivation may not only trigger a sleep disorder, it can also be the consequence of having a sleep disorder.

Affective functioning

Many people tend to be easily irritated or short-tempered after they awaken from poor sleep, which you may know through personal experience. The link between sleep deprivation and mood change has been long-established by psychological research. It has been observed repeatedly by researchers among all sorts of participants under numerous sleep deprivation conditions.

Psychologists have also investigated links between sleep deprivation and other aspects of affective (emotional) functioning. Many have found that sleep deprivation can interfere with emotional regulation and reactivity. In particular, there is a strong link between inadequate sleep and our ability to control our emotions, often resulting in *amplified emotional responses*. Our emotional reactions may be too quick and more intense or exaggerated, often out of proportion to how we would ordinarily react when not sleep deprived.

Sleep loss seems to compromise our brain's ability to process emotional information, make accurate emotional perceptions and then regulate how we respond emotionally. We can find it harder to accurately judge other people's emotions and reactions, making us more prone to unwarranted emotional outbursts. For example, some studies have found a strong link between sleep deprivation and impaired facial recognition of emotions and between sleep deprivation and reduced emotional empathy. Both can impact on our ability to identify and appreciate the emotional state of others, which are important aspects of our emotional decision making and reactions in our everyday interactions with others (Guadagni, et al., 2014; van der Helm, Gujar & Walker, 2010).

When we haven't slept well, our emotional response threshold can be lowered, increasing our emotional reactivity and making us more likely to overreact to relatively neutral events. Sleep loss can also have a detrimental effect on our ability to sort out the unimportant from the important, and this can lead to poor judgments in relation to our emotional responses. We may overreact emotionally to trivial matters when there is actually no need to react. We

may feel provoked or emotionally explode when no provocation actually exists. We may find it harder to control impulses. For example, some studies have found that sleep loss is associated with becoming aggressive more quickly than usual and with the outward expression of aggressive impulses. We are more likely to quarrel with other people and get frustrated and overreact in traffic jams. Even a single night of inadequate sleep can have these effects (Goldstein & Walker, 2014; Guadagni, et al., 2014; Gujar, et al., 2011; Kamphuis, et al., 2012).

NREM and REM sleep seem to play different roles in emotion regulation. For example, research findings suggest that emotional reactivity is more likely to occur with REM sleep deprivation (Rosales-Lagarde, et al., 2012). However, the exact neural processes that account for the link between sleep and emotion regulation remain unclear. They share the complex set of brain structures called the limbic system (which includes the amygdala), so this area has been a target of research interest (Gruber, et al., 2014; Talbot, et al., 2010; Yoo, et al., 2007).

Behavioural functioning

Sleep deprivation also directly influences many aspects of our behaviour. One of the immediate effects on behavioural functioning can be **sleep inertia** — the performance impairment that occurs immediately after awakening. This is a sleep-to-wake transition effect that can follow a poor night's sleep, especially if abruptly awoken during slow wave deep sleep or when sleep duration is insufficient (Bruck & Pisani, 1999).

With sleep inertia, the individual typically feels groggy, partly awake and disoriented as they transition toward full alertness. Sometimes described as a 'state of grogginess', sleep inertia is strongest at wake time, but dissipates, or decays, rapidly thereafter. It usually lasts for a few minutes but can last for much longer (Santhi, et al., 2013).

Sleep inertia can interfere with the ability to perform a wide range of behavioural and cognitive tasks, including the simplest of everyday actions. Overall, our reaction time tends to be slow and we tend to perform below our best until we reach full alertness and recover from the inertia effects. Motor and cognitive functions in particular are not at their full capacity during sleep inertia, so performing tasks that require full alertness but can compromise the safety of the individual involved and others need to be avoided. For example, road traffic and on-the-job accidents can occur during sleep inertia.

Awakening during the deep sleep of NREM stages 3 and 4 produces more sleep inertia than awakening in stage 1 or 2. Waking up during REM sleep produces sleep inertia more like awakening from deep sleep than light sleep stages. Sleep inertia may also be experienced after a short nap. In addition, it tends to last longer when a person has been sleep deprived, as compared to no deprivation (Bruck & Pisani, 1999; Santhi, et al., 2013).

Figure 10.21 Sleep loss is associated with becoming aggressive more quickly than usual and with the outward expression of aggressive impulses. We are more likely to quarrel with other people and get frustrated and overreact in traffic jams.

The primary behavioural effect of sleep deprivation is *excessive sleepiness* during normal waking time. Excessive sleepiness most commonly occurs during the day, but it may be present at night in a person, such as the shift worker who has their major sleep episode during the day. As well as affecting our mood, emotions and emotional reactivity, excessive sleepiness involves difficulty in maintaining an alert awake state. Fatigue is a common symptom. There is a persistent feeling of tiredness and lack of energy. Like sleep inertia, fatigue contributes to drowsiness, difficulty maintaining concentration and reduced awareness on the environment. It reduces our efficiency and we tend to take longer to finish tasks, have slower than normal reaction times and make more mistakes. These can have significant negative effects on performance of our daily activities, especially those requiring vigilance or sustained attention. Slower reaction time in particular is a significant impairment when driving or doing other tasks that require a quick response. You don't need to fall asleep at the wheel to be a danger. And slower reactions can affect people in all types of situations.

Sometimes lack of sleep or excessive sleepiness may result in unintended, involuntary lapses into sleep called microsleeps. A **microsleep** is a brief period of sleep, lasting up to a few seconds. During a microsleep the person typically has a fixed gaze, a blank expression on their face and doesn't blink. They may remain sitting or standing and they become less responsive to external stimuli. After a microsleep, which may last between 1–10 seconds, the person may have no recollection of what happened during their microsleep. They won't remember going into the microsleep, but may be aware of a lapse in concentration when they wake up (Bruck, 2006).

Microsleeps can affect how you function. For example, if you're listening to the teacher explaining something in class, you might miss some of the information or feel like you don't understand the point on your return to normal waking consciousness. In reality, though, you may have slept through part of the lesson and not been aware of it.

Research studies have identified many other aspects of behaviour functioning associated with partial sleep deprivation. These include:

- impaired regulation or control of behaviour e.g. behaviour problems at home; naughtiness and disruptive behaviour at school; risk-taking behaviour by adolescents
- higher teacher rated inattentiveness by students in class
- poorer teacher rated social functioning by school children
- school lateness and absenteeism
- lower participation rate in extracurricular activities at school
- higher injury rates and injury prone behaviours in preschool age and school age children
- reduced motor coordination, particularly eye–hand coordination
- reduced speed and accuracy.

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Cognitive functioning

Research studies have long established that sleep deprivation may impair cognitive functioning. This has been found in relation to a wide range of mental abilities of varying complexity, many of which are also involved in our affective and behavioural functioning.

It is clear that even a relatively small amount of sleep deprivation can adversely affect attention. In particular, excessive sleepiness due to sleep deprivation tends to reduce alertness and our ability to stay focused on a task. With prolonged sleep deprivation, we tend to experience lapses in selective attention and reduced ability to divide our attention on tasks that require simultaneous attention to multiple sources of information. These skills are required for the performance of many everyday tasks such as driving a motor vehicle or cooking the family dinner, as well as numerous jobs in the workplace. Tasks often begin well, but performance tends to deteriorate as task duration increases (Goel, et al., 2009; Jackson, et al., 2011).

Figure 10.22 A student who has experienced partial sleep deprivation may be less attentive in class.

The greater the sleep deprivation, the more likely it is that attention will be impaired and that errors associated with loss of attention will increase. This is even more likely when a task lacks interest or complexity. For example, when sleep deprived research participants are required to complete simple, monotonous, repetitive tasks, such as identifying bleeps and flashing lights on a computer monitor, they will inevitably make a significantly higher number of errors than when they had not been deprived of sleep. In the real world, these types of errors can occur in visual tasks similar to those involved in reading x-rays, CAT scans, baggage screening and even air traffic control. Errors in these types of contexts can have devastating consequences. As described in Chapter 8, one full night's of sleep deprivation is similar to having a blood alcohol content level of 0.05., which is one of the reasons sleep deprivation is an issue of public concern.

When sleep deprived, our ability to think clearly tends to reduce, especially for tasks that require more complex thought (such as when solving maths problems). We are also more likely to think in irrational ways, and have difficulty making decisions and solving problems that require creative thinking. There is a tendency to need more time to analyse situations and respond physically to events as they happen. We tend to lose situational awareness and it is easier to overlook important details. In children, sleep deprivation has been found to reduce verbal creativity and the ability to think abstractly. The ability to do tasks that need visual and spatial abilities (such as working with different patterns or maps) or work involving eye–hand coordination, such as drawing and writing, may also be affected. Adults experience similar impairments (Bruck, 2006; Goel, et al., 2009; Gruber, et al., 2014).

There is also considerable research evidence that sleep deprivation may impair various learning and memory processes. Generally, sleep-deprived participants tend to perform worse on learning and memory tasks, compared with well-rested individuals, especially when sleep deprivation is prolonged. For example, reduced attention can adversely impact on acquisition of new information during learning. Similarly, processing information in short-term working memory can be significantly impaired, making it difficult to keep details in conscious awareness for use when required (Goel, et al., 2009; Gruber, et al., 2014).

The deterioration in cognitive functioning from prolonged partial sleep deprivation has further implications for shift workers in jobs with significant responsibility for the health and wellbeing of others. For example, medical staff in the emergency department of a hospital cannot afford to miss any changes in vital signs and must be able to think clearly and make decisions quickly if a patient's condition changes. Likewise, it is critical that an air traffic controller, who must continually scan a monitor for small but significant changes in aircraft position, doesn't miss important information. In these types of situations, errors in judgment, as well as wrong decisions and lack of clear, logical thinking, may result in loss of human life.

Figure 10.23 For many shift workers, including doctors in hospital emergency departments who have to grab opportunities to sleep whenever they can, prolonged sleep deprivation can impact on their ability to think clearly and make decisions.

BOX 10.7 Total sleep deprivation

Studies on the effects of prolonged total sleep deprivation in humans have tended to rely on convenience samples. Case studies of people who performed sleep deprivation stunts while monitored by psychologists or doctors are among the better-known. These have mainly involved individuals who have deprived themselves of sleep for 10 or more consecutive days. In all cases, there were no long-lasting effects, either psychologically or physiologically. Most observed and self-reported effects of prolonged total sleep deprivation were temporary and disappeared after the individual slept uninterrupted and their sleep–wake cycle returned to normal.

One of the best-known sleep deprivation stunts is that of 17-year-old American Randy Gardner. In 1964 Gardner stayed awake for a world record 264 consecutive hours (11 days and 11 nights) as part of a high school science project. Unlike the previous world record holder, Gardner did not use stimulants to help stay awake. There was a gradual onset of various impairments as the sleep loss period progressed. Overall, he became irritable and had difficulty concentrating, thinking clearly and remembering things. By the fourth day he was experiencing hallucinations and delusions. For example, he saw fog that wasn't present, believed a street sign to be a person and imagined himself to be a famous football player. By the ninth day his thinking become fragmented, his speech was slurred and he often did not finish sentences. He was generally unsmiling and expressionless. His vision was blurred and his right eye was making involuntary sidewise movements, which caused him considerable bother.

Although Gardner experienced a range of debilitating effects in the sleep deprivation period, there were no significant lasting effects. For the first three days after the stunt, Gardner slept longer than his usual 8 hours (15 hours on the first night, 12 hours the second night and 10.5 hours the third night). His first night of sleep was predominantly slow wave and REM sleep. During the day, he continued his usual activities without difficulty. In all, it took Gardner about 3 days to resume his normal sleep–wake cycle. Follow-up tests 10 days after the stunt confirmed that Gardner had suffered no long-term harmful effects. However, it was apparent that he withstood prolonged total sleep deprivation better than others. This has been partly attributed to his younger age, not taking stimulants and the home setting in which the stunt was conducted (Dement, 1976).

In 1977, English woman Maureen Weston went without sleep for 18.7 days during a rocking chair marathon. This is recognised as the world record (Guiness) for the longest period without sleep. Weston is reported as having experienced hallucinations, paranoia, blurred vision, slurred speech and memory and concentration lapses, but no lasting effects. It is unclear whether she used stimulants.

Studies show that once a sleep-deprived person is able to catch up on a big chunk of the lost sleep and reset their sleep–wake cycle and other biological rhythms, the physiological and psychological effects tend to disappear.

Some psychologists explain the finding that there are usually few lasting effects of sleep deprivation as being due to the difficulty in ensuring that participants in sleep deprivation studies are, in fact, completely sleep-deprived. *Total* sleep deprivation is difficult to ensure because after a period of prolonged sleeplessness, people automatically drift into periods of microsleep over which they have no control.

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Video — DJ Peter Tripp's sleep deprivation 7m 25s

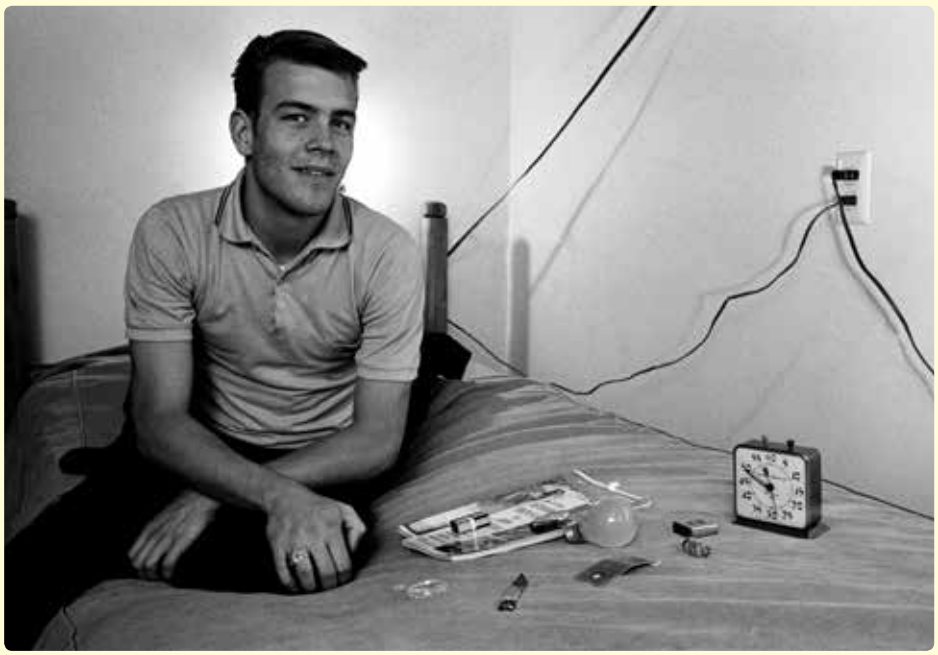

Figure 10.24 Randy Gardner on a bed next to various household objects he later had to identify by memory as part of the sleep deprivation experiment he undertook as a high-school science project.

BOX 10.8 Are you sleep-deprived?

The following questionnaire is designed to determine whether you are getting as much sleep as you need. Answer each question by circling Yes or No.

1	Do you usually need a loud alarm clock to wake you up in the morning?	Yes	No
2	Do you usually hit the snooze control to get a few minutes more sleep when the alarm goes off in the morning (or simply turn off the alarm and try to catch a bit more sleep)?	Yes	No
3	Do you find that getting out of bed in the morning is usually a struggle?	Yes	No
4	Do you sometimes sleep through the alarm?	Yes	No
5	Do you usually find that a single beer, glass of wine or other alcoholic drink seems to have a noticeable effect on you?	Yes	No
6	Do you sleep longer on weekends than you normally do during the week?	Yes	No
7	On holidays, do you sleep longer than you normally do in regular school/work weeks?	Yes	No
8	Do you often feel that your 'get-up-and-go' has got up and gone?	Yes	No
9	Do you find that it is more difficult to attend to details or routine chores than it used to be?	Yes	No
10	Do you sometimes fall asleep when you had not intended to?	Yes	No
11	Do you sometimes find yourself getting very sleepy while you are sitting and reading?	Yes	No
12	Do you sometimes find yourself getting very sleepy or dozing off when you are watching TV?	Yes	No
13	When you are a passenger in an aeroplane, car, bus or train and the trip lasts over an hour without a break, do you commonly find yourself getting very sleepy or dozing off?	Yes	No
14	Do you usually feel extremely sleepy or doze off when you are sitting quietly after a large lunch without alcohol?	Yes	No
15	Do you tend to get sleepy when you are sitting quietly in class, in an assembly or in a movie theatre?	Yes	No
16	Have you sometimes found yourself getting extremely sleepy, with the urge to doze, when you drive or are a passenger in a car or bus, and are stopped for a few minutes in traffic?	Yes	No
17	Do you drink more than four cups of coffee, tea or other drink containing caffeine during the day? (Remember to count refills; also count extra-large take-away cups as two cups.)	Yes	No

To score this questionnaire, count the number of times you circled Yes. The interpretation of your scores is as follows:

4 or less
You are obtaining an adequate amount of sleep and are not showing significant signs of any sleep deprivation.

5 or 6
You are probably getting an adequate amount of sleep on most days, although there are some days when you don't get enough sleep, which may cause you to be less than 100% alert on some activities.

7 or 8
You are showing evidence of sleep deprivation that may cause a noticeable reduction in your efficiency at school or work and your ability to finish all your required activities on time. Things to watch for are simple errors and short episodes of inattention. You will occasionally just 'slip up', act clumsily, reach a wrong conclusion or miss an important detail. Usually at this level you will recognise the errors if you have the chance to recheck your work, although the ones that get through may be embarrassing or costly.

9-11
Definitely sleep deprivation (and a large sleep debt). Your work is likely to suffer from large, random errors; even small errors may be missed when the work is reviewed a second time.

12-14
In addition to experiencing the same symptoms of those with scores of 9 to 11, your general quality of life suffers. Perhaps you are less interested in things formerly found to be fascinating and less inclined to spend time socialising. You may also be a bit accident-prone and subject to temporary memory impairments such as momentarily forgetting your address or phone number.

15 and above
Sleep deprivation is a major problem. Level of sleepiness is in the range often found in people with a sleep disorder involving severe insomnia.

Source: Adapted from Coren, S. (2009). Sleep health and its assessment and management in physical therapy practice: The evidence. *Physiotherapy theory and practice*, 25, 442–52. 10.1080/09593980902835351.

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Practical activity
Are you sleep deprived?

LEARNING ACTIVITY 10.11

Review questions

1. Explain the meaning of the term sleep deprivation with reference to sleep quantity and quality.
2. (a) Explain the meaning of 'sleep quantity and quality'.
   (b) How are sleep quantity and sleep quality commonly measured?
   (c) What is a possible objective measure of sleep quality?
3. How are partial and total sleep deprivation defined?
4. (a) What is sleep inertia and when it is more likely to occur?
   (b) Explain whether a person is asleep or awake when experiencing sleep inertia.
5. (a) What is a microsleep and when it is more likely to occur?
   (b) Explain whether a microsleep is a mini-version of a major sleep episode.
6. (a) Prepare a table or Venn diagram in which you summarise some of the possible effects of partial sleep deprivation using the headers affective, behavioural and cognitive.
   (b) Twins Sara and Adam partied for two consecutive nights on the weekend of their 18th birthday and had almost no sleep throughout this period. On the morning after the last party, both attended their casual jobs. Sara is employed as a lifeguard at the local pool. Her duties include closely monitoring activity in the pool to ensure swimmers' safety, responding quickly to unsafe situations and dealing calmly with swimmers behaving in an unsafe manner. Adam works at a Tattslotto agency. His duties include scanning Tattslotto tickets, identifying when to pay out on winning tickets from beeps on the computer and explaining to customers the processes involved in filling out their tickets.
      (i) Describe the possible impact for Sara and Adam of their sleep deprivation on their respective abilities to do the tasks required in their casual jobs.
      (ii) When Sara and Adam had their first major sleep episode, what were the likely pattern and proportions of NREM and REM sleep?
7. (a) How quickly and how well do people usually recover from the effects of partial sleep deprivation?
   (b) What key factor(s) would influence(s) recovery from partial sleep deprivation?

LEARNING ACTIVITY 10.12

Reflection

What do sleep deprivation effects suggest about the purpose and function of sleep? Do they suggest support for restorative or evolutionary theories? Explain your answer.

LEARNING ACTIVITY 10.13

Experimental design on sleep deprivation

Outline the design of an experiment that could be conducted to compare the effects of partial sleep deprivation on performance of simple and complex tasks.

- Present your experimental design as a flowchart showing the key features: aim, ethical issues, research hypothesis, operationalised independent and dependent variables, sampling procedure, experimental groups, participant allocation procedure.
- If your hypothesis were supported, what results might be obtained, what conclusion(s) could be drawn and what generalisation(s) could be made? Ensure that your results are consistent with theoretical expectations.
- Explain your choice of experimental design and identify two potential extraneous or confounding variables that are taken account of in your design.

INTERVENTIONS TO TREAT SLEEP DISORDERS

Most sleep disorders can be treated successfully and a number of effective interventions are available. Making some lifestyle changes can help relieve mild or occasional symptoms, but professional support may be required if symptoms persist and are causing unwanted distress or problems in everyday functioning. There are a range of treatment options, with the choice depending on the disorder, its symptoms and severity, the potential risks and benefits of treatment options, and the individual involved.

In this section, we examine the use of cognitive behavioural therapy to treat insomnia and the use of bright light therapy for circadian rhythm phase disorders.

Cognitive behavioural therapy

As the name suggests, **cognitive behavioural therapy**, commonly referred to as CBT, is a type of psychotherapy that combines cognitive and behavioural therapies to treat mental health problems and disorders. It has also been successfully applied to the treatment of a range of sleep disorders, especially those for which lifestyle factors and inappropriate sleep habits significantly contribute to the onset or experience of symptoms.

A core assumption of CBT is that the way people feel and behave is largely a product of the way they think. Unlike other types of 'talking' therapies, CBT does not involve talking freely about whatever comes to mind or dwelling on events in a person's past to gain an insight into their psychological state. It is not a 'lie on the couch' type of therapy.

CBT provides a structured program that tends to be relatively short-term and focused on the 'here and now' — how a person's current thoughts, feelings and behaviours are presently affecting them. Although CBT recognises that events in a person's past have shaped the way they currently think and behave, this is not the focus. CBT aims to find solutions on how to change a person's current thoughts and behaviours so that they can function better now and in the future.

Many people with insomnia develop sleep-related thoughts and behaviours that have the unintended consequence of maintaining or worsening their sleep problems. These may include, for example, misunderstandings about the causes of insomnia, faulty beliefs about sleep-promoting practices, amplifications of the consequences of insomnia or poor sleep and unrealistic sleep expectations. Often, their behaviours, such as spending a lot more time in bed, sleeping in and daytime napping, begin as strategies to combat the sleep problem by getting more sleep. Their inappropriate thoughts and behaviours can also lead to excessive worry or anxiety about not sleeping, apprehensions about daytime impairments, fear of sleeplessness, heightened physical arousal when trying to sleep, a mental hyperarousal state ('a racing mind'), and constant clock watching when in bed, all of which are counterproductive, especially if they become conditioned with sleep time or the normal sleep environment (APA, 2013; Schutte-Rodin, et al., 2008).

According to *cognitive behavioural therapy for insomnia,* often called CBT-I, identifying and changing these negative thoughts and inappropriate behaviours about insomnia and sleep with more balanced and realistic ones is very important to alleviating symptoms or overcoming the disorder. Consequently, the goal of CBT-I is to help individuals with insomnia identify and replace thoughts and behaviours that cause, perpetuate or worsen their insomnia with thoughts and behaviours that minimise the likelihood of their insomnia and promote good sleep. It also aims to treat insomnia in a drug- or medication-free way (NSF, 2018j).

Overall, a CBT-I program consists of about 8–10 sessions. An important starting point in making effective changes through the program is for the individual to understand the difference between thoughts, feelings and behaviour, their interrelationship and their relevance to sleep and insomnia. A CBT-I program may therefore include an introductory sleep education session during which the individual is assisted to understand the sleep–wake cycle, insomnia and factors that can cause and maintain insomnia. The individual may also be encouraged to complete a sleep diary as they learn and apply the various CBT strategies. This allows improvement to be monitored and assessed.

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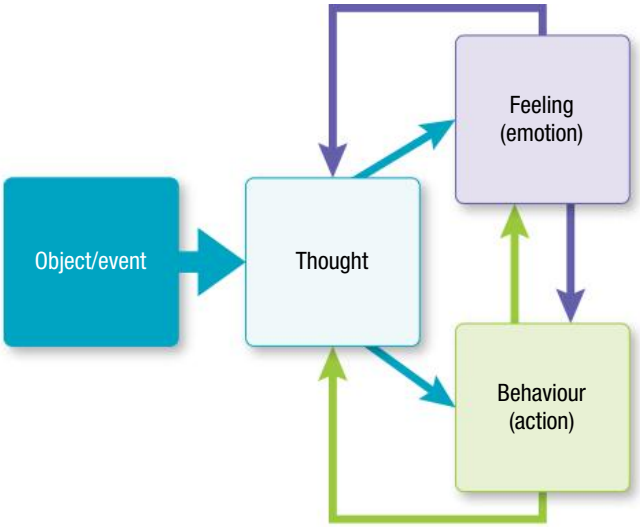

Figure 10.25 A key assumption of CBT is that any object or event we encounter is initially cognitively appraised or interpreted, which leads us to feel and behave in ways that reflect our thoughts. Our behaviour may also influence our feelings, and our feelings may also influence our behaviour.

Cognitive component

The cognitive part of CBT-I assists the individual to recognise and change inappropriate or dysfunctional attitudes, beliefs and other thoughts about their sleep. This includes addressing anxiety or preoccupation with sleep difficulty and learning how to control or eliminate worries and negative thoughts that prevent sleep onset. After identifying faulty or dysfunctional thoughts, alternative interpretations of what is making the person anxious or causing concern about sleep may be offered so that they are able to think about their insomnia in a different way. For example, they may be encouraged to develop and maintain realistic expectations of their sleep, not blame insomnia for all their daytime impairments, not believe that losing a night's sleep will bring awful consequences, not give too much importance to sleep and to develop some tolerance to the effects of lost sleep (APA, 2016b).

An example of how thoughts can influence sleep onset is as follows:

Fact: 'I'm not feeling very sleepy right now.'

Thoughts: 'It's already 1.30 am I'm never going to fall asleep. Everybody else is sleeping. I'm no good at sleeping. I don't know how I'm going to cope at work.'

Emotions: Fear of sleeplessness and helplessness

Consequence: Inadequate sleep quantity and quality.

In this example, the individual has thought about the fact that they are not very sleepy right now in a faulty way — by generalising that they will never get any sleep at all. The reality is that people with insomnia do sleep for some time most nights, but tend to underestimate their total sleep time afterward. Therefore, a thought such as 'I'm never going to fall

asleep' is highly likely to be false. The individual places more emphasis on this thought than the fact itself. Their thinking also triggers inappropriate emotional reactions that fuel their faulty thoughts, further affecting their ability to sleep.

Through the cognitive component of CBT-I, the individual would be encouraged to consider an alternative way of thinking about their sleep situation; for example:

Fact: 'I'm not feeling very sleepy right now.'

Thoughts: 'I'm not sleepy now, but I usually get some sleep during the night. I will eventually feel sleepy. I always make it through the next day without any disaster' *or* 'It doesn't matter whether or not I fall asleep. Rest is still good for me — it does not have to be sleep. I can function well with little sleep. I will relax and not worry about it. I will fall asleep when my body is ready.'

Consequence: Less anxiety, less aroused/more relaxed, positive thinking and therefore increased likelihood of sleep.

In appraising the situation more accurately, realistically and positively rather than negatively, the individual does not place undue pressure on themself to fall asleep, is less psychologically and/or physically aroused, and is less likely to behave in ways that impair sleep onset or return to sleep after a premature awakening (Mental Health Foundation UK, 2011).

Figure 10.26 'I'm never going to fall asleep.' The cognitive component of CBT-I directly targets attitudes, beliefs and thoughts that interfere with sleep onset.

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Weblinks

- National Sleep Foundation article on CBT-I use with a patient
- Animation on CBT-I (and other therapies) 5m 31s
- Sleep expert explains CBT-I 3m 54s

Behavioural component

The behavioural part of CBT-I helps the individual develop good sleep habits and avoid behaviours that prevent them from sleeping well. Two of the most effective behavioural therapy techniques for insomnia are called stimulus control therapy and sleep hygiene education.

Stimulus control therapy

Stimulus control therapy for insomnia was developed by American psychologist Richard Bootzin in 1972 to overcome the learned associations acquired by people with insomnia and to lead them to form new associations that suit sleep. It has since been modified by other psychologists or researchers but the basic approach is still the same.

According to Bootzin, people with insomnia often spend long periods of time in bed trying to fall asleep or get back to sleep. This can result in their bed and bedroom becoming associated with behaviours that are incompatible with sleep, such as watching television, texting, eating, reviewing the day's events, planning, worrying, lying awake, and becoming anxious, stressed or frustrated from trying to fall asleep or get back to sleep. Their bed and bedroom may also become conditioned stimuli for anxiety, stress or frustration associated with being unable to fall asleep. The more time they spend in bed trying to sleep or engaging in activities that don't suit sleep, the stronger the learned associations become, which perpetuates their difficulty in falling asleep (Bootzin & Epstein, 2011; Bootzin & Perlis, 2011).

Figure 10.27 'Clock-watching' is one behaviour that can maintain sleep-onset insomnia and make it even harder to fall asleep.

The aims of **stimulus control therapy** are to strengthen the bed and bedroom as cues ('stimuli') for sleep, to weaken them as cues for behaviours that are incompatible with sleep, and to establish a regular sleep–wake schedule that is consistent with the circadian sleep–wake cycle. It essentially involves bedroom behaviours and practices designed to re-establish an association between sleep and the bed and bedroom.

These are apparent in the *stimulus control instructions* given to people with insomnia in order to address the following points: when to go to sleep; what activities are permitted or disallowed when in bed; what to do if sleep is not attained within a reasonable period of time; when to rise in the morning; and daytime napping. It is also necessary to caution individuals not to 'clock-watch'.

The stimulus control instructions and their underlying rationale are:

1. Determine an appropriate time to go to bed based on feelings of sleepiness rather than what time it is. Only lie down and go to sleep when you are sleepy. Bear in mind being sleepy is not the same thing as being tired. (This instruction helps prevent lying in bed engaging in negative sleep-related thoughts.)
2. Do not use your bed for anything else except sleep; that is, do not read, use a computer, send text messages, check email, talk on the phone, watch television, eat or worry in bed. (Reserving the bed for sleep helps to establish new sleep habits, whereas engaging in activities performed when awake result in arousal, making it difficult to sleep. It is also important for the bed and bedroom to be conditioned stimuli for sleep, not arousal or wakefulness.)
3. If you find yourself unable to fall asleep, get up, and go into another room and engage in a relaxing activity such as some light reading or using a relaxation technique until you do feel drowsy.

   Stay up as long as you wish and then return to the bedroom to sleep. (Getting out of bed if not sleepy strengthens the association between the bed and bedroom and falling asleep. Getting out of bed when unable to sleep also helps develop a perception of control over insomnia.)
4. If you still cannot fall asleep within 10 minutes, repeat step 3. Do this as often as is necessary throughout the night, but do not clock watch. Repeat this step as many times as you need to during the night. (Clock watching is an action that reinforces wakefulness.)
5. Set an alarm and get up at the same time every morning (even on weekends), irrespective of how much sleep you got during the night. (Irregular sleep–wake times disrupt the circadian sleep–wake cycle.)
6. Do not nap during the day. (Not napping minimises disruption to the sleep–wake cycle while helping ensure you fall asleep more easily because you are more tired. More easily falling asleep is also a reinforcer, which helps maintain compliance with the stimulus control therapy instructions and further strengthens the association between the bed and bedroom and falling asleep.)

Figure 10.28 The aims of stimulus control therapy for insomnia are to strengthen the bed and bedroom as cues for sleep, to weaken them as cues for behaviours that are incompatible with sleep, and to develop a consistent sleep–wake pattern.

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Weblink
Animation on stimulus control therapy 2m 27s

BOX 10.9 Stimulus control therapy and conditioning principles

Stimulus control therapy originated from an analysis of sleep using operational and classical conditioning principles.

From an operant conditioning perspective, sleep is viewed as an instrumental act (i.e. an operant) intended to produce reinforcement (i.e., sleep). Stimuli associated with sleep become antecedents (discriminative stimuli) for the occurrence of reinforcement. Difficulty in falling asleep, or in returning to sleep after awakening, may be due to inadequate stimulus control.

The operant conditioning goals of stimulus control are to strengthen sleep-compatible associations with the bed and bedroom environment and to remove sleep incompatible ones; the classical conditioning goals are to break the association between the bedroom and insomnia.

The stimulus control instructions decrease the bed and bedroom as cues for arousal and re-establish the bed and bedroom as strong cues for sleep. They additionally promote a more regular circadian sleep–wake cycle (Sharma & Andrade, 2012).

Figure 10.29 Stimulus control therapy for insomnia was developed by American psychologist Richard Bootzin (1940–2014) to overcome the learned associations acquired by people with insomnia and to lead them to form new associations that suit sleep.

Sleep hygiene education

Sleep hygiene education is often used in conjunction with stimulus control therapy (and CBT) to assist the person with insomnia to change their sleep-related activities. **Sleep hygiene education** involves providing information about practices that tend to improve and maintain good sleep and full daytime alertness. The term *sleep hygiene* is often used interchangeably with *sleep habits* because it involves changing basic lifestyle habits that influence sleep onset, good quality sleep and alertness during the normal waking period (NSF, 2018k).

Like all types of hygiene, the sleep hygiene practices used by an individual can be appropriate and support good sleep or inappropriate and inhibit good sleep. Inappropriate practices may include irregular sleep onset and wake times, stimulating and alerting activities before bedtime, and consuming stimulants too close to sleep time. These do not necessarily cause sleep disturbance in all people. For example, an irregular bedtime or wake time that produces insomnia in one person may not be important in another. However, there is considerable research evidence that certain practices tend to be highly effective in the treatment of insomnia and helping people with insomnia to establish and maintain a regular sleep–wake pattern seven days a week.

Good sleep hygiene practices include the following:

- *Establish a regular relaxing sleep schedule and bedtime routine*. Maintain a regular sleep–wake schedule, particularly a regular wake-up time in the morning. Waking up late during weekends or days when you are off school or work can also disrupt the sleep–wake cycle. It is not possible to do the same thing every day, but it should be most days. Try to avoid emotionally upsetting conversations and activities before trying to sleep. Don't dwell on, or bring worries, concerns or problems to bed.
- *Associate your bed and bedroom with sleep*. It's not a good idea to use your bed to watch TV, make phone calls, listen to the radio, read or study. Such activities can not only inhibit sleep onset, but weaken the sleep and bed/bedroom association.
- *Avoid activities that are stimulating in the hour before bed.* This includes vigorous exercise, video games, television, movies and important discussions as they can be arousing and some inhibit melatonin (light emission).
- *When you cannot sleep get up.*
- *Avoid napping during the normal waking period.* It can disrupt the sleep–wake cycle, especially if they are longer than 20 to 30 minutes or occur close to the major sleep episode.
- *Avoid stimulants such as caffeine, nicotine and alcohol too close to bedtime.* While alcohol can speed up sleep onset, it can disrupt the second half of the sleep episode as the body begins to metabolise the alcohol, thereby causing arousal and making it harder to stay asleep. Other stimulants can delay sleep onset.
- *Exercise can promote good sleep.* Exercise regularly for at least 20 minutes during the day, preferably

more than four to five hours prior to bedtime if vigorous. A strenuous workout just before you go to bed will keep you awake for longer than normal because it creates arousal and should therefore be avoided. A relaxation technique such as progressive muscle relaxation or a relaxation exercise like yoga can be used before bed to help initiate sleep onset.

- *Food can be disruptive just before sleep*. Your digestive system also follows a biological rhythm. It is ready to digest food during the day, but not at night time. Stay away from large meals close to bedtime. Although it is important to not be hungry at bedtime, having a full stomach makes it difficult to sleep. The evening meal should be at least 2 hours before bedtime. Some people find that having a small snack at bedtime helps them to sleep better. Avoid foods that require more digestion time, such as red meat, raw vegetables, spicy foods and most take-away foods. Easy-to-digest foods include fish, poultry, cooked vegetables, soup and yoghurt.
- *Ensure adequate exposure to natural light*. Exposure to natural light helps maintain a normal sleep–wake cycle. (Bonnet & Arand, 2016; NSF, 2018k; SHF, 2018b)

Figure 10.30 Using devices, watching television or eating just before sleep time is not considered good sleep hygiene practice.

Bright light therapy

Interventions to treat circadian rhythm phase disorders aim to re-set the biological clock (SCN) regulating a person's sleep–wake cycle to align it with the sleep–wake schedule they desire or require. Given that light exposure can cause our biological clock to advance or delay, thereby affecting the phase ('timing') of our sleep–wake cycle, light can be used to re-set the biological clock and gradually shift someone's circadian sleep–wake cycle to a more appropriate or conventional schedule.

Bright light therapy, also called *phototherapy*, involves timed exposure of the eyes to intense but safe amounts of light. When used for circadian rhythm phase disorders, the aim is to shift an individual's sleep–wake cycle to a desired schedule, typically the day–night cycle of their physical environment. The light may be sunlight or artificial. In many places, sunlight is not available at the right intensity at the required time for the right amount of time to be used for therapeutic purposes. Artificial light is therefore used as an alternative as it can affect the biological clock in the same way that sunlight does.

Various types of lamps, visors and other devices have been devised for use in bright light therapy. A *light box* is the most commonly used device. The box houses fluorescent tubes that produce light of variable intensity. As shown in Figure 10.31 below, it sits on top of a table or desk and is portable. During a treatment session, which is usually self-administered at home, the individual has to keep within a certain distance of the box, usually about 30 centimetres from it. Generally, the light that is emitted is brighter than indoor light but not as bright as direct sunlight. There is no need to look directly into the light. Instead, the person may simply face in the direction of the box. It is therefore possible to do activities such as texting, reading, gaming or even eating during a light exposure session. The light will be reflected from surfaces and received by the eyes for transmission to the SCN, which will then influence melatonin secretion from the pineal gland.

Figure 10.31 An example of a light box designed for bright light therapy. A suitable device must be capable of producing light intensity of at least 2500 lux, with 10 000 lux generally considered 'bright light' for therapeutic purposes (lux is a unit of illumination intensity as perceived by the human eye). Indoor evening room light is usually less than 100 lux and a brightly lit office is typically less than 500 lux. Outdoor light is much brighter. For example, a cloudy grey winter day is around 4000 lux and a sunny day can be 50 000 to 100 000 lux or more (Westrin & Lam, 2007).

Bright light therapy requires a number of sessions across a number of days until the body adjusts to the new times. Exposure sessions can last from 15 minutes to two hours, once or twice a day, depending on the disorder, the required phase shift, the light intensity used, the equipment and the individual. Generally, the three important variables are to use the light at the right time of day at the right intensity for the right amount of time. The timing of the light exposure in particular is critical. There is a peak or optimal time for light exposure and the closer to the time an individual is exposed to light, the more effective the treatment is likely to be. The peak time can be determined by core body temperature.

The sleep–wake cycle shift is gradually changed. For example, bright light exposure might occur for 45 minutes each day for a week at times that are scheduled to get progressively earlier or later depending on the direction of the desired phase shift. Regular sleep patterns help to keep the biological clock set at the new time.

Circadian rhythm phase disorders for which bright light therapy may be used include the following.

Delayed sleep phase disorder: This causes people to feel sleepier much later at night than is desired and experience later sleep onset, as occurs with the sleep–wake cycle shift during adolescence. As a result, their waking time also shifts to later in the morning. This sleep pattern can interfere with their schedule of activities for the day.

To correct a persistent delayed sleep phase, light exposure generally takes place during the early morning hours (e.g. between 6–8 am) to help advance the circadian rhythm to an earlier time (i.e. shift the phase forward) so that the person will be sleepier earlier and wake up earlier.

Advanced sleep phase disorder: This causes people to feel sleepier much earlier at night than is normal, resulting in symptoms of sleepiness much earlier than desired, an early sleep onset and an awakening that is earlier than desired. Circadian rhythms of older people tend to be phase advanced when compared with those of younger people.

To correct a persistent advanced sleep phase, light exposure takes place early at night/in the evening to help delay the circadian rhythm to a later time (i.e. shift the phase backward) so that the person will be sleepier later and wake up later.

Shift work sleep disorder: This occurs due to a work schedule, such as night shift, that takes place during the time when the body wants to sleep. Therefore, the person has to try to sleep when their body expects to be awake.

In general, using light treatment in the evening can help someone who regularly works nights. In such cases, it is also best to avoid daylight between the end of the shift and sleep time. Dark sunglasses or special goggles can be worn to help. Correcting a shift work sleep disorder is particularly difficult because the required work schedules, days off and social activities can alter exposure to light from day to day. The instability of the sleep–wake cycle due to frequent changes in the sleep times makes it harder to re-set the biological clock.

Jet lag: Jet lag causes sleep problems and other symptoms when people rapidly cross many time zones on a flight. The timing of light exposure depends on the direction of travel and the number of time zones crossed. Generally, when travelling east, the sleep–wake cycle should be advanced, so light therapy in the morning at the destination may help after easterly travel. For travelling west, the sleep–wake cycle should be delayed, so bright light in the evening may help reduce jet lag.

Bright light therapy has been found to be effective for treating the various phase disorders, at least partially for many people. Many people have reported sufficient improvement that enables them to function reasonably well on their new schedule. It does not seem to produce any major side effects when used within the proper limits for intensity and time. Minor side effects may include eye irritation, headache, nausea and dryness of skin (AASM, 2014b; Dodson & Zee, 2010).

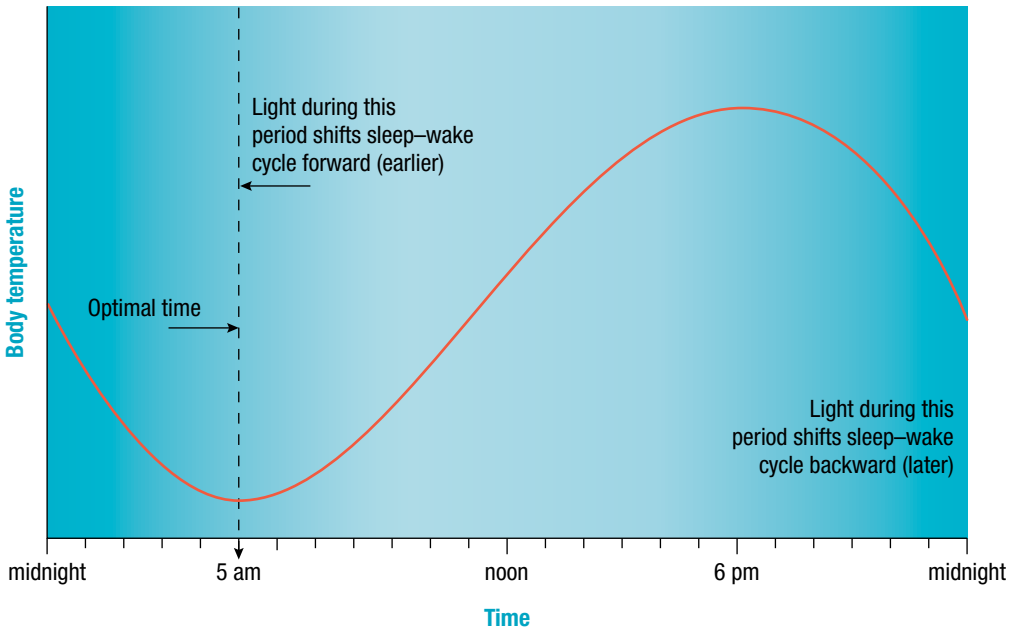

Figure 10.32 Normal circadian sleep–wake cycle with a waking time of 7 am. The timing of light exposure is crucial to bright light therapy. Optimal times for different circadian rhythm phase shifts can be determined by core body temperature (another circadian rhythm tied to the sleep–wake cycle).

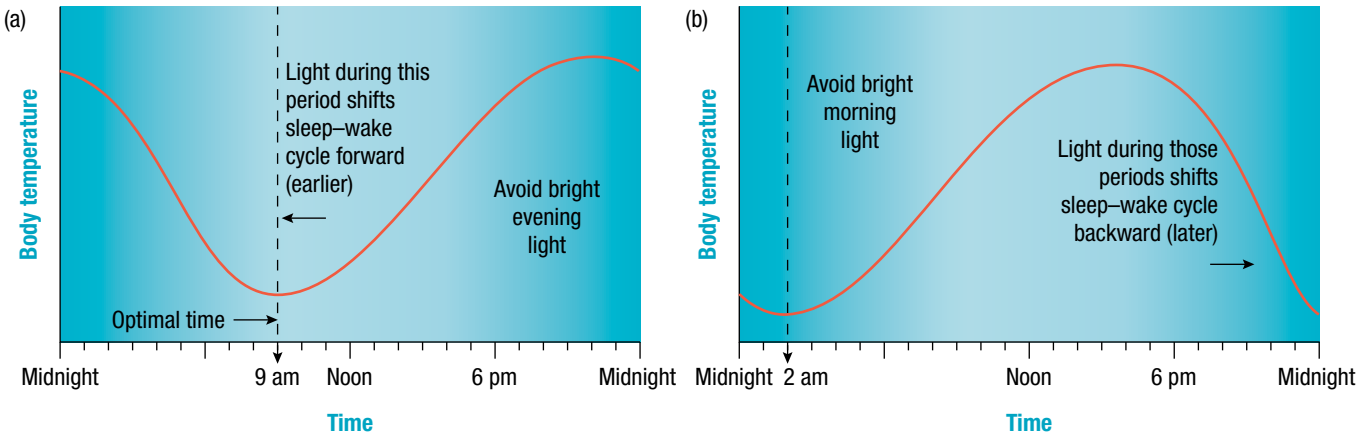

Figure 10.33 (a) Delayed circadian sleep–wake cycle with a waking time of 11 am or later (b) Advanced circadian sleep–wake cycle with a waking time of 4 am or earlier

LEARNING ACTIVITY 10.14

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Word copy of table

Review questions

1. (a) What is cognitive behavioural therapy?
(b) How would a CBT therapist most likely view the cause(s) of insomnia and factors maintaining its symptoms?
(c) List three examples of inappropriate cognitions and three examples of inappropriate behaviours that may contribute to the development or maintenance of insomnia.
(d) What would a CBT therapist prioritise for change when developing a treatment plan for insomnia?
(e) How might a CBT therapist achieve cognitive change in someone with insomnia?
(f) Name, describe and give relevant examples of two behavioural techniques that may be used in CBT for insomnia.
(g) (i) Using classical conditioning principles, explain how someone's bed and bedroom may become conditioned stimuli for anxiety associated with being unable to fall asleep. You may use a labelled diagram to illustrate the three phase process.
(ii) Explain how operant conditioning can maintain or strengthen sleep compatible associations with the bed and bedroom environment.
(h) Explain why CBT would be a preferred treatment method for insomnia rather than a circadian rhythm phase disorder.
(i) Explain how sleep hygiene education could be used as part of a treatment plan for the sleep–wake cycle shift in adolescence, with reference to three practices of specific relevance to the disorder.

2. (a) What is bright light therapy?
(b) What three aspects of light usage are crucial to its effective use?
(c) How does bright light therapy influence circadian phase change?
(d) Complete the table below to summarise use of bright light therapy as a therapeutic intervention for various circadian phase disorders.
(e) Under what circumstances would bright light therapy be a suitable intervention for insomnia?

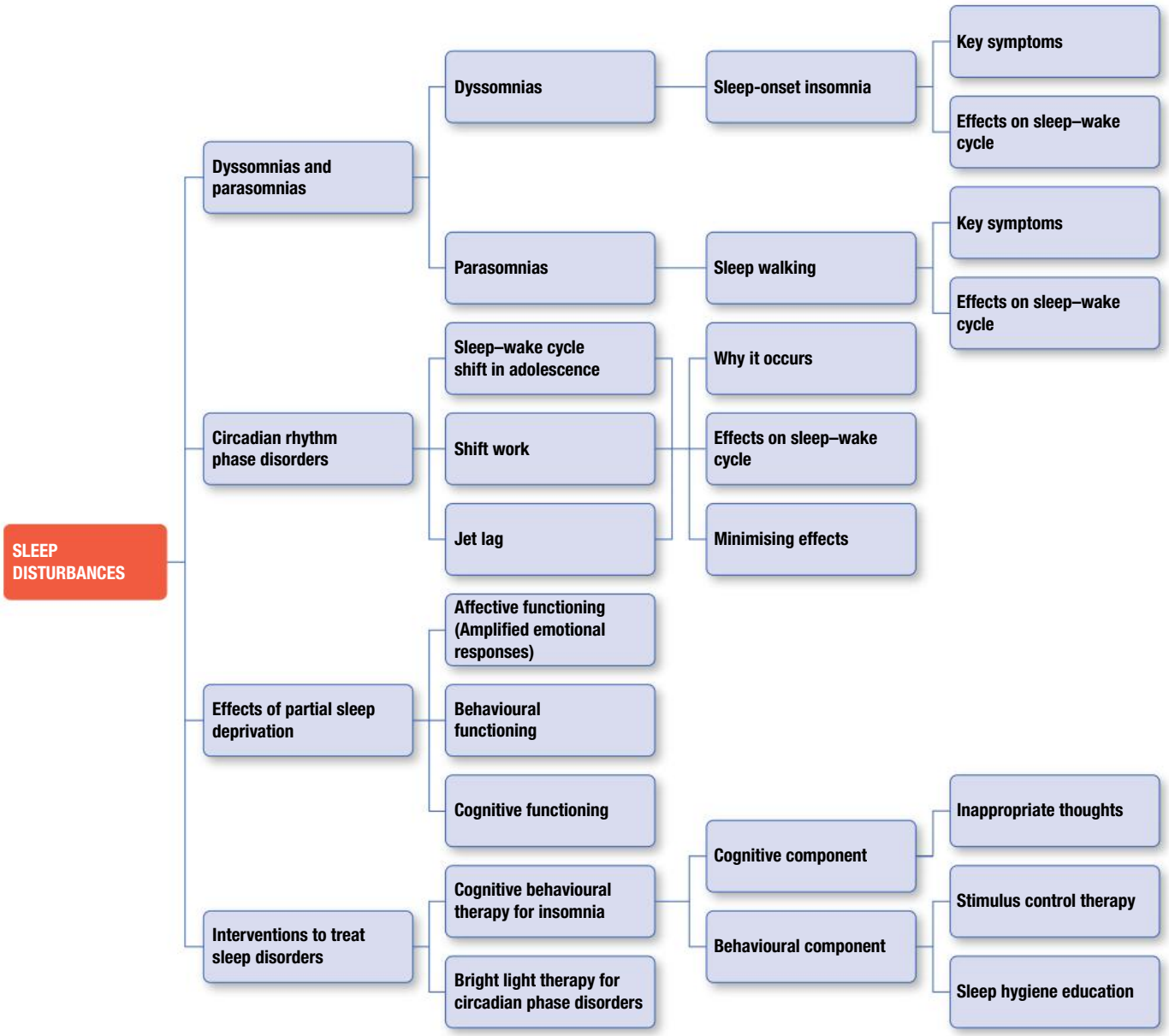
Circadian rhythm phase disorder	Example	Features of desynchronised phase shift	Timing of light exposure to re-shift sleep–wake cycle
Delayed sleep phase disorder			
Advanced sleep phase disorder			
Shift work disorder			
Time zone change syndrome (jet lag)			

LEARNING ACTIVITY 10.15

Reflection

To what extent does CBT for insomnia reflect the biopsychosocial model?

CHAPTER SUMMARY



KEY TERMS

advanced sleep phase p. 548
affective functioning p. 536
amplified emotional response p. 536
behavioural functioning p. 537
bright light therapy p. 547
circadian rhythm phase disorder p. 525
cognitive behavioural therapy p. 542
cognitive behavioural therapy for insomnia (CBT-I) p. 543
cognitive functioning p. 538
delayed sleep phase pp. 526, 548
dyssomnia p. 514
excessive sleepiness p. 538
fixed vs rotating shift schedule p. 529
insomnia p. 514
jet lag p. 532
microsleep p. 538
parasomnia p. 518
phase advance vs phase delay p. 534
primary vs secondary sleep disorder p. 512
sleep debt p. 526
sleep deprivation (partial vs total) p. 535
sleep disorder p. 512
sleep disturbance p. 512
sleep hygiene education p. 546
sleep inertia p. 537
sleep quality p. 535
sleep quantity p. 535
sleep walking p. 519
sleep-onset insomnia p. 515
sleep–wake cycle shift p. 526
somnambulism p. 519
stimulus control therapy p. 545

LEARNING CHECKLIST

Complete the self-assessment checklist below, using ticks and crosses to indicate your understanding of this chapter's key knowledge (a) before and (b) after you attempt the chapter test. Use the 'Comments' column to add notes about your understanding.

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Word copy of checklist

Key knowledge I need to know about sleep disturbances	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
Sleep disturbance vs sleep disorder			
Primary vs secondary disorder			
Dyssomnias and parasomnias			
Distinguishing symptoms			
Dyssomnias			
• Sleep-onset insomnia			
– Key symptoms			
– Effects on sleep–wake cycle			
Parasomnias			
• Sleep walking			
– Key symptoms			
– Effects on sleep–wake cycle			
Circadian rhythm phase disorders			
• Sleep–wake cycle shift in adolescence			
Why it occurs			
Effects on sleep–wake cycle			
Minimising effects			
• Shift work			
Why it occurs			
Effects on sleep-wake cycle			

(continued)

Key knowledge I need to know about sleep disturbances	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
Minimising effects			
• Jet lag (time zone change syndrome)			
Why it occurs			
Effects on sleep–wake cycle			
Minimising effects			
Effects of partial sleep deprivation			
Affective functioning (amplified emotional responses)			
Behavioural functioning			
Cognitive functioning			
Interventions to treat sleep disorders			
Cognitive behavioural therapy for insomnia (CBT-I)			
• Cognitive component (for inappropriate thoughts)			
• Behavioural component			
– Stimulus control therapy			
– Sleep hygiene education			
Bright light therapy for circadian phase disorders			

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Unit 4 > Area of study 1 > Topic 4

Concept screens and practice questions

CHAPTER 10 TEST

SECTION A — Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Question 1

Sleep walking is most likely to take place within _____ hours of falling asleep.

A. 1–2
B. 3–4
C. 5–5
D. 7–8

Question 2

Impairments of daily functioning associated with partial sleep deprivation are best explained in terms of

A. proportions of REM and NREM sleep.
B. external cues in the environment.
C. biologically induced hormones.
D. accrued sleep debt.

Question 3

The most common behavioural effect of sleep deprivation is

A. sleeplessness.
B. restlessness.
C. excessive sleepiness.
D. emotional reactivity.

Question 4

Shift work sleep disorder is more likely to occur if a person regularly works a roster that

A. is fixed for ongoing night shift work.
B. rotates quickly from one shift type to another.
C. rotates slowly from one shift type to another.
D. rotates every week rather than every three days.

Question 5

Which of the following is best described as a circadian rhythm phase disorder?

A. jet lag
B. insomnia
C. excessive sleepiness
D. excessive sleeplessness

Question 6

Which of the following would be best classified as a sleep disorder involving arousal from NREM sleep?

A. jet lag
B. sleep walking
C. excessive sleeping
D. sleep-onset insomnia

Question 7

A sleep disorder that is associated with inappropriate activation of the central and/or autonomic nervous systems during sleep is best described as a

A. dyssomnia.
B. parasomnia.
C. sleep disturbance.
D. circadian rhythm phase disorder.

Question 8

Which of the following statements about sleep deprivation is correct?

A. Sleep deprivation has no psychological effects.
B. Sleep deprivation has lasting physiological effects.
C. Sleep deprivation temporarily affects performance on cognitive tasks.
D. The effects of sleep deprivation disappear only after the individual has slept for the same amount of time they were sleep deprived.

Question 9

Sleep inertia is most likely to be experienced during

A. awakening.
B. sleep onset.
C. REM sleep.
D. NREM sleep.

Question 10

Circadian rhythm phase disorders are best described as disturbances primarily involving

A. shift work.
B. difficulty initiating or maintaining sleep.
C. unwanted physical movements or actions during sleep.
D. a sleep pattern that is misaligned with lifestyle demands and social expectations.

SECTION B

Answer **all** questions in the spaces provided. Write using blue or black pen.

Question 1 (3 marks)

(a) A sleep walker is likely to have a _____ arousal threshold. 1 mark

(b) Explain why it is unlikely that a sleep walker would be acting out a dream. 2 marks

Question 2 (2 marks)

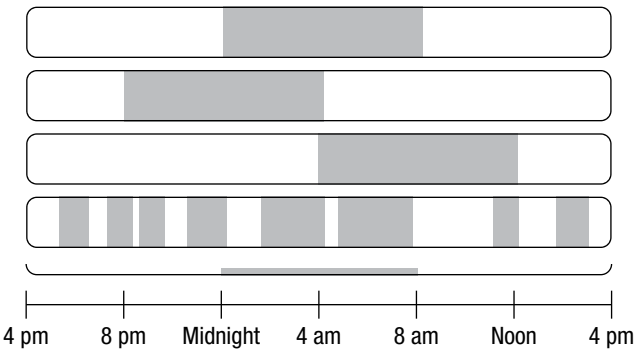
Describe two distinguishing characteristics of a microsleep.

Question 3 (2 marks)

Explain the distinction between dyssomnias and parasomnias.

Question 4 (2 marks)

The chart below shows four different sleep-wake cycles.



Label the graphs showing:

(a) delayed sleep phase disorder _____ 1 mark

(b) advanced sleep phase disorder. _____ 1 mark

Question 5 (5 marks)

(a) What is jet lag? 1 mark

(b) AFL teams based on the west coast of Australia regularly travel by jet for up to five or more hours to compete with teams on the east coast of Australia. Explain whether these west coast teams are likely to be affected by jet lag on arrival at their destination. Ensure you refer to the conditions when jet lag is most likely to occur. 4 marks

Question 6 (4 marks)

(a) Explain the meaning of sleep hygiene. 2 marks

(b) Describe a sleep hygiene practice that could contribute to the development of each of the following disorders.

(i) sleep-onset insomnia 1 mark

(ii) a circadian rhythm phase disorder 1 mark

Question 7 (4 marks)

(a) Define sleep deprivation as commonly used in the study of sleep. 1 mark

(b) Explain the meaning of amplified emotional responses in relation to sleep deprivation. 1 mark

(c) What are two factors that can influence the speed of recovery from sleep deprivation? 2 marks

Question 8 (8 marks)

(a) Define sleep-onset insomnia with reference to three symptoms. 3 marks

(b) Explain how someone with sleep-onset insomnia could develop a circadian rhythm phase disorder and name the probable type of phase disorder. 2 marks

(c) What would cognitive behavioural therapy for insomnia primarily target for change? 1 mark

(d) What would be two goals of stimulus control therapy for insomnia? 2 marks

Question 9 (7 marks)

(a) Explain how shift work can disrupt a person's sleep–wake cycle and make them susceptible to a circadian rhythm phase disorder. 2 marks

(b) Give an example of a change to sleep timing, quantity and quality that may be caused by shift work. 3 marks

sleep timing:

sleep quantity:

sleep quality:

(c) Give an example of how a shift worker may be able to readjust or compensate for a sleep–wake cycle shift and explain why this practice would be effective. 2 marks

Question 10 (14 marks)

An experiment to investigate treatment of insomnia with melatonin used 12-year-old children as participants, all of whom had persistently experienced sleep-onset insomnia for more than 12 months.

Each child was randomly allocated to one of two groups. The experimental group took a pill containing 5 mg of melatonin each night throughout a four-week period. The control group was given a placebo throughout the same period of time.

In this experiment, neither the research assistants who distributed the medication nor the participants were aware of the treatment allocation — that is, which participants received the melatonin pill and which participants received the placebo.

The results showed that children treated with melatonin slept significantly better in relation to sleep quantity and quality, and had improved health during the period of treatment compared with children not treated with melatonin over the same period.

The researchers concluded that children with insomnia may be helped by melatonin treatment, at least in the short term. The long-term effects of melatonin use for insomnia would be a target of future research.

(a) Suggest a research hypothesis for the experiment that would be supported by the results obtained. 2 marks

(b) Name the experimental design. 1 mark

(c) Identify the experimental and control conditions. 2 marks

(d) Identify the operationalised independent and dependent variables. 2 marks

(e) Why was random allocation used? 1 mark

(f) Why was a placebo used in the control condition? 1 mark

(g) Explain whether a single- or double-blind procedure was used and why it was used. 2 marks

(h) Explain two ethical issues that are of relevance to this particular experiment. 2 marks

(i) Explain a potential limitation of the experiment. 1 mark

Question 11 (9 marks)

Noah is approaching adolescence and even keener to assert his individuality and independence. He goes to bed and sleep at different times during the week, and these times vary even more on weekends when he can sleep in as much as wants to. Noah believes that it doesn't matter if he stays up late to study or socialise on Friday or Saturday night because he can sleep in as late as he wants the following day.

(a) Explain why it is important for Noah to maintain a regular sleep–wake schedule even on weekends if he wants to limit or avoid a sleep–wake cycle shift. 2 marks

(b) What is bright light therapy? 1 mark

(c) What three features of light usage are crucial to its effectiveness? 3 marks

(d) Explain how bright light therapy could influence a re-shift of circadian phase change during adolescence. 3 marks

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The answers to the Section A multiple-choice questions are in the answer section at the end of this book and in eBookPLUS. The answers to the Section B questions are in eBookPLUS.

11 MENTAL HEALTH

KEY KNOWLEDGE

- mental health as a continuum (mentally healthy, mental health problems, mental disorders) influenced by internal and external factors that can fluctuate over time
- the typical characteristics of a mentally healthy person, including high levels of functioning, social and emotional well-being and resilience to life stressors
- ethical implications in the study of, and research into, mental health, including informed consent and use of placebo treatments.

Source: ©VCAA, VCE Psychology Study Design (June 2017 update), p. 30.

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There are many definitions of mental health, and they typically refer to a state of well-being, often emphasising emotional and social well-being. The most commonly used definitions in psychology are variations of the World Health Organization [WHO] 2018 definition which views **mental health** as 'a state of wellbeing in which an individual realises his or her own abilities, can cope with the normal stresses of life, can work productively and is able to make a contribution to his or her community'.

According to this definition, good mental health is a positive and productive state. The individual has a sense of wellbeing, confidence in their abilities and therefore good self-esteem. It enables them to fully enjoy and appreciate other people, day-to-day life and their environment in general.

A person in good mental health can:

- make the most of their potential
- cope with the challenges of everyday life
- play a full part in their family, school, workplace, and community and when among friends.

The WHO definition also reflects a shift from viewing mental health in terms of the presence or absence of symptoms of a mental illness or disorder to an emphasis on what it means to be in good mental health and what we can each do as individuals to foster our own mental wellbeing.

Psychologists view mental health as just as important as physical health, and a vital part of overall health and wellbeing. It is also recognised that our mental health doesn't always stay the same. It can vary over time as circumstances change and as we move through different stages of our life.

In this chapter we examine what it means to be mentally healthy, factors that influence our mental wellbeing and ethical issues of particular relevance to the study of, and research into, mental health.

Figure 11.1 Good mental health is a positive and productive state of wellbeing.

MENTAL HEALTH AS A CONTINUUM

Mentally healthy means being in a generally positive state of mental wellbeing, having the ability to cope with and manage life's challenges, working productively, striving to fulfil one's goals and potential, and having a sense of connection to others and the community in general. It is a desirable quality in its own right and is more than the absence of mental ill-health (WHO, 2018a).

Good mental health does not mean we do not have times of sadness, anger or anxiety. Good mental health is reflected in how well we deal with the positive and negative emotions associated with the various stressors and other events in our lives. For example, a mentally healthy student who is preparing to do an end-of-year exam may feel anxious and be grumpy or short-tempered. However, they will probably still be able to eat, study, sleep, remember what to take to the exam, hold a conversation with friends and laugh when something funny happens.

Mental health is not considered in an arbitrary way as something we either have or do not have. Instead, we may be more or less mentally healthy (or not healthy). Therefore, mental health is often represented as a continuum of mental wellbeing. As shown in the examples in Figure 11.2 below the continuum may range from *mentally healthy*, when we are feeling positive and functioning well in everyday life, through to a *mental health problem* that interferes with functioning but is relatively moderate in severity and tends to be temporary, to a diagnosable *mental disorder* that tends to be more serious, longer-lasting and may require treatment. Although degree of severity is shown to increase from left to right and lines are used, there are no absolute or clear-cut dividing lines between different points along the continuum. Similarly, mentally healthy and mental disorder are represented at different ends of the continuum, but this does not mean that they are entirely separate, can be compartmentalised, or that a continuum cannot extend beyond the end points used in the top example in Figure 11.2.

The location of an individual's mental health on the continuum is also unstable. This means that it is not fixed because it may vary or fluctuate over time depending on circumstances. An interplay of internal and external factors combine to influence our mental health at different points in time. For example, the mapping of an individual's mental health on the continuum may shift from the left to right side following exposure to a stressor, then back to the left side when the stressor passes or following intervention such as use of a coping strategy. In addition, an individual's mental health may have many different possible values on a continuum if its different elements were mapped separately.

A **mental health problem** adversely affects the way a person thinks, feels and/or behaves, but typically to a lesser extent and of a shorter duration than a mental disorder. Nor does it meet the criteria for diagnosis of a mental disorder. Experiencing a mental health problem is sometimes referred to as a 'rough patch', a 'low point' or 'the blues'. This does not necessarily mean that the problem is trivial or that it doesn't cause distress or impair functioning to some degree. Examples of mental health problems include the sadness and despair associated with loss or grief, and symptoms associated with stress.

Mental health problems can cause a range of personal difficulties such as worry, irritability, inability to concentrate for as long as usual, reduced motivation, social withdrawal, and changes in appetite and sleep pattern. Over the course of a

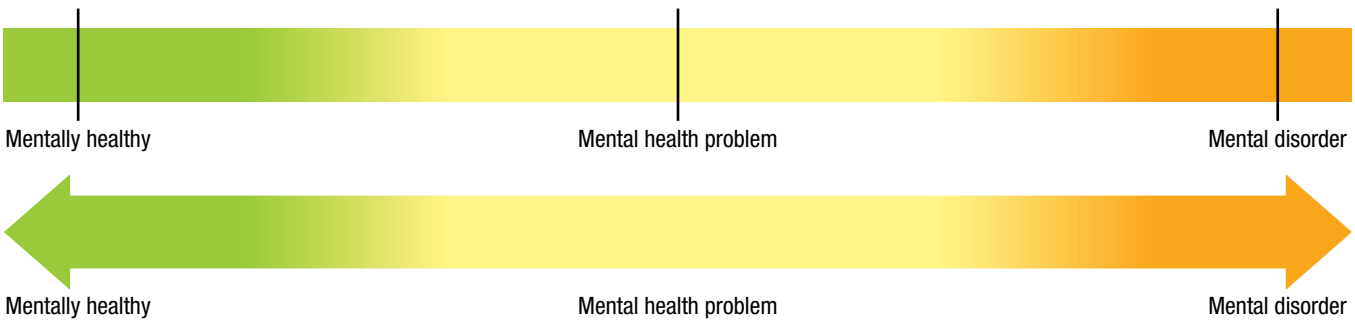

Figure 11.2 Mental health may be represented as a single continuum of mental wellbeing. Although degree of severity is shown from left to right and lines are used, there are no clear-cut dividing lines between different points along the continuum, nor end points. Some psychologists prefer to show a mental wellbeing continuum without a 'border' at either end, instead using arrowheads. Some prefer two continuums as in Figure 11.3 on the next page.

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Animation on mental health continuum 2m 17s

person's lifetime, every individual will most likely experience mental health problems like these at some time. Usually, they are normal, short-term reactions that occur in response to difficult situations such as school- or work-related stressors, conflict in relationships, loss of a significant relationship, a change in living arrangements and so on. However, symptoms will typically resolve with time or when the source of the problem changes or passes. We can get over them or learn to live with them. However, if a mental health problem persists or increases in severity it may develop into a mental disorder (Everymind, 2018).

A **mental disorder**, also called *mental illness*, involves a combination of thoughts, feelings and/or behaviours which are usually associated with significant personal distress and impair the ability to function effectively in everyday life. The term is most commonly used in relation to a clinically diagnosable disorder involving mental health, such as schizophrenia, major depressive disorder (commonly called depression) or an anxiety disorder (American Psychiatric Association [APA] 2013; Mental Health Foundation of Australia (Victoria), 2016; WHO, 2018b).

There is a wide range of mental disorders, each with its own set of symptoms. As shown in Table 11.2, they are typically organised in categories such as mood disorders, psychotic disorders and personality disorders based on common experiences by people with the disorder. Each disorder is diagnosed according to standardised criteria that have been derived through research.

The essential characteristics of a mental disorder are:

- the disorder occurs within the individual and results from dysfunction within the individual
- there is clinically diagnosable dysfunction in thoughts, feelings and/or behaviour e.g. low levels of functioning, social and emotional wellbeing
- causes significant personal distress or disability in functioning in everyday life
- actions and reactions are atypical ('not typical') of the person and inappropriate within their culture
- the disorder is not a result of a personal conflict with society (APA, 2013).

Each of these characteristics captures a part of what a mental disorder is. All must be evident for a mental disorder to be diagnosed, but diagnosis of a disorder does not necessarily mean that there is a need for treatment. To the mental health professional, the need for treatment is an issue that is separate from diagnosis and takes into consideration a range of other factors such as the severity of the symptoms, the level of distress experienced by the individual, resilience to life stressors, social and emotional wellbeing, the types and levels of impairment to daily functioning, the risk of self-harm, and the risks and benefits of possible treatments (APA, 2013). Overall, however, a mental disorder usually lasts longer than a mental health problem and causes more distress and disruption to a person's life.

As with mental health problems, mental disorders differ in severity and involve variable amounts of impairment and distress to the individual. It is also possible for a person to feel 'mentally ill' even though a mental health professional or doctor cannot find evidence of any known disorder.

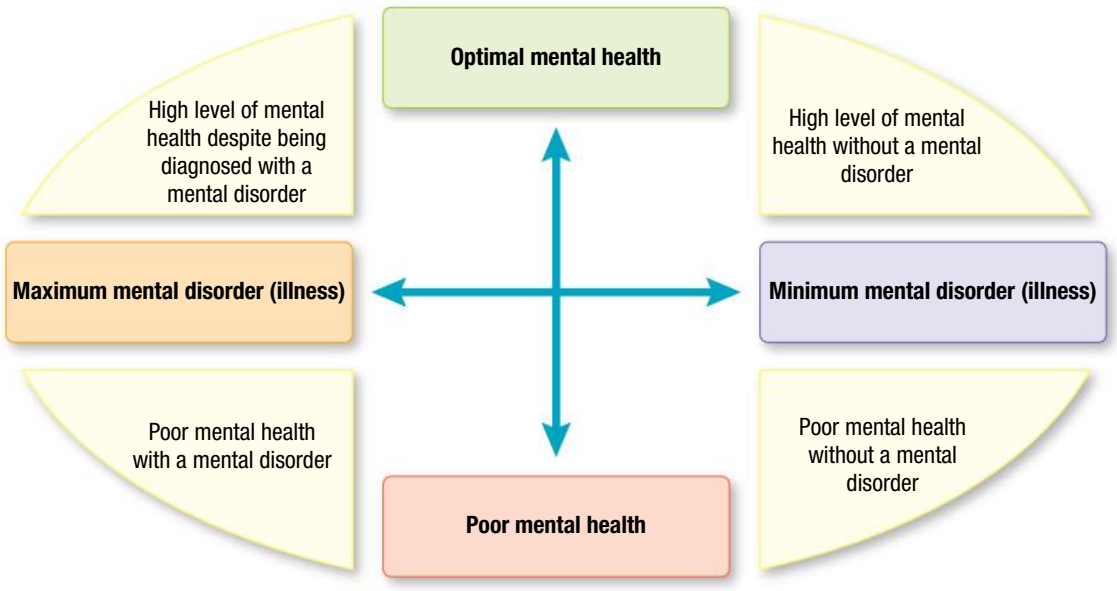

Figure 11.3 An example of a *two continua model* of mental wellbeing. This model is designed to avoid representing mental health and mental disorder (illness) at opposite ends of a single continuum. Instead, mental health and mental disorder (illness) are depicted on two separate continuums. The model also emphasises that mental health is not simply the absence of mental disorder (illness). For example, people diagnosed with a mental disorder can still have a high level of general mental wellbeing, while those without a diagnosed mental disorder can show a low level of mental wellbeing.

TABLE 11.1 Characteristics of being mentally healthy, having a mental health problem or a mental disorder

Mentally healthy	Mental health problem	Mental disorder
People who are mentally healthy usually can: • function at a higher level than people who have a mental health problem or disorder • use their abilities to reach their potential • cope with and manage life's challenges, including change, uncertainty and challenges that are stressors (e.g. a good level of resilience) • work productively at school and in employment • contribute constructively to their community • form and maintain good relationships with other people (i.e. good social wellbeing) • feel, express and manage a range of positive and negative emotions (i.e. good emotional wellbeing) • learn from their experiences • think logically and clearly • enjoy and appreciate other people, day-to-day life and their environment.	People with a mental health problem may: • feel worried, tense, low, irritable, quiet, confused, angry (often in response to a stressor) • feel sadness or despair associated with loss or grief • have difficulties concentrating, making decisions and thinking clearly • become forgetful • experience changes in sleep and appetite • experience a loss of energy and motivation • feel that things are somehow 'different' • socially withdraw • develop negative feelings or attitudes to themselves, school or work, and life in general.	People are diagnosed with a specific type of mental health disorder such as: • anxiety disorder e.g. a phobia, panic disorder, separation anxiety disorder • obsessive compulsive disorder • mood disorder e.g. depression, bipolar disorder • psychotic disorder e.g. schizophrenia, delusional disorder • personality disorder e.g. antisocial personality disorder, narcissistic personality disorder • neurodevelopmental disorder e.g. an intellectual disability, autism spectrum disorders • feeding and eating disorders • substance-related and addictive disorders.

TABLE 11.2 Examples of mental disorders

Category	Description
Anxiety disorders	Include *phobias*, *panic attack*, *panic disorder*, *separation anxiety disorder* and *substance/medication-induced anxiety disorder*.
Neurodevelopmental disorders	Include *Autism spectrum disorders*, *Attention-Deficit/Hyperactivity Disorder* (ADHD), *intellectual disability* (with onset early in development) and various learning and motor disorders that first present early in the lifespan.
Neurocognitive disorders	Include disorders involving major or minor impairment to cognitive functioning, such as those due to *Alzheimer's disease*, *Parkinson's disease*, *Korsakoff's syndrome*, *traumatic brain injury* and *delirium*.
Substance-related and addictive disorders	Include *alcohol-related disorders*, *cannabis-related disorders*, *hallucinogen-related disorders*, *stimulant-related disorders* and *gambling disorder*.
Schizophrenia spectrum and other psychotic disorders	Common symptoms include delusions, hallucinations and disorganised thinking.
Depressive disorders	Characterised by severe lowering of mood for an extended period of time. Include *major depressive disorder* and *premenstrual dysphoric disorder*.
Bipolar and related disorders	Characterised by severe disturbances of mood involving alternating episodes of mania (e.g. elation, high energy and activity) and depression (e.g. sadness, low energy and activity).
Obsessive–compulsive and related disorders	Characterised by recurring thoughts and/or impulses that are difficult to control. Include *obsessive–compulsive disorder*, *hoarding disorder*, *trichotillomania (hair-pulling disorder)* and *excoriation (skin-picking) disorder*.
Feeding and eating disorders	Include avoidant and restrictive food intake of infancy and early childhood, and serious eating disorders more common in adolescence such as *anorexia nervosa*, *bulimia nervosa* and *binge-eating disorder*.
Sleep–wake disorders	Characterised by persistent sleep related disturbances. Include *insomnia*, *circadian rhythm phase disorders*, *narcolepsy*, *substance/medication-induced sleep disorder* and breathing related sleep disorders such as *sleep apnea.*
Disruptive, impulse-control and conduct disorders	Characterised by problems in behavioural and emotional self-control. Include *kleptomania*, *pyromania* and *intermittent explosive disorder* (e.g. aggressive outbursts).
Personality disorders	Include *general personality disorder*, *narcissistic personality disorder*, *antisocial personality disorder* and *dependent personality disorder*.

Source: American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, Virginia: Author.

MENTAL HEALTH AS A PRODUCT OF INTERNAL AND EXTERNAL FACTORS

Our mental health is influenced by a wide variety of internal and external factors throughout our lifespan that can fluctuate over time.

Internal factors are influences that originate inside or within a person. These can be organised as biological and psychological factors. *Biological factors* involve physiologically based or determined influences, often not under our control, such as the genes we inherit, whether we are male or female, balances or imbalances in specific neurotransmitters, substance use, our physiological response to medication, brain and nervous system functioning, hormonal activities and fight–flight–freeze and other bodily responses to stress. *Psychological factors* involve all those influences associated with mental processes such as our ways of thinking, beliefs, attitudes, our skills in interacting with others, prior learning, perceptions of ourselves, others and our external environment, how we learn, make decisions, solve problems, understand and experience emotions, respond to and manage stress, and reconstruct memories.

External factors are influences that originate outside a person. These can include school- and work-related factors, the range and quality of our interpersonal relationships, the amount and type of support available from others when needed, exposure to stressors, level of education, employment history, level of income, housing, risks of violence, access to health care and other community resources, exposure to social stigma, and specific cultural influences such as our values and traditions.

Internal and external factors affect and are affected by one another. For example, internal factors may combine with other internal factors as well as external factors to influence a person's mental health. This complex interaction of multiple factors helps account for individual differences in

Figure 11.4 Biological, psychological and social factors interact to influence mental health.

mental health, as well as the onset or experience of mental health problems and disorders. For example, depression could be explained by the combined effects of genes and brain chemistry (biological), negative ways of thinking and prior learning experiences (psychological) and the death of a loved one (social). However, it is recognised that specific factors may have more or less influence on an individual's mental health at a given time and put the individual at more or less risk of having good mental health or developing a mental disorder. For example, being rejected by a boyfriend or girlfriend on its own may not cause depression, but if it occurs at a time when the person has also been made redundant from their job, the combination of these two factors at that point in that person's life may be enough to precipitate the onset of depression.

In contemporary psychology, internal and external factors tend to be organised within a framework called the biopsychosocial model. As shown in Figure 11.4, the *biopsychosocial model* is a way of describing and explaining how biological, psychological and social factors combine and interact to influence a person's mental health. The model is based on the idea that mental health is best understood by considering specific factors from within each domain (areas) and how these factors may combine and interact to influence our wellbeing (WHO, 2018a).

The biopsychosocial model reflects a *holistic* view of mental health — the individual is considered as a 'whole person' functioning in their unique environment. The focus is not just on the individual's mental condition ('within the individual'), but also on their wider social setting and circumstances ('outside the individual'). In addition, focusing on the influence of factors from one or two domains, rather than all three, is likely to give an incomplete and therefore inaccurate picture of a person's mental health. This also applies to a mental health problem or mental disorder an individual may have and the treatment that may be required.

LEARNING ACTIVITY 11.1

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Review questions

1. (a) What is a mental health continuum?
(b) List three considerations when mapping or interpreting the location of an individual's mental health on a continuum.

2. Complete the following table to distinguish between mentally healthy, mental health problem and mental disorder.

Mental health state	Definition	Examples of characteristics associated with the state	Distinguishing characteristics when compared with other states
mentally healthy			
mental health problem			
mental disorder			

3. For each of the following four cases, suggest whether the person is mentally healthy, has a mental health problem or has a mental disorder, and give a reason for your answer.
(a) Samina is 29 years old. She has been working as a salesperson in a toy shop but has found this increasingly difficult to manage due to feelings of extreme lethargy and tearfulness. Samina used to really enjoy working at the toy shop but it now doesn't bring her any enjoyment at all. Last week, it all got too much and Samina quit her job. Since then, she hasn't left the house where she now spends most of her time crying, watching TV and sleeping. She hasn't eaten much either.
(b) Harriet is 21 years old and completing her first year of a law degree at university. Recently, she has been experiencing a loss of energy and motivation and has been going out less with her friends than usual. Harriet is also feeling confused and questioning whether she wants to continue to study law at all or whether it was a mistake and she should have chosen something less demanding. She has decided to continue to go to her classes while she makes her decision.
(c) Xavier is 17 years old and just finishing Year 11. He has two more exams to go. He's quite irritable, but he's able to concentrate well, do his revision, he's still sleeping and eating well and catching up with his male friends and girlfriend.
(d) Simon is 46 years old. He's in charge of a major project at work at the moment and is feeling very worried and stressed about meeting the deadlines. He's having difficulties concentrating, making decisions and thinking clearly. This morning he left his laptop on the train coming in to work. Simon is also feeling really tired right now, but despite feeling so tired he still finds it hard to get to sleep at night.

(continued)

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4. (a) What is the essential difference between internal and external factors that can influence mental health?
(b) Give two examples of internal factors that can influence mental health.
(c) Give two examples of external factors that can influence mental health.

5. (a) What is the biopsychosocial model?
(b) Name and describe the three domains in the biopsychosocial model with reference to relevant examples.
(c) For each domain, give two additional examples of factors not referred to in the text.
(d) Briefly describe three key characteristics of the biopsychosocial model's explanation of mental health.
(e) Write a series of questions that a psychologist who has adopted the biopsychosocial model might ask a patient or client presenting with symptoms of a mental disorder.

6. Read the case of Michael below and identify the biological, psychological and social factors contributing to his mental disorder.

> *Michael is a 26-year-old male who has been diagnosed as having schizophrenia. He finished year 10 at school before completing a bakery apprenticeship in the regional town where he grew up. At age 20 he moved to Melbourne to get work but struggled to establish friendships and was not happy despite enjoying his work. He was diagnosed with a psychotic episode at 21, when he was experiencing auditory hallucinations and delusional beliefs. He has a first cousin who was diagnosed with schizophrenia, and his grandfather committed suicide in his mid-twenties. Michael has had difficulties coping with stress and used cannabis in his later teens to avoid dealing with issues and to 'chill out'. His family connected him to a mental health support service after his supervisor noticed odd behaviours and deterioration in his previously good work habits.*
>
> *Michael has had to be hospitalised three times due to his symptoms but has not been to hospital for two years. He generally experiences few symptoms, and takes antipsychotic medication regularly. He currently works as a baker but reports recent trouble with his supervisor. He broke up with his girlfriend last month. Michael has had increased auditory hallucinations and hasn't slept for two nights.*

Source: Mental Illness Fellowship of Australia (2015). Retrieved March 1, 2015 from http://www.mhpod.gov.au/assets/sample_topics/combined/Biopsychosocial_factors/biopsychosocial_objective1/biopsychosocial_obj1_activity1/index.html

LEARNING ACTIVITY 11.2

Reflection

Comment on whether a single continuum (as shown in Figure 11.2) is an appropriate way of representing mental health and whether there may be an alternative, more appropriate way. For example, consider the two continua model in Figure 11.3.

TYPICAL CHARACTERISTICS OF A MENTALLY HEALTHY PERSON

Multiple biological, psychological and social factors determine the level of mental health of a person at any point of time (WHO, 2018a). There are, however, some characteristics that mentally healthy people tend to have in common. These include high levels of functioning, social and emotional wellbeing and resilience to life stressors.

High level of functioning

In relation to mental health, the term **functioning** generally refers to how well an individual independently performs or operates in their environment. It is most evident in observable behaviour when meeting the ordinary demands of everyday life. This includes underlying cognitions and emotions as they are considered critical to daily functioning.

A person's functioning may vary in a number of ways. It is commonly described as varying in level and can be represented on a continuum like mental health. As shown in Figure 11.6, functioning may range from a high level (e.g. superior functioning, functioning competently or very well) at one extreme through a moderate level of function to a low level (e.g. poor or impaired functioning) at the other extreme.

Level of functioning tends to correspond with how well or adaptively a person is meeting the challenges of living across a range of domains or areas such as the following:

- *interpersonal relationships* e.g. ability to interact with and get along with other people (such as family, friends, peers/colleagues, online contacts, neighbours, unknown people in the community)
- *school and work/occupational settings* e.g. productive and achieving goals

- *leisure/recreational activities* e.g. participation in extracurricular activities at school, hobbies/interests/structured or unstructured activities in 'free' time outside school/work, engagement in sports or community activities
- *daily living skills* e.g. participation in self-care and independent living activities such as personal hygiene, dressing, eating, remembering to take any prescribed medications, fulfilling household responsibilities, management of personal resources, ability to access private and public transportation and travel/commute safely
- *cognitive skills* e.g. learning and applying knowledge, understanding and communicating, logical and clear thinking, planning and decision-making
- *emotions* e.g. self-regulation of a range of emotions, dealing with positive and negative emotions, keeping effects of daily worries, hassles and other stressors under control.

Figure 11.5 Level of functioning tends to correspond with how well or adaptively a person is meeting the challenges of everyday life.

Mentally healthy people typically have a high level of functioning in most of the above domains. They are able to cope effectively with living independently in everyday life and in meeting the challenges of living. They tend to actively engage and cooperate with others, develop and maintain warm and trusting relationships, get involved in a range of activities inside and outside of the home, have a balance of work, rest and recreation in their life, a desire for activity and are positive, flexible and productive in how they approach challenges and what they do. They are emotionally stable and tend to deal with transient (temporary) difficulties and everyday worries and stressors effectively. They also tend to see themselves as developing into better people, have a direction in life, feel they belong to and are accepted by their communities, seek to develop, belong and contribute to society in meaningful ways, and have a degree of self-determination (Keyes, 2002; WHO, 2010).

The behaviour of someone with a high level of functioning is primarily adaptive. *Adaptive behaviour* involves actions that enable a person to effectively carry out their usual everyday tasks, such as in the domains described previously. Basically, the individual is able to 'adapt' to the demands of daily living and do so relatively independently. In contrast, *maladaptive behaviour* interferes with the person's ability to carry out their usual activities in an effective way. Maladaptive behaviour is sometimes called *dysfunctional* behaviour because it disrupts or impairs everyday functioning. There is a reduced ability to do the things one normally does each day.

Maladaptive behaviour is commonly associated with a low level of functioning. Similarly, mental disorders typically involve a significant impairment in one or more areas of everyday functioning and are therefore associated with a low level of functioning in one or more areas. For example, schizophrenia and depression often significantly affect a person's ability in each of the domains described above, such as socially connecting with others, attending to self-care and daily living tasks, and engaging in school, work and leisure activities (Roeling, 2010).

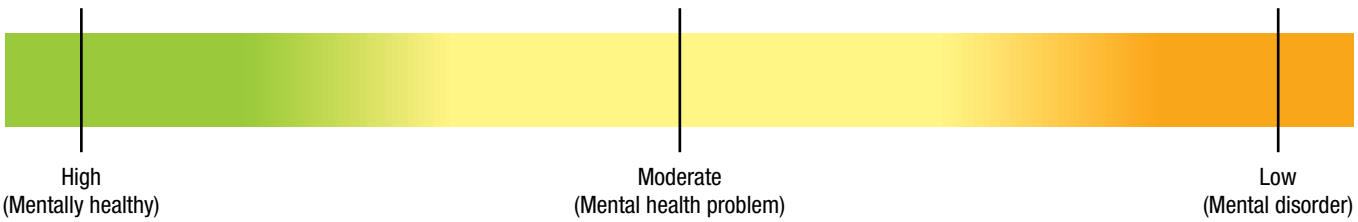

Figure 11.6 A continuum of functioning. Mentally healthy people tend to have a high level of functioning.

BOX 11.1 World Health Organization Disability Assessment Schedule 2.0

The *World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0)* is a questionnaire designed to measure level of functioning in adults aged 18 and older. Level of functioning is assessed in relation to the following six domains.

- *Self-care* e.g. ability to attend to personal hygiene, dressing and eating, and to live alone
- *Getting along* e.g. ability to interact with other people
- *Life activities* e.g. household responsibilities, leisure, school and work
- *Participation in society* e.g. engaging in community activities
- *Cognition* e.g. understanding and communicating
- *Mobility* e.g. ability to get around

Individuals are asked to answer a number of questions in each domain, rating how much difficulty they had doing various activities using a 5-point scale. For example:

In the past 30 days, how much difficulty did you have in:					
maintaining a friendship?	*None*	*Mild*	*Moderate*	*Severe*	*Extreme/ Cannot do*
getting out of your home?	*None*	*Mild*	*Moderate*	*Severe*	*Extreme/ Cannot do*
joining in community activities (e.g. church) in the same way as anyone else can?	*None*	*Mild*	*Moderate*	*Severe*	*Extreme/ Cannot do*
starting and maintaining a conversation?	*None*	*Mild*	*Moderate*	*Severe*	*Extreme/ Cannot do*
getting all the work done that you needed to do?	*None*	*Mild*	*Moderate*	*Severe*	*Extreme/ Cannot do*
getting dressed?	*None*	*Mild*	*Moderate*	*Severe*	*Extreme/ Cannot do*
concentrating on doing something for 10 minutes?	*None*	*Mild*	*Moderate*	*Severe*	*Extreme/ Cannot do*
taking care of your household responsibilities?	*None*	*Mild*	*Moderate*	*Severe*	*Extreme/ Cannot do*

There are two versions of the WHODAS 2.0 — a 36-item version that takes about 20 minutes to complete and a shorter 12-item version that takes about 5 minutes to complete. Responses can be scored simply. For example, the individual's answer for each question is converted to a rating score, with a score of 0 assigned to 'None' and a score of 4 to 'Extreme/Cannot do'. The scores are then totalled and mapped on a continuum ranging from 0 to 100, where 0 = high level of functioning and 100 = extremely poor level of functioning/disability.

Summary scores for each domain can also be calculated and high scores in a particular domain may indicate functional impairments requiring further assessment or intervention.

The WHODAS 2.0 has been adopted as a measure of function by the DSM-5 — the manual most commonly used in Australia by mental health professionals for diagnosis of mental disorders.

Source: World Health Organization (2010). *Manual for WHO Disability Assessment Schedule: WHODAS 2.0.* Geneva: Publisher.

High levels of social and emotional wellbeing

Wellbeing refers to our sense of 'wellness' or how well we feel about ourselves and our lives. The term may be used globally in relation to our overall mental and/or physical state or in relation to a specific domain or area of functioning.

The Australian Psychological Society [APS] (2015) has described six different but inter-related 'wellness' domains, each of which contributes to a person's overall sense of wellbeing. These are shown in Figure 11.7 opposite. Social and emotional wellbeing are two of the domains. A mentally healthy person tends to have a high level of both social and emotional wellbeing.

Social wellbeing is based on the ability to have satisfying relationships and interactions with others (APS, 2015). It essentially involves 'getting along' with other people and includes the ability to establish and maintain positive relationships with family, friends, peers, colleagues and acquaintances, as well as the ability to socially interact in appropriate ways with people in the community (including known and unknown people). It also encompasses abilities such as good communication skills (including use and interpretation of body language), understanding of other people's motives and problems, giving and receiving social support, and appreciating the differences in people.

- Intellectual wellbeing — the ability to learn, grow from experience and utilise intellectual capabilities
- Physical wellbeing — the ability to carry out daily tasks with vigour
- Emotional wellbeing — the ability to control emotions and express them appropriately and comfortably
- Spiritual wellbeing — a guiding sense of meaning or value in life
- Social wellbeing — the ability to have satisfying relationships and interactions with others
- Vocational wellbeing — having interests, employment, volunteer work or other activities that provide personal satisfaction and enrichment in daily life

Figure 11.7 Six wellness domains that contribute to a person's overall sense of wellbeing

Source: Based on Australian Psychological Society (2015). *Stress & wellbeing: How Australians are coping with life*. Melbourne: Author

For example, a person with a high level of social wellbeing is likely to be willing and able to:

- develop and maintain healthy relationships with family and friends
- socially interact with others in appropriate ways
- respect and understand other individuals
- respect the cultural identities of others
- competently resolve conflicts with others
- effectively manage unhealthy relationships
- spend time with loved ones
- feel self-confident alone or with others (AIHW, 2012; NIHCE, 2009).

Emotional wellbeing is based on the ability to control emotions and express them appropriately and comfortably (APS, 2015). It encompasses the abilities to understand, share and regulate our emotions, to acknowledge and appropriately share both positive and negative emotions with others in socially or culturally appropriately ways and to enjoy life despite its occasional set-backs, disappointments and frustrations.

For example, a person with a high level of emotional wellbeing is likely to be willing and able to:

- develop awareness and understanding of their own emotions
- regulate their emotions and exercise control when appropriate
- express a range of emotions in a suitable manner
- identify emotions in others and empathise
- have a positive attitude about emotions, their experience and expression
- consider thoughts and behaviour as well as feelings when making personal choices and decisions
- accept mistakes or setbacks and learn from them
- make decisions with a minimum of worry, stress or anxiety
- manage their stress reactions using appropriate coping skills
- live and work independently while realising the importance of seeking and appreciating the support and assistance of others
- take on challenges, take risks and recognise conflict as being potentially healthy
- take responsibility for their actions (AIHW, 2012; University of California, 2014).

Figure 11.8 People who are mentally healthy have high levels of social and emotional wellbeing. Even though this couple are having a discussion about a serious matter, they are respecting each other, listening to each other's viewpoints and regulating their emotions.

Resilience to life stressors

Having good mental health does not mean we do not go through bad times or fail to experience disappointment, sadness, anger, fear, anxiety or other unsettling reactions to daily hassles, major stressors and other disturbing events. Instead, mental health is linked to our resistance to adversity and how well we cope with life stressors. This involves resilience.

Resilience is the ability to cope with and adapt well to life stressors and restore positive functioning. It means 'bouncing back' from adversity or difficult experiences that are stressors — such as family and relationship problems, school or workplace stressors, rejections, failures, threats or even tragedy—and restoring positive functioning. Adaption through resilience may involve either adjusting to or overcoming the stressor (APA, 2016c).

Some people have more or less resilience than others. In particular, people who are mentally healthy are commonly described as 'resilient' because they tend to have a high level of resilience, whereas people who are mentally unwell tend to have a low level of resilience and may therefore be described as 'not resilient'.

Resilience is one reason why people perceive and respond or adapt differently to life stressors. For example, a mentally healthy person tends to be 'resilient' and therefore more likely to perceive a life stressor as an opportunity to excel because they have the resources to cope, whereas a mentally unwell person tends to be 'not resilient' and therefore more likely to feel significantly challenged or even overwhelmed, possibly to the point of breakdown.

Research studies have found that resilience is not an unusual or extraordinary characteristic. People commonly demonstrate resilience when faced with significant adversity. For example, resilience is apparent in the numerous Australians who rebuild their lives and bounce back after devastating natural disasters such as floods and bushfires. Our resilience is the product of a range of personal skills and is significantly influenced by external factors, particularly our social connections and access to social support.

Psychologists have studied resilience in adolescents and adults when dealing with life stressors. On the basis of this research, they have identified a number of characteristics that enable someone to 'bounce back' and get back on track when faced with adversity. These characteristics include a strong belief in their abilities to accomplish tasks and succeed (i.e. high self-efficacy); high self-esteem; approaching adversity and stress with a sense of optimism, opportunity and hope; being adaptable and flexible; being organised; having problem-solving skills; and having the ability to make realistic plans and carry them out. Resilient people also tend to have good social support systems, or know other people they can talk to or get help from in difficult times. In particular, they tend to have caring and supportive relationships within and outside the family. Relationships that create love and trust, provide appropriate role models for problem solving, and offer encouragement and reassurance, help bolster a person's resilience (APA, 2016b). We consider characteristics associated with resilience in more detail in Chapter 14 when examining maintenance of mental health.

Having a lot of resilience does not mean that a person never experiences difficulty or distress or is always untroubled or endlessly happy. Every single person experiences adversity and other challenges to varying degrees in their lives. Through resilience, we interpret, respond and either overcome or adapt to that adversity. Importantly, resilience is not a 'fixed' ability that cannot be developed or enhanced. It is possible to learn knowledge and skills that can promote or build resilience (APA, 2018b; Mind Matters, 2018a).

Figure 11.9 Refugees and asylum seekers tend to have a high level of resilience which helps them to adapt and recover from the adversity they experience in seeking a new life in a new country.

LEARNING ACTIVITY 11.3

Review questions

1. (a) Explain the meaning of functioning in relation to mental health.
(b) List three characteristics that may be attributed to a person with a low level of functioning.
(c) Write four or five questions a psychologist assessing level of functioning may ask a client for the purposes of the assessment.

2. (a) Explain the meaning of social wellbeing and emotional wellbeing with reference to examples of characteristics associated with high and low levels of functioning in each of these domains.
(b) Explain whether having low levels of social and emotional wellbeing is the same as having a mental health problem or disorder.

3. (a) What is resilience?
(b) Describe the relationship between resilience and mental health, ensuring you refer to life stressors.
(c) List three personal characteristics you would reasonably expect to observe in someone described as resilient.
(d) In what way does having a good social support system contribute to resilience?
(e) Explain whether a high level of resilience is possible without having a good social support system.

ETHICAL IMPLICATIONS IN MENTAL HEALTH STUDY AND RESEARCH

S.G. is an elderly man who was diagnosed with depression in his early twenties. He has tried numerous anti-depressant medications over the years and continues to use them despite his belief that 'they have not cured me'. S.G. has been asked to participate in research on a new drug for depression that has been trialled with animals and since been approved for human trials. The study involves hospitalisation for a 4-week period during which S.G. must not take any medication at all. Volunteer participants will then be assigned to either an experimental group (who will be given the new drug) or a control group (who will be given a placebo treatment). S.G. agrees to participate in the study, commenting that, 'I don't care anymore. I don't care if I get the medicine or the placebo. What difference does it make anyway?'

Despite S.G.'s apparent ambivalent attitude, many participants before him have played vital roles in mental health, advancing knowledge about neural mechanisms and processes involved in mental disorders and enabling the discovery of new and better drug treatments to complement psychotherapy and other interventions. Similarly, many animals have suffered from drug testing to ensure suitability for use with humans. As a result, millions of people throughout the world with disorders such as depression, bipolar disorder, schizophrenia and various anxiety disorders are able to lead more productive and fulfilling lives.

Much of the human research requires the cooperation of participants like S.G. who suffer from the mental disorder under investigation. However, many people with a mental disorder are particularly vulnerable as research participants. For example, S.G.'s hopelessness and desperation may have impaired his ability to properly consider the possible effects on his mental health of being un-medicated for a considerable period of time. This may occur despite being 'fully informed' by the researchers, including having the opportunity to ask questions.

Consequently, the welfare and rights of such participants are in need of protection that is especially suited and targeted to their specific vulnerabilities. Safeguards in the form of ethical standards and guidelines help provide this protection.

For example, as described in Chapter 1, when conducting any research with human participants, the researcher must be aware that there is a need to ensure that all risks of discomfort or harm to participants are balanced by the likely benefit to be gained. As well as ensuring that no psychological or physical harm is caused to research participants, a researcher must also respect and ensure the security of each participant's human rights.

The *National Statement on Ethical Conduct in Human Research 2007* has a specific section that outlines considerations that must be adhered to when conducting research with people with mental disorders (and other 'mental impairments').

People with mental disorders are entitled to participate in research. However, some may be vulnerable in relation to research and this must be taken into account. Although the National Statement refers to vulnerability, it is not defined, nor is the vulnerability of people with a mental disorder clarified. Vulnerability is relevant to a researcher's need to take account of the fact that some people who are mentally unwell may have one or more cognitive impairments that diminish (reduce) their capacity for decision-making and judgments about their participation in research, including susceptibility to harm in the particular circumstances of the research.

Two issues that pose particular ethical challenges for researchers studying and conducting research with vulnerable participants who have a mental disorder are informed consent and use of placebo treatments.

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Figure 11.10 People with a mental disorder have the right to participate in research. However, they may be vulnerable in some circumstances in relation to research and this must be taken into account.

Informed consent

A core component of ethical research is informed consent — the process by which a researcher discloses appropriate information to a potential research participant so that the person may make a voluntary and informed choice about whether or not to participate.

As described in Chapter 1 (pages 113–14), participant consent should be voluntary and based on sufficient information and adequate understanding of both the proposed research and the consequences of participation in it. In order for this to be achieved, information should be given on such aspects as the nature and purpose of the research, the procedures to be used, possible risks or adverse effects of the procedures, the demands and possible disadvantages of participating, the right to decline to participate or to withdraw at any time, and possible benefits or other outcomes of the research. All relevant information about the research and participation should also be documented in plain, comprehensible language on or with a 'consent form'.

An important issue is therefore that potential participants must be able to understand the proposed research, the nature of their involvement and the associated risks. A participant's informed consent cannot be considered as having met ethical requirements unless they have received all the information required for consent, understood it and voluntarily agreed to participate. Voluntary consent means the decision to participate is free of coercion and pressure from the researcher (or any other person).

A participant for mental health research (and any other type of human research) should have the *competence* to give informed consent. This means that they should have the ability to understand the information relevant to making an informed decision to participate. A wide variety of symptoms, diseases, injuries and other conditions can affect a person's ability to understand such information, to weigh the advantages and disadvantages of their participation, and to subsequently reach a truly informed decision about whether to agree to participate.

In particular, a wide range of mental disorders are associated with one or more impairments that can adversely affect the ability to provide informed consent; for example, impairments to attention, concentration, reasoning, judgment, short-term working memory, long-term memory, decision-making and other relevant cognitive functions. The

presence of a mental disorder can therefore interfere with a person's capacity to give genuine consent as it may prevent them from fully understanding some or all of the details of what it is that are actually consenting to (Amer, 2013).

Like mental health, the capacity to provide informed consent is considered to be on a continuum and depends in part on the complexity of the decision required of the participant. Generally, the more complex a research study and the information provided, the harder it will be to understand all the relevant consent issues. Understanding is even more difficult when a mental disorder impairs cognitive functioning (National Institute of Health [NIH], 2009).

Competency is not overlooked in the National Statement. One of its requirements is that researchers should outline to an ethics committee (HREC) how they will determine the capacity of a person with a mental disorder to give informed consent. The National Statement also advises that if a person's mental disorder is temporary or episodic, an attempt should be made to obtain consent at a time when their symptoms do not interfere with their capacity to give informed consent. Finally, it is also recognised that a person's mental health may deteriorate during the course of a study or research. Consequently, they may initially give informed consent, but then their capacity to continue to participate in the research may vary or be lost altogether. The researcher is therefore required to have a discussion with the participant about this possibility before the research commences to find out the participant's preference if deterioration occurs.

Of course, having a mental disorder does not necessarily mean that an individual is incapable of giving informed consent, or, if incapable, the person will always be incapable. For example, although people with schizophrenia tend to have impaired reasoning and decision-making skills, they may still be able to competently give informed consent if provided with appropriate support to do so. Even people with severe schizophrenia may be able to give informed consent following 'educational interventions'; for example, by providing information about the research in more comprehensible or accessible ways, such as by using prompts to assist them to understand key points, and by providing the information on more than one occasion, or in alternative formats at different times (Carpenter, et al., 2000).

Figure 11.11 Participants in research usually give informed consent and the presence of a mental disorder raises special considerations about the ethical requirements for consent.

In the event that a potential participant is unable to give informed consent, this can be obtained from their legal guardian or any person or organisation authorised by law to do so on the participant's behalf. If informed consent has been given by someone other than the participant, the researcher is still required to explain to the participant, as far as possible, what the research is about and what participation involves. In addition, if the participant recovers the capacity to give consent at some time after the research commences, the researcher should offer them the opportunity to continue their participation or to withdraw.

Despite ethical safeguards in the National Statement (and the APS Code of Ethics), it is still possible to include a person in mental health research without their consent. This includes research testing a medical procedure such as the use of a new medication, equipment or treatment (commonly called a 'clinical trial'). This type of research can and does occur with patients in the public mental health system who have not given informed consent. Moreover, it is legally permissible under Victoria's *Mental Health Act 2014* and can include patients who have been involuntarily hospitalised under the Act. For example, research requiring participants as part of a clinical trial or for the administration of medication may be carried out on a person who 'does not have the decision making capacity to make a medical treatment decision in relation to the proposed medical research procedure' if approval is obtained by a human research ethics committee. The committee may be based at the hospital where the patient is being treated or it may be at another hospital, a university or other institution (Office of the Public Advocate, 2018).

Figure 11.12 It is legally permissible in Victoria under certain conditions to conduct medical research with patients in the mental health system who have not given informed consent.

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Weblinks
- Mental Health Act 2014
- Office of the Public Advocate: Medical research for patients who cannot consent

Use of placebo treatments

Placebo treatments are commonly used in research studies (or 'clinical trials') to determine the *efficacy* ('effectiveness') of a new or improved medication or other treatment such as psychotherapy, physical therapy, exercise, a special diet or even surgery. For example, a placebo treatment may be used in research to test whether a new version of a medication alleviates targeted symptoms of a particular mental disorder.

The placebo is the substance or treatment that appears real and resembles the actual substance or treatment, but is actually inert — it is neutral or has no known effect. Exposure to a placebo can result in a placebo effect involving a change or improvement in wellbeing that may be short-term or lasting. The placebo effect is triggered by a person's belief in the treatment and their expectation of relief or feeling better, rather than the specific form the placebo takes. Although many theories have been proposed to explain the placebo effect, mechanisms and processes that can actually produce physiological change due to a placebo treatment remain unclear.

Experiments and other studies that are conducted to test the efficacy of new medication typically use a placebo treatment. In a simple experiment, there may be two groups — an experimental group (who receive the drug treatment) and a control group (who receive the placebo treatment). None of the participants know whether they are taking the active or inactive drug. Often, not even the researchers know because the double blind procedure is commonly used. After a suitable period of time to allow for the drug to exert its effects, comparisons are made between participants in both groups on relevant measures of the dependent variable. It is assumed that any participant change or response due to merely taking what is believed to be an active drug would have occurred in both groups. In many studies, multiple groups are used. For example, there could be three experimental groups, each of which receives a different dose of the drug, and one control group who receive the placebo treatment. Generally, the placebo-controlled double-blind experiment with random assignment to groups is widely considered to be the 'gold standard' for a clinical trial or other research that tests the efficacy of a treatment.

The placebo effect observed in studies on medications and other treatments is not unusual. Furthermore, symptoms of a disorder can actually be relieved by taking an inert substance or undergoing a fake placebo procedure. Many people demonstrate symptom relief or reduction after taking a placebo. The placebo effect is often significant and long-lasting. For example, one team of researchers who analysed the results of 75 studies that used a placebo found that 29.7% of participants with a diagnosed depression disorder improved after they received a placebo treatment which they believed was an antidepressant medication (Walsh, et al., 2002). Placebos can also cause unwanted side-effects. For example, nausea, drowsiness and allergic reactions such as skin rashes have been observed as placebo effects (Davis, et al, 2011; Khin, et al, 2012).

According to the National Statement, use of a placebo treatment is ethically acceptable when all relevant ethical requirements have been addressed. For example, it is essential that the research is justifiable and potential harm to participants is negligible. When it is ethically justifiable to conduct such a study, then it is also vital that all treatment conditions in the research study pose a low and acceptable risk of harm to the participants and that all participants are fully informed about and understand such risks. These conditions also apply to studies for which informed consent is not obtained.

Some psychologists, however, hold ethical concerns about the use of placebo treatments, especially when testing medications with people who have a mental disorder. One concern is that researchers intentionally withhold an effective treatment from people who genuinely need the treatment and are therefore allowed to remain unwell and may also suffer as a consequence. For example, in many experiments (or clinical trials), placebo control group participants are denied their usual 'real' treatment for the duration of the study. If they are not permitted to take their prescribed medication(s), then there is the possibility of symptoms that are under control re-appearing or worsening.

Figure 11.13 Use of a placebo treatment in studies on treatments for mental disorders raises specific ethical issues.

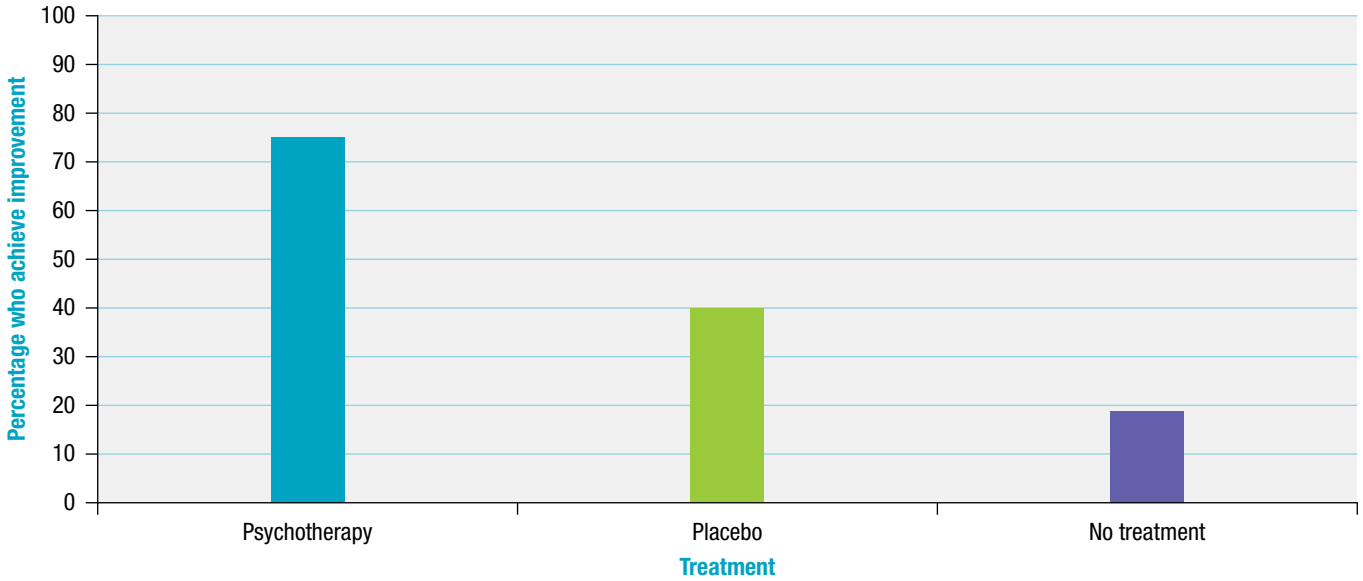

Figure 11.14 An analysis of the results of more than 300 studies found that about 75% of people who access psychotherapy (e.g. CBT) achieve at least some improvement, compared with a placebo and no treatment. These results also show that about 25% of people do not benefit from psychotherapy. It has also been found that an estimated 5%–10% of adult clients leave treatment worse off than they began treatment.

Source: Based on Lambert and Ogles (2004). Lambert, M.J., & Ogles, B.M. (2004). The efficacy and effectiveness of psychotherapy. In M. J. Lambert (Ed.), *Bergin and Garfield's handbook of psychotherapy and behavior change* (5th ed., pp. 139–193). New York: Wiley.

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Weblink
TED Talk — The magic of the placebo 9m 05s

This can cause severe discomfort, distress or some other unwanted psychological or physical problems that can inhibit or prolong recovery. An associated ethical concern is that the researcher would be aware of this possibility but has nonetheless decided to administer a treatment that they know will be ineffective at best. Note that placebo group participants are also not given the medication being tested. This raises the ethical issue of their having been knowingly and intentionally denied access to a treatment that they most likely need and from which they could possibly benefit.

In addition, experiments to test drugs are often conducted over a prolonged period which increases the probability of participant attrition. This loss tends to be more likely in studies using participants with certain mental disorders because of the very nature of their disorder. For example, many people with depression experience difficulties maintaining motivation which can reduce their commitment to a study after it starts. Consequently, a participant may withdraw mid-way during active treatment as a member of the experimental group taking a new, not fully tested drug, or, as a member of placebo treatment group not taking prescribed medication and with a belief that they have been taking an appropriate alternative. In such cases, follow-up by the researchers is vital but not always possible when participants do not formally withdraw and simply discontinue their involvement without contacting researchers.

The National Statement recognises the need to protect participants from exposure to research that poses a significant risk to their wellbeing and therefore specifies that it is ethically unacceptable to conduct a research study for which there is 'a known risk of significant harm in the absence of treatment'. Nonetheless, such studies are still possible under Victoria's Mental Health Act.

Ethical concerns have also been expressed about the use of deception. For example, participants in the placebo treatment group must be deceived by being led to believe that they are taking an active drug that may reduce or inhibit their symptoms. Although deception is ethically permissible for placebos, critics of placebo treatments maintain that deception is wrong, regardless of whether the deceived participant experiences improvement or even an end to their symptoms. For example, it is argued that deception involves wilfully misleading participants and is a violation of trust and a person's informed consent. Furthermore, many believe it is inappropriate in studies of mental disorders because vulnerable people are likely to be manipulated. In many cases, a well-tested drug treatment may already exist so it is suggested that people already taking this active drug should be used as a control group. An active-treatment control group may not raise ethical concerns, but it can be more difficult to demonstrate a difference between different types of active treatments.

BOX 11.2 Research using a placebo to test a new drug for the treatment of schizophrenia

American psychiatrist Christoph Correll and his colleagues (2015) conducted a study to investigate the efficacy, safety and tolerability of a new anti-psychotic drug called brexpiprazole. This drug was designed for the treatment of schizophrenia. The study was part of the procedure required for drug approval by the US Food and Drug Administration authority.

Participants for the study consisted of 636 volunteer adults diagnosed with acute schizophrenia who were hospitalised as part of their treatment. All were randomly assigned to either of three groups to receive one of three doses of the drug (0.25 mg, 2 mg or 4 mg) or to a placebo treatment group for a 6-week period. None of the researchers or participants knew which groups received which treatment.

The PANSS test (Positive and Negative Syndrome Scale) which assesses positive and negative symptoms of schizophrenia was completed by all participants at the start (baseline) and end of the study. This test has been found to be a valid and reliable measure of schizophrenia symptoms.

The mean changes in PANSS total scores from baseline until study end were:

- 0.25 mg: −14.90
- 2 mg: −20.73
- 4 mg: −19.65.

For the placebo group, the figure was −12.01. All these 'negative' scores indicate a reduction in symptoms.

The most common side-effect reported for the drug was restlessness (2 mg: 4.4%; 4 mg: 7.2%; placebo: 2.2%). Weight gain with drug use was moderate (1.45 and 1.28 kg for 2 and 4 mg, respectively, versus 0.42 kg for placebo at week 6).

On the basis of the results, the researchers concluded that at week 6, compared with the placebo treatment, participants who used brexpiprazole at dosages of 2 and 4 mg/day demonstrated greater reductions in psychotic symptoms and good tolerability of the drug.

The researchers also reported that 59.2% of participants in the placebo group were able to complete the 6-week study. The remaining 40.8% had to withdraw at various points due to an intolerable worsening of their psychotic symptoms. In addition, only 62.2% of the participants in the 0.25 mg group completed the study.

LEARNING ACTIVITY 11.4

Review questions

1. (a) Explain the meaning of informed consent for research.
(b) In what way might someone with a mental disorder be vulnerable to giving informed consent without fully comprehending what that means or may involve?
(c) What is an ethical standard or guideline that helps protect research participants who may be vulnerable?
(d) What is a procedure that can be used by a researcher to help ensure a potentially vulnerable adult gives consent that is truly informed?
(e) Explain whether research involving people with a mental disorder can be undertaken without their informed consent and outline relevant ethical issues that may be raised.
(f) K.L. has bipolar disorder (once called manic depression) and agreed to participate in a 4-week research study comparing the effectiveness of two types of psychotherapies. K.L. is in a group that is exposed to the new therapy but is not required to discontinue his medication. During the second week of the study, K.L. develops mania. He becomes grandiose, his thoughts are racing and incoherent, he is extremely distractible, he is getting little sleep and is spending most nights gambling at the casino.

Does the researcher have any ethical obligations with regard to K.L.? If so, what should be done?

2. (a) Explain the meaning of placebo treatment.
(b) What is the difference between a placebo and placebo effect?
(c) Give an example of a placebo treatment that could be used in a study testing the efficacy of a new psychotherapy for a mental disorder.
(d) Comment on whether the deception required for research using a placebo treatment exploits vulnerable people.
(e) Outline three ethical issues, other than deception, that may be raised in relation to the use of a placebo treatment.

LEARNING ACTIVITY 11.5

Evaluation of research using a placebo treatment

Read the research study conducted by Correll and his colleagues (2015) described in Box 11.2 on page 577 and answer the following questions.

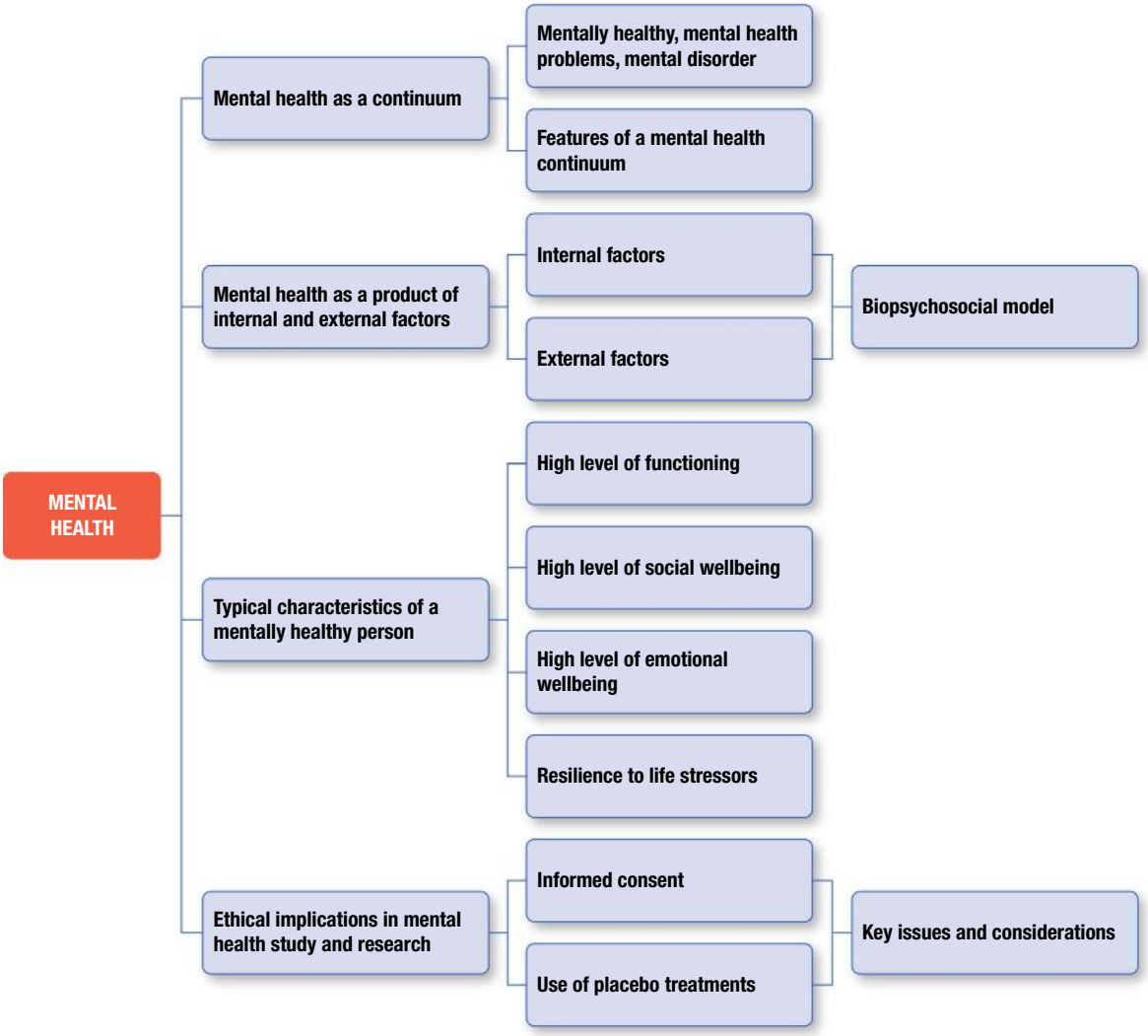
1. What was the aim of the research?
2. Who were the participants in the research?
3. Identify the operationalised independent and dependent variables.
4. Identify the experimental and control groups.
5. Formulate a research hypothesis that would be supported by the results.
6. Explain whether a single- or double-blind procedure was used and why it was used in this particular experiment.
7. (a) Describe the results obtained with reference to each group of participants.
   (b) Explain whether the conclusions are consistent with the results obtained.
   (c) What is a possible explanation of the improvement in psychotic symptoms by the placebo group?
   (d) What is a possible limitation of the research and its findings?
8. Describe three ethical issues of relevance to this particular study.

LEARNING ACTIVITY 11.6

Reflection

What is your view on the ethical behaviour of the researcher who intentionally allows some people to remain unwell for a considerable period of time in the interests of testing a potentially effective treatment that could ultimately benefit millions of others throughout the world?

CHAPTER SUMMARY



KEY TERMS

biopsychosocial model p. 565
continuum p. 561
emotional wellbeing p. 569
ethical implications p. 571
external factor p. 564
functioning p. 566
informed consent p. 572
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life stressor p. 570
mental disorder p. 562
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LEARNING CHECKLIST

Complete the self-assessment checklist below, using ticks and crosses to indicate your understanding of this chapter's key knowledge (a) before and (b) after you attempt the chapter test. Use the 'Comments' column to add notes about your understanding.

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Word copy of checklist

Key knowledge I need to know about mental health	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
Mental health as a continuum			
• mentally health			
• mental health problem			
• mental disorder			
• mental health/wellbeing continuum			
– key features			
Mental health as a product of internal and external factors			
• internal factors			
• external factors			
• biopsychosocial model			
Typical characteristics of a mentally healthy person			
High level of functioning			
High level of social wellbeing			
High level of emotional wellbeing			
Resilience to life stressors			
Ethical implications in mental health study and research			
Informed consent			
Use of placebo treatments			
Key issues and considerations			

studyon

Unit 4 > Area of study 2 > Topic 1

Concept screens and practice questions

CHAPTER 11 TEST

SECTION A — Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Question 1

A mental disorder is best described as

A. maladaptive or dysfunctional behaviour.
B. a mild and temporary change in the way a person thinks, feels and behaves.
C. a mental condition that will usually resolve itself without treatment.
D. a diagnosable psychological condition that significantly disrupts how a person usually thinks, feels and behaves.

Question 2

Which of the following individuals is most likely experiencing a significant mental health problem rather than a mental disorder?

A. A. H., who has been experiencing changes in appetite, motivation and mood but is still managing to get to work each day and be quite productive.
B. R. P., who became annoyed when someone crashed into her car, but got over it quickly.
C. D. M., who is a manager at a local fast food outlet and has a good group of friends.
D. S. L., whose anxiety about coming into contact with other people is causing a lot of distress and preventing him from leaving his house.

Question 3

Which of the following is a psychological factor that could contribute to the development of a mental disorder?

A. gender
B. not having enough money for the basic essentials of everyday life
C. being bullied by someone at school
D. how we perceive our internal and external environments

Question 4

Which of the following is **not** a biological factor that could contribute to the development of a mental disorder?

A. low self-esteem
B. poor nutrition
C. low birth weight
D. prenatal brain damage from exposure to drug use

Question 5

A mentally healthy student with a high level of functioning is likely to

A. be socially disconnected from others.
B. participate fully in school and leisure activities.
C. avoid extracurricular activities at school.
D. have negative feelings about themself and life in general.

Question 6

The biopsychosocial model would account for mental health or the development of a mental health problem or disorder by explaining

A. the relative contribution of biological, psychological and social factors.
B. the interaction of biological, psychological and social factors.
C. how biological factors influence psychological factors, which in turn influence social factors.
D. the impact of underlying biological factors on psychological and social factors.

Question 7

Before any psychological research with human participants can be conducted, the researcher must

A. be a registered psychologist.
B. obtain informed consent from their peers or colleagues.
C. obtain written approval from their employer.
D. obtain written approval from their ethics committee.

Question 8

A mental health continuum can be used to show

A. internal and external factors influencing mental health.
B. biopsychosocial factors influencing mental health.
C. the variability of mental health.
D. impairments in the ability to function effectively in everyday life.

Question 9

O. M. has developed satisfying interpersonal relationships with a diverse range of people, which makes her feel good about herself. It is likely that O. M. has a _____ level of _____ wellbeing.

A. low; social
B. high; emotional
C. low; emotional
D. high; social

Question 10

Which of the following reasons best explains why a placebo treatment is likely to be of ethical concern when used in an experiment to test a new drug for a mental disorder?

A. The treatment typically causes a placebo effect.
B. The treatment may interfere with a person's capacity to give informed consent.
C. Participants in the control group may be exposed to harm in the absence of treatment.
D. Participants in the experimental group may be exposed to harm when the placebo treatment is introduced.

SECTION B

Answer all questions in the spaces provided. Write using blue or black pen.

Question 1 (4 marks)

(a) Define 'mentally healthy'. 1 mark

(b) Give three examples of characteristics considered to be typical of a mentally healthy person. 3 marks

Question 2 (2 marks)

What two criteria could be used to distinguish a mental health problem from a mental disorder?

Question 3 (4 marks)

Explain the difference between internal and external factors that can influence a person's mental health, with reference to an example of each type of factor.

Question 4 (3 marks)

Give three examples of criteria that could be used to locate someone's mental health status on a continuum.

Question 5 (2 marks)

What two features of a treatment plan for a mental health problem or disorder would reflect use of a biopsychosocial approach?

Question 6 (3 marks)

List three characteristics typical of someone with a high level of emotional wellbeing.

Question 7 (3 marks)

Explain the meaning of resilience with reference to a characteristic that distinguishes someone with low resilience.

Question 8 (4 marks)

Give two examples of ethical issues associated with each of the following in the study of, or research into, mental health.

(a) informed consent 2 marks

(b) use of a placebo treatment 2 marks

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The answers to the Section A multiple-choice questions are in the answer section at the end of this book and in eBookPLUS. The answers to the Section B questions are in eBookPLUS.

12 MENTAL DISORDER

KEY KNOWLEDGE

- the distinction between predisposing risk factors (increase susceptibility), precipitating risk factors (increase susceptibility and contribute to occurrence), perpetuating risk factors (inhibit recovery) and protective factors (prevent occurrence or re-occurrence)
- the influence of biological risk factors including genetic vulnerability to specific disorders, poor response to medication due to genetic factors, poor sleep and substance use
- the influence of psychological risk factors including rumination, impaired reasoning and memory, stress and poor self-efficacy
- the influence of social risk factors including disorganised attachment, loss of a significant relationship and the role of stigma as a barrier to accessing treatment
- the concept of cumulative risk.

Source: © VCAA, VCE Psychology Study Design (June 2017 update), p. 30.

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Anyone can develop a mental health disorder. Research findings indicate that about one in five Australians aged 16–85 years experiences a mental disorder at some time in their lives. This is around 4.5 million people. Younger people are more likely to have a mental disorder than older people, with the prevalence decreasing with age.

Mental disorders impact on people's lives at different levels of severity. Although a significant number of people report symptoms that have a severe, chronic and disabling effect on their lives, many do not seek or have access to support. Of those who access support, many do not fully engage with or continue receiving support. Of those who receive appropriate ongoing treatment and support, most recover well and are able to lead fulfilling lives (ABS, 2008; SANE, 2018a).

A combination of internal and external factors contribute to the development and progression of a mental disorder at any point in time. Some factors are common among particular types of disorders whereas others occur in relation to specific disorders only.

In this chapter we will examine examples of biological, psychological and social factors that tend to place an individual at a greater risk for developing a mental disorder and which may perpetuate the disorder or inhibit recovery. We start with a description of the 4P factor model that may be used in analysing mental health and the development and progression of a mental health disorder.

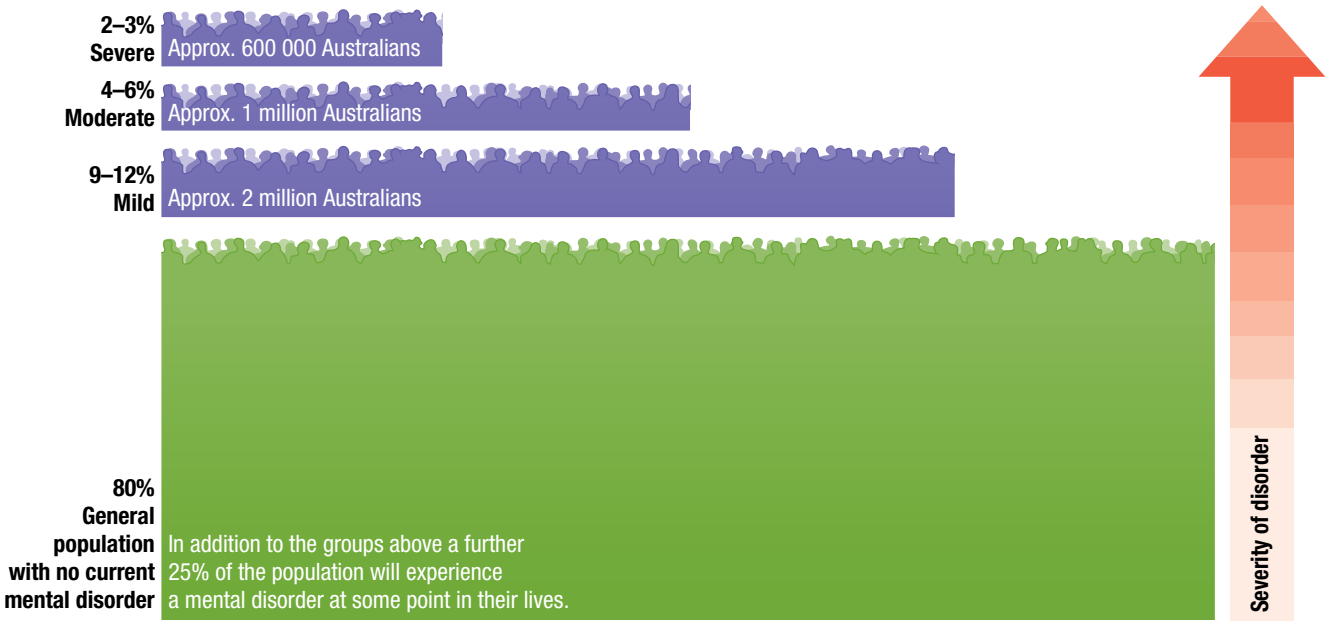

Figure 12.1 Twelve-month prevalence estimates of mental disorder in the Australian population by severity level, based on diagnosis, disability and chronicity (with a long duration)

Source: Department of Health and Ageing (2013). *National Mental Health Report 2013: Tracking progress of mental health reform in Australia 1993—2011*. Commonwealth of Australia, Canberra.

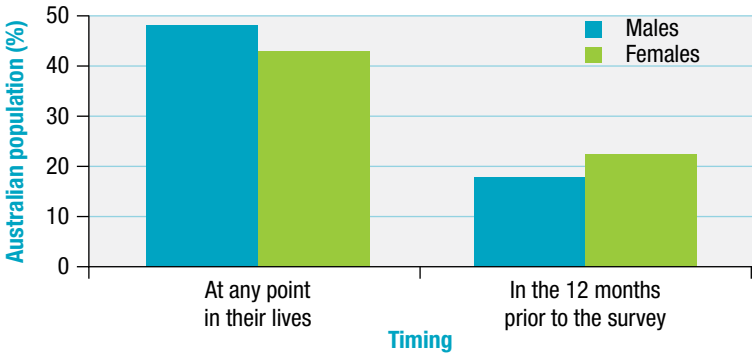

Figure 12.2 Proportion of people aged 16–85 with a mental disorder at any point in their lives

Source: Australian Bureau of Statistics (2008). *National Survey of Mental Health and Wellbeing: Summary of results*, 2007.

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Weblinks
Facts and figures about mental health

4P FACTOR MODEL

The **4P factor model** describes four influences on mental health and occurrence or re-occurence of a mental health disorder. These are called

- predisposing risk factors
- precipitating risk factors
- perpetuating risk factors
- protective factors.

All are crucial elements of the model.

In the 4P factor model, a **risk factor** is any characteristic or event that *increases* the likelihood that a mental disorder will develop, or increase in severity when it occurs, or will hinder recovery from a disorder. This may be a biological, psychological or social factor.

Risk factors can have a direct or indirect effect on mental wellbeing and typically combine in a way that is unique to each individual. Similarly, a risk factor for one person may not have the same effect or degree of influence on another person.

The presence of one or more of the risk factors does not necessarily mean someone will develop a mental disorder or never recover. However, as the number of risk factors increases so too does the likelihood of developing a disorder tend to increase, as does the likelihood of recovery being inhibited. Some risk factors are more significant than others. Some have been described as 'toxic'; for example, sexual or physical abuse (Mind Matters, 2018b).

The impact of a risk factor can often be reduced, either by addressing the specific factor or by strengthening one or more protective factors. A **protective factor** is any characteristic or event that *reduces* the likelihood of the occurrence or recurrence of a mental disorder, either on its own or when risk factors are present. Protective factors may be thought of as strengths or assets that help safeguard against the effects of risk factors and minimise their impact. As with risk factors, protective factors may be biological, psychological or social in origin. Common protective factors include those associated with resilience (e.g. positive outlook, ability to regulate emotions) and access to social support (including supportive family relationships and support from within the wider community).

All risk and protective factors occur within the context of everyday life. Generally, risk factors are considered undesirable and therefore negative influences on mental health, whereas protective factors are considered desirable and therefore positive influences.

The 4P factor model is sometimes described as a subset of the biopsychosocial approach when analysing a mental disorder. As shown in Table 12.1 below, the model can be used to bring together and organise the variety of factors believed to contribute to the development and progression of a mental disorder in any individual. This assists the mental health professional to understand why the person developed a disorder and why it is progressing as it is, taking account of the relative contributions of different types of factors. Figure 12.4 on the next page shows the Table 12.1 factors within a representation of the biopsychosocial model.

TABLE 12.1 Factors that contribute to the development and progression of mental health disorders

4P factor model	Biopsychosocial approach		
	Biological factors	**Psychological factors**	**Social factors**
Predisposing risk factors	• Genetic vulnerability	• Personality traits (e.g. poor self-efficacy)	• Disorganised attachment
Precipitating risk factors	• Poor sleep • Substance use/misuse	• Stress	• Loss of a significant relationship
Perpetuating risk factors	• Poor response to medication due to genetic factors	• Rumination • Impaired reasoning and memory	• Role of stigma as a barrier to accessing treatment
Protective factors	• Adequate diet and sleep	• Cognitive behaviour strategies	• Support from family, friends and community

Source: VCAA (2015). *Mental Health in the VCE Psychology Study Design 2016–2021 — how can a biopsychosocial approach be used in conjunction with a '4P Factor' model to analyse mental health?* Implementation briefing handouts.

Figure 12.3 A mental health professional can use the 4P factor model to help understand why an individual is presenting with a mental health disorder at a particular point in time.

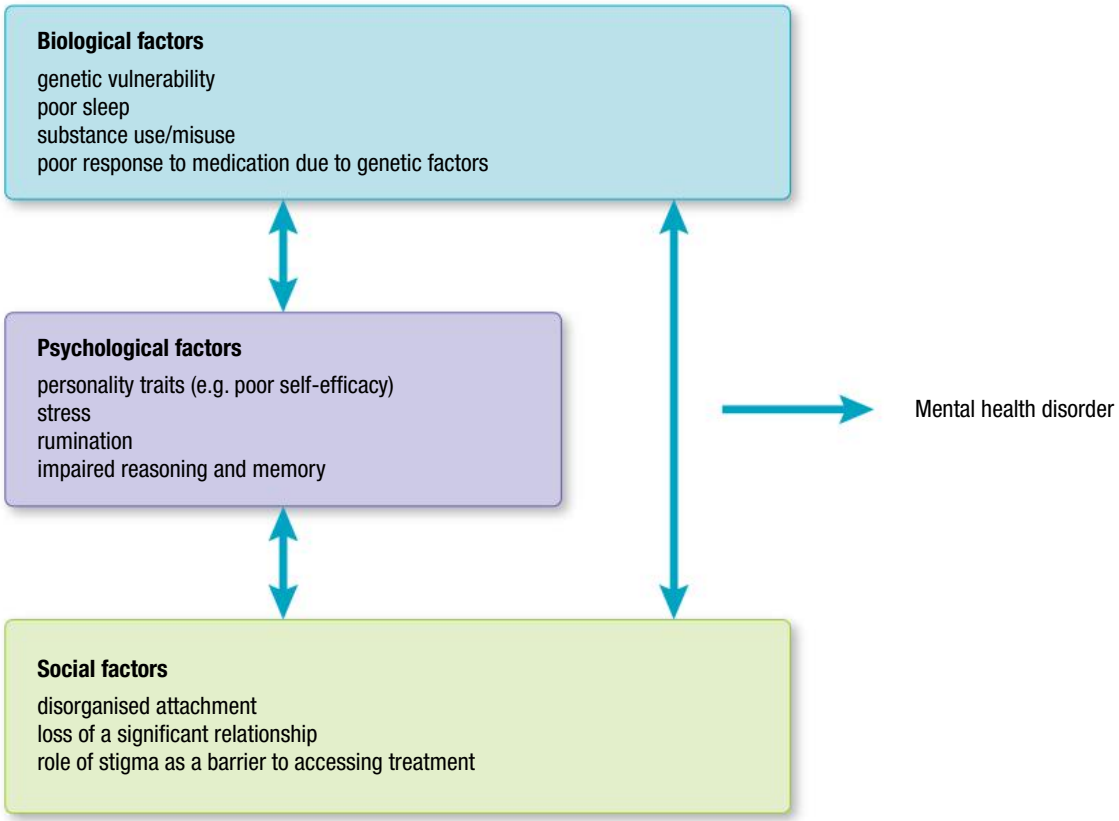

Figure 12.4 An explanation of mental health disorders using the biopsychosocial model. The factors are drawn from Table 12.1 on the previous page. Note how factors from within each domain affect and are affected by one another. Nor is there an even number of factors from each domain.

The four factors

A **predisposing risk factor** increases susceptibility to a specific mental disorder. For example, a family history of schizophrenia is a predisposing risk factor for developing schizophrenia.

A 'predisposition' increases the likelihood of the development of a disorder. It does not mean that an individual will inevitably develop the relevant disorder at some time in their life, so it is not a 'causal' factor. Instead, an individual with a family history of a particular disorder, for example, is considered more likely to develop that disorder than someone without a family history of the disorder. Similarly, experiencing a traumatic event places an individual at a higher risk of developing post-traumatic stress disorder than someone who has not been exposed to a traumatic event.

Brain injury, low levels of particular neurotransmitters, substance abuse, low self-esteem, loss of a loved one, chronic poor sleep or a serious medical condition can all be predisposing risk factors, depending on the individual and their circumstances.

A **precipitating risk factor** increases susceptibility to and contributes to the occurrence of a specific mental disorder. Precipitating factors typically hasten the onset of a disorder and commonly precede or are present at the time of onset. For example, an individual may have a genetic predisposition for developing schizophrenia as both their parents have the disorder. However, they do not develop symptoms requiring intervention until they are exposed to a major stressor and seek relief from their stress through excessive cannabis use. In this case, the individual's weak stress coping skills and cannabis use were precipitating risk factors that contributed to the onset of schizophrenia. Similarly, a major stressor or the experience of acculturative stress or a catastrophic event may be a precipitating risk factor that triggers onset of an anxiety disorder for a person with a predisposition to developing an anxiety disorder due to one or more relevant biological, psychological and social factors.

As with predisposing risk factors, two different people may experience the same precipitating event but react differently depending on their personal attributes, life experiences and current circumstances, including exposure to other predisposing and precipitating risk factors.

A **perpetuating risk factor** maintains or prolongs the occurrence of a specific mental disorder (i.e. 'perpetuates') and inhibits recovery. These are the factors that are causing a person's symptoms to continue or progressively worsen and thereby hinder or prevent recovery. For example, continuing to use a particular substance may perpetuate an associated substance use disorder and also prevent recovery from the disorder.

Other perpetuating risk factors could be unresolved predisposing or precipitating factors, ongoing bullying, being in an abusive relationship or dysfunctional family environment, a chronic medical condition, homelessness, poverty, insomnia and personal characteristics such as poor coping skills and lack of resilience.

A **protective factor** helps prevent the occurrence or re-occurrence of a mental disorder. These factors typically vary in relation to a specific disorder. For example, lack of substance use would help prevent onset ('occurrence') of a substance use disorder or relapse ('re-occurrence').

Some of the more generic protective factors that tend to be relevant to many disorders include having good relationships with family and friends, an easy-going temperament, high levels of emotional and social wellbeing, good physical health, having an adequate diet, good sleep habits, regular exercise and relaxation, not being in poverty and personal characteristics such as resilience, good coping and stress management skills, high self-esteem and average or above average intelligence.

Figure 12.5 The 4P factor model describes four influences on mental health and occurrence or re-occurrence of a mental disorder. These may be biological, psychological or social in nature and are also classified as risk factors or protective factors. Regular exercise and relaxation are considered protective factors for many disorders.

Table 12.2 below shows an example of the contribution of the 4P factors to the development and progression of a mental disorder. This example involves 46-year old 'Catherine' who has just been diagnosed as having major depressive disorder. Catherine works 60+ hours per week as chief executive officer of a biochemical company. Her job is extremely demanding and she is responsible for a team of 73 employees. Because Catherine lives alone, she makes the time to regularly attend a church with a community that is very supportive. Catherine has a family history of depression (her maternal grandmother) and three months ago, she found out she has motor neurone disease.

TABLE 12.2 Example of the 4P factor model: the case of Catherine

4P factor model	Catherine's factors
Predisposing risk factors *increase susceptibility*	• family history of depression
Precipitating risk factors *increase susceptibility and contribute to occurrence*	• diagnosis of a serious illness (motor neurone disease)
Perpetuating risk factors *inhibit recovery*	• lives alone • unsupportive and demanding work environment
Protective factors *prevent occurrence or recurrence*	• church community provides a source of social support • resilience • self-esteem • intelligence

LEARNING ACTIVITY 12.1

Review questions

1. Explain what the 4P factor model is.
2. (a) Distinguish between risk and protective factors with reference to their impact on mental health.
   (b) Give an example of a specific personality characteristic that could be a risk factor and/or a protective factor, ensuring you explain how the characteristic could function as either type of factor.
3. Name and describe the 4P factors with reference to examples different from those in the text.
4. Describe the relationship between the 4P factor and biopsychosocial models in relation to mental health.
5. Explain why exposure to and influence of risk and protective factors may be considered unique to each individual.
6. (a) Make a copy of Table 12.1 on page 587 including only the headers for the columns and rows.
   (b) Refer to Table 12.2 above and allocate each of 'Catherine's factors' to one of the categories of your table.
   (c) Complete the rest of your table with examples of other possible factors.

BIOLOGICAL RISK FACTORS

Biological risk factors either originate or develop within the body and consequently may not be under our control. These can include genetic vulnerability to a specific disorder, poor response to medication due to genetic factors, poor sleep and substance use.

Genetic vulnerability

A **genetic vulnerability** to a mental disorder means having a risk for developing a specific mental disorder due to one or more factors associated with genetic inheritance. Having a genetic vulnerability places an individual at a higher risk than that of the general population, but it does not mean that they will definitely develop the relevant disorder. Nor does it mean that there is a single gene for developing a disorder. Instead, a number of genes are likely to contribute in subtle ways to the onset and expression of a disorder under certain conditions.

Schizophrenia is one of the best known examples of genetic vulnerability to a mental disorder. Many research studies have consistently found that people who have a biological relative with schizophrenia have an increased risk of developing schizophrenia.

Schizophrenia is a psychotic disorder characterised by disturbances and disorganisation of thoughts, perceptions, feelings and behaviour. Many people with schizophrenia hear or see things that are not there, hold beliefs that are odd or not true, and may speak or behave in a disorganised way that is often hard for other people to understand. As a psychotic disorder, schizophrenia involves a loss of contact with reality.

One of the most comprehensive and best known studies on the genetic vulnerability to schizophrenia was reported by American psychiatrist Irving Gottesman. Gottesman (1991) analysed the results of 40 widely regarded family and twin studies previously conducted by other researchers. The pool of data in this meta-analysis was vast, including one study of 4000 relatives and another of 3000 relatives.

Gottesman found that the greater the genetic similarity of relatives, the more likely they were to have been diagnosed with schizophrenia. For example, as shown in Figure 12.6, identical twins (who share 100% of their genes) had a risk estimated at approximately 50%. This means that if one twin has schizophrenia, the other one will too in about 50 out of every 100 pairs of identical twins. In contrast, parents and their non-identical children are much less genetically alike than are identical twins. When data on parents and their offspring were analysed, it was found that if one parent has schizophrenia, there is a 17% chance of any of their biological children having schizophrenia.

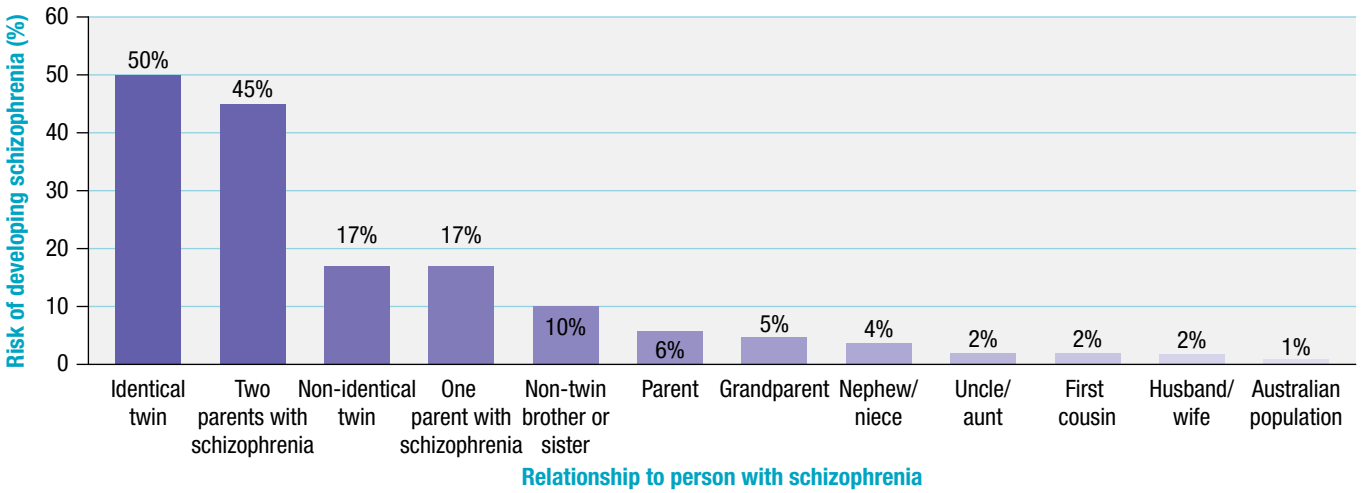

Figure 12.6 Although having a genetic vulnerability increases the likelihood of developing schizophrenia, the risk depends on the degree of the biological relationship. Genetic vulnerability alone does not cause schizophrenia.

Source: Adapted from Gottesman, I.I. (1991). *Schizophrenia genesis: The origins of madness*. New York: Freeman. p. 96.

Gottesman's results provided compelling evidence for a genetic vulnerability to schizophrenia. Along with the results of numerous other subsequent studies by researchers throughout the world, Gottesman's data indicate that schizophrenia is partly genetic in origin. However, the risk is nowhere near as high as would be expected if the disorder was entirely genetic. For example, although the results of some twin studies show that if one identical twin has schizophrenia, the risk for the other twin is 50%, the same evidence suggests that 50% of the risk of developing schizophrenia is *not* accounted for by genetic factors. This means that other factors must also have a contributory role.

Psychologists have traditionally referred to these other factors collectively as 'environmental factors', with environment essentially meaning any non-genetically determined influence on the development of schizophrenia. Therefore, environmental factors as well as genes contribute to the development of schizophrenia. However, isolating the relative contribution of genetic and environmental factors is not a simple process since genes are always inherited and exert their influence in an environmental context.

Even with twin studies it is difficult to separate the effects of genes and the environment on schizophrenia because twins are usually raised together. Thus, when the child of a parent with schizophrenia develops schizophrenia, three explanations are possible:

- the mother or father may have genetically transmitted schizophrenia to the child
- the parent(s) with schizophrenia may have created an environment conducive to the onset of schizophrenia in other family members (e.g. an environment in which certain psychological and social factors are present)
- the child's schizophrenia may have resulted from a combination of genetic factors and an environment conducive to the onset of schizophrenia.

Therefore, researchers have also conducted adoption studies to better understand the genetic predisposition to schizophrenia as well as the role of 'environment'.

Figure 12.7 Research on family histories of people with schizophrenia has found a genetic vulnerability to the disorder and influenced researchers to investigate genetic vulnerability to other mental disorders. Twin studies have provided the strongest evidence.

studyon

Adoption studies involve researching individuals born to a parent(s) with schizophrenia but who have been adopted by other parents shortly after birth and have therefore had no contact with the biological parent(s). This eliminates the possibility that being raised in an environment with a parent(s) with schizophrenia increases the likelihood of developing the disorder.

In one of the best-known adoption studies, American psychiatrist Seymour Kety and his colleagues (1988) traced through the records of childcare authorities and institutions. Of nearly 5500 adults who had been adopted early in life, the researchers identified 33 with schizophrenia. A control group of 33 participants who did not have schizophrenia was then selected from the same population. These participants were adoptees who were similar in age, sex and schooling to the individuals with schizophrenia.

Next, the researchers located 365 biological and adoptive relatives of these 66 adoptees, including both parents and siblings. The relatives were then separated into four groups: Group 1 — biological relatives of adoptees with schizophrenia; Group 2 — adoptive relatives of adoptees with schizophrenia; Group 3 — biological relatives of adoptees without schizophrenia; and Group 4 — adoptive relatives of adoptees without schizophrenia. Thirty-seven of the relatives were found to qualify for a diagnosis of either schizophrenia or another psychotic disorder. Most of these 37 relatives turned out to be the biological relatives of the adoptees with schizophrenia. Altogether, 14% of the biological relatives of the adoptees with schizophrenia were themselves also diagnosed with the disorder, whereas only 2.7% of their adoptive relatives were given this diagnosis. The biological and adoptive relatives of the adoptees without schizophrenia had schizophrenia prevalence rates of 3.4% and 5.5% respectively.

These results add to the substantial evidence supporting genetic vulnerability as a contributory factor in schizophrenia. Various other adoption studies have also provided considerable supporting evidence of the major role played by genes. Overall, adoption studies have consistently shown that if either biological parent of an individual had schizophrenia, the adopted individual is at greater risk to develop schizophrenia.

Researchers have since conducted twin and adoption studies to establish a genetic vulnerability for a range of other mental disorders, including anxiety disorders, mood disorders, personality disorders, substance-related disorders, addictive disorders, feeding and eating disorders, as well as mental disorders classified as neurodevelopmental (e.g. autism and ADHD) and neurocognitive (e.g. Alzheimer's disease, Parkinson's disease) (APA, 2013).

LEARNING ACTIVITY 12.2

Analysis of data

Consider the data in Figure 12.6 on page 591 and answer the following questions.

1. What is the risk of a person developing schizophrenia if one of their biological parents has or has had the disorder?
2. What is the risk of a person developing schizophrenia if both of their biological parents have or have had the disorder?
3. (a) In what way do studies of people with varying genetic similarity provide evidence of a genetic vulnerability for schizophrenia? Explain with reference to data in Figure 12.6.
   (b) In what way do the data in Figure 12.6 also provide evidence for the role of non-biological contributory factors?
4. (a) In relation to schizophrenia, what is an adoption study?
   (b) Explain, with reference to the results, why the adoption study conducted by Kety and his colleagues (1988) provides evidence for some people having a genetic vulnerability for schizophrenia.
5. Explain why genetic vulnerability to a mental disorder does not mean causation.

Poor response to medication due to genetic factors

Hundreds of different medications ('drugs') have been designed to treat mental health disorders. Called *psychotropic* medications, these are most commonly prescribed to complement other therapies as part of an overall treatment plan; for example, with psychotherapy and/or a relaxation technique. Generally, their use with psychotherapy helps ensure the effectiveness of that therapy, while also helping ensure the effectiveness of the medication. A therapist can monitor whether the medication is being used appropriately, as well as its effects on symptoms.

Psychotropic medications are primarily used to control onset or severity of targeted symptoms so that the individual can function more effectively. Although psychotropic medications may inhibit, alleviate or reduce symptoms, they do not cure the underlying condition.

Generally, psychotropic medications for mental disorders are as effective as medications used for physical disorders. For example, an anti-depressant is as likely to help someone suffering from depression as an antibiotic is to help someone with pneumonia. However, no medication in any field of medicine, including psychiatric medicine, is likely to work 100% of the time. In particular, psychotropic medications are not necessarily effective for everyone and not without side effects or risks. People are not the same, and not all people respond or react to the medications in the same way (Diamond, 2009).

Even when used appropriately, there remains a proportion of people who have a poor response to certain medications. Generally, a *poor response to medication* means having little to no reduction in the number or severity of symptoms despite taking medication as prescribed. For example, it has been estimated that up to 45% of people with depression have a poor response to anti-depressant medications (Preskorn, 2014) and that up to 50% of people who have had schizophrenia for more than two years are only partially responsive to anti-psychotic medications, while 5–10% of people get no benefit at all (Lambert & Castle, 2003; Pantelis & Lambert, 2003).

There may be a poor response to medication at any time in the development of any mental disorder; for example, when symptoms first appear and the disorder is not yet established or following onset when symptoms increase in number and/or severity. Consequently, a poor response to medication is considered a risk factor for both the development and progression of mental disorder.

There are a number of reasons why someone may have a poor response to medication. A significant biological factor involves genetics. Research studies have found that some genes are responsible for how our body processes medications and that genetic variations can cause different people to respond in different ways to the same medication. For example, variations in genes may affect the absorption, distribution, metabolism or elimination of a particular medication. Therefore, because of their genetic makeup, some people may not respond well, if at all, to a medication designed and prescribed for their specific mental disorder (Belle & Singh, 2008; NIH, 2013).

For example, someone's body may metabolise ('break down') a particular psychotropic medication too slowly. The medication may then build up in the body, causing severe side effects. Someone else's body may metabolise the same medication too quickly, reducing or eliminating it before it has a chance to work effectively. And yet another person may be genetically predisposed to having significant and undesirable side effects from a medication, for example, because of the presence of too much or too little of the neurotransmitter or receptors targeted by the medication.

Although genetic variables may have a significant impact on the metabolism of a specific drug, they do not work in a vacuum. An individual's response to medication can also be affected by other biological factors such as age, sex, body weight, race, receptor sensitivity, diet and other co-existing disorders the individual may have or other drugs or substances they might be using. There are also psychological and social factors that can affect responsiveness to medication (see Box 12.1 on the next page).

Given that a person's response to medication may be influenced by genetic factors, some researchers are devising genetic tests that could be used to measure an individual's responsiveness to a specific psychotropic medication *before* they start taking it. For example, preliminary studies of people with schizophrenia indicate that DNA testing of the gene for a specific receptor for the neurotransmitter serotonin can predict their likely response to antipsychotic drugs. A similar form of gene testing is being devised to measure responsiveness to various antidepressant and anti-anxiety medications (NIH, 2013; Preskorn, 2014).

Figure 12.8 Hundreds of different medications have been designed to treat mental disorders, but some people have a poor response to medication due to genetic factors. The study of how genes affect the way a person responds to medications is called pharmacogenetics or pharmacogenomics.

BOX 12.1 Other reasons why there may be a poor response to a psychotropic medication

According to American psychiatrist and expert in psychopharmacology Ronald Diamond (2009), there are a number of reasons in addition to genetic factors that should be considered if a prescribed psychotropic medication does not work.

- *Is the diagnosis correct?* The medication is unlikely to work if the wrong disorder is being treated. For example, correcting someone's biological predisposition to schizophrenia is less likely to be effective if the person is being overwhelmed by social stressors.
- *Has a physical illness gone unrecognised?* It is estimated that 10% of people diagnosed with a mental disorder have unrecognised physical illnesses that are causing or contributing to their disorder.
- *Is substance abuse interfering?* Many of the symptoms common among a wide range of mental disorders can be caused, or made worse, by alcohol, stimulants, or other drugs.
- *Is the person taking the medication?* It has been estimated that half of all people with a diagnosed mental disorder do not take medications as prescribed. A medication is unlikely to work if it is not being taken, or not being taken correctly.
- *Has the dose been high enough for a long enough period of time?* Almost all of the psychotrophic medications take days to weeks to be effective. Some medications, such as clozapine (for schizophrenia), can take months. Too often people quit taking the medication before it has had a chance to work. Many people who are labelled 'nonresponders' go from one medication to another without giving any of them enough time to see if they would be effective. In other cases, a person will have stayed on a medication long enough but at such a low dose that it is unlikely to help.
- *Are there stressors in the person's life that would interfere with the medication's efficacy?* Medications do not work by themselves. Too often, people with a mental disorder deal with poor housing, not enough money and disrupted social support systems. Although medication is important, it is only one part of the treatment process.
- *Are there other things the person can do, in addition to taking the medication, to promote his or her own recovery?* Almost all people with a diagnosed disorder are doing the best that they can; their mental unwellness is not their fault. At the same time, if their life is going to change, they are going to have to be involved in making the change happen. What makes the symptoms better? What makes them worse? Are there behavioural strategies or activities that can help alleviate some of the symptoms? It is important the person is an active partner in his or her own treatment.

Figure 12.9 There are many possible reasons why some people have a poor response to psychotropic medication.

LEARNING ACTIVITY 12.3

Reflection

When prescribing a psychotropic medication, a doctor or psychiatrist tends to start with a standard dose then monitor how the patient responds, which is like a 'trial and error' process. In the future, it may be possible to use a patient's genetic profile to determine the best medication and the optimal dose.

What three ethical issues would be of particular relevance when this occurs?

Poor sleep

Poor sleep quantity or quality is associated with a range of mental disorders. These include mood disorders, anxiety disorders, addictive disorders, personality disorders, schizophrenia and other psychotic disorders. For example, difficulty in falling or staying asleep (which produces poor sleep) is one of the diagnostic criteria for posttraumatic stress disorder, acute stress disorder, generalised anxiety disorder and depression (AASM, 2014a; APA, 2013; Gruber, et al, 2014).

A significant number of people with these types of mental disorders report chronic poor sleep prior to its onset and/or following onset or diagnoses. It is possible that poor sleep may disrupt restorative functions during NREM states that may influence mental health. Consequently, poor sleep is considered a risk factor for the development or progression of certain mental disorders.

Figure 12.10 Poor sleep and depression often occur at the same time. Research studies have found that most people with depression have poor sleep and that people with sleep problems that cause poor sleep are more vulnerable to developing depression.

Although it is clear that poor sleep can precede the development of the symptoms that typify a disorder in a way that enables it to be distinguished from others, the relationship between poor sleep and mental disorders is commonly described as bi-directional, or 'two-way'. This means that poor sleep may contribute to or cause a mental disorder, or that a mental disorder may be the cause of poor sleep. This is a complex relationship that can make it difficult to isolate cause from effect. For example, some people with depression experience its symptoms before the onset of sleep problems, whereas sleep problems appear first with others (Alvaro, Roberts & Harris, 2013; NSF, 2018k).

Insomnia is very common among people of all ages with depression. They may suffer from a range of insomnia symptoms, including difficulty falling asleep (sleep onset insomnia), difficulty staying asleep (sleep maintenance insomnia), unrefreshing sleep, and daytime sleepiness. There is research evidence that people with insomnia have as much as a ten-fold risk of developing depression compared with those who sleep well. The risk of developing depression tends to be highest among people who experience both sleep onset and sleep maintenance insomnia (Baglioni, et al., 2011; NSF, 2018k; Taylor, et al., 2005).

Of course, poor sleep is also associated with many other mental disorders, but cause and effect can also be difficult to separate in relation to these disorders. For example, poor sleep and anxiety disorders share a close relationship. Many people with anxiety disorders get poor sleep from sleep-onset insomnia due to anxiety about not being able to fall asleep or to have as much sleep as desired. Poor sleep may then worsen existing symptoms and contribute to problems associated with the disorder.

Similarly, a person with schizophrenia is also likely to have poor sleep, especially before and during a psychotic episode. They typically take longer to go to sleep, awaken more frequently and get less sleep per night. And people with obsessive compulsive disorder may associate going to bed with a series of elaborate and unusual bedtime rituals (such as rearranging all the soft toys in their room or repeatedly checking that all the doors in their house are locked). These rituals can significantly delay going to sleep. Once asleep they may wake quite often and get less deep sleep (Bruck, 2006).

Substance use

Substance use is also considered a biological risk factor for mental disorder. *Substance use* refers to the use or consumption of legal or illegal drugs or other products. This may include alcohol, tobacco, prescription drugs and over-the-counter drugs. In some cases, the active ingredients of the substance may directly contribute to the development or progression of a disorder.

As with poor sleep, substance use and mental disorders often occur together. There is a high prevalence of this co-existence in relation to a wide range of substances and disorders. Furthermore, people with a mental disorder tend to experience substance use problems at far higher rates than the general population.

For example, studies have found that individuals diagnosed with a mood or anxiety disorder are about twice as likely to suffer also from a substance use disorder (involving abuse or dependence) compared with people in the general population. Similarly, people with schizophrenia have higher rates of tobacco, alcohol and other substance use or abuse than the general population. For example, some studies have found that the rate of smoking among people with schizophrenia can be as high as 90%, especially in samples of people hospitalised for treatment. People with schizophrenia are also more likely to use cannabis, and in greater quantities, than the general population. For example, one study found that almost 30% of people with schizophrenia had used cannabis in the 12-month period preceding the study and about 20% did so heavily. Cannabis use has also been strongly linked to other psychotic disorders, mood disorders and anxiety disorders, especially if family history suggests a genetic vulnerability to the disorder (ADF, 2018e; Green, Young & Kavanagh, 2005; National Institute of Drug Abuse [NIDA], 2010).

The reverse is also true, suggesting a bi-directional relationship between substance use and mental disorder. There is considerable research evidence that people who regularly use or abuse drugs or other substances are at a higher risk of developing a diagnosable mental disorder. For example, a person diagnosed with a substance use disorder is about twice as likely to suffer also from a mood or anxiety disorder. Similarly, one Australian study found regular cannabis use increases the risk of experiencing psychotic symptoms to a one in five chance (ADF, 2017; Large, et al., 2011; NIDA, 2010).

As with poor sleep and mental disorders, the high prevalence of coexistence between substance use issues and mental disorders does not necessarily mean that one caused the other, even if one appeared first. Establishing causality or what occurred first — the problematic substance use or the mental disorder — is difficult. The reasons a person may experience both problematic substance use and a mental disorder vary between individuals (ADF, 2017e). It may be that the person's symptoms prompt substance use or that the substance use is due to the mental disorder, or a combination of both. For example, someone developing or experiencing a mental disorder may use a substance as a form of self-medication in an attempt to alleviate anxiety, stress reactions, poor sleep or other specific symptoms. In addition, they may gravitate towards the substance that best medicates their particular symptoms. For example, the use of tobacco products by people with schizophrenia is believed to lessen symptoms of the disorder and improve cognition. Similarly, a person with social phobia may use alcohol to help feel more comfortable in social situations and a person with depression who is lethargic and unmotivated may use stimulants to increase their drive to get things done.

Establishing causality or what occurred first is also potentially complicated by a third set of issues such as work or relationship difficulties that have contributed to the development of the mental disorder, the substance use or both. Furthermore, imperfect recollections of when substance use or abuse started by people with mental disorders can also make it difficult to determine which came first (ADF, 2017; NIDA, 2010).

Figure 12.11 There is a higher rate of alcohol, tobacco and other substance use or abuse among people with schizophrenia than the general population.

Figure 12.12 Coexistence between substance use issues and mental disorders does not mean that one caused the other, even if one appeared first.

BOX 12.2 Cannabis use and mental health

What is it?

Cannabis is the most commonly used illegal drug in Australia and it comes in a number of different forms. For example, pot is the dried leaves and flowers of the cannabis plant and looks like tightly-packed dried herbs, and hash is a black-brown solid material made from the resin of the plant. Cannabis is usually mixed with tobacco and smoked in joints. It can also be smoked in bongs or pipes, baked into food (e.g. cakes and cookies) or sometimes drunk as a brew.

Safety

There is no 'safe way' to use cannabis, however, if you are choosing to use, it is important that you use as safely as possible.

Cannabis is also known as ...

marijuana, pot, dope, grass, hash, ganja, hashish, choof, hemp, herb, skunk, smoke, spliff, weed

Cannabis and your mental health

People usually use cannabis because they want to feel good, and in most cases they do. However if you already have a mental health problem, you might find that cannabis makes you feel worse. Sometime cannabis can make feelings of anxiety, panic or paranoia more intense. Young people who use cannabis are at risk of developing mental health problems, such as psychosis. Psychosis is when you start to believe strange things or see and hear things that aren't there. The risk of developing psychosis can be even higher if you start using cannabis when you are young or if other people in your family have had mental health problems.

Source: headspace (2018). *Cannabis* [Resources for young people]. Adapted from http://headspace.org.au/assets/Uploads/Resource-library/Young-people/Cannabis-web.pdf

eBookplus
Weblink
headspace

LEARNING ACTIVITY 12.4

eBookplus
Word copy of table

Review questions

1. Complete the following table to summarise biological risk factors for mental health disorder.

Biological risk factor	Description of risk factor	Example	Explanation of the risk
genetic vulnerability			
poor response to medication due to genetic factors			
poor sleep			
substance use			

2. (a) What characteristic primarily distinguishes biological risk factors from other types of risk factors?
(b) Explain whether all biological influences on thoughts, feelings or behaviour are necessarily due to genetics or inheritance.

3. Explain the meaning of a bi-directional relationship between a risk factor (such as poor sleep or substance use) and mental disorder.

4. (a) Why is it difficult to determine cause–effect when a risk factor and mental disorder coexist?
(b) Give an example of a research method that could be used to identify whether a risk factor or mental disorder occurs first.

5. To what extent can the impact of biological risk factors be controlled?

LEARNING ACTIVITY 12.5

Reflection

Understanding the coexistence and interrelatedness of mental disorder and poor sleep and/or substance use has been likened to answering the question of the chicken and the egg, i.e. *Which came first, the mental disorder or the poor sleep (or substance use)?*

To what extent is this an accurate analogy?

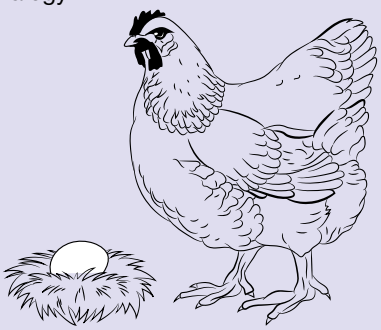

Figure 12.13 Which came first, the chicken or the egg?

PSYCHOLOGICAL RISK FACTORS

Psychological risk factors for mental disorders either originate or develop within the mind, which means there is often the potential to exert some control over their occurrence or influence. In this section we examine four examples of psychological risk factors — rumination, impaired reasoning and memory, stress and poor self-efficacy.

Rumination

Think about your tendencies when dealing with a disturbing problem or issue. When something upsets you, do you tend to mull on it, and keep going over the problem again and again? Do you dwell on why you feel bad and often express to others how bad you feel? If so, then you may be a ruminator.

Rumination involves repeatedly thinking about or dwelling on undesirable thoughts and feelings, such as problems or bad moods, without acting to change them. When we ruminate, we continuously think about aspects of negative situations that are upsetting, such as their causes or potential consequences, but do nothing to change anything (Nolen-Hoeksema, Parker & Larson, 1994; Selby, 2010).

According to American psychologist Edward Selby (2010), rumination is a risk factor for developing a mental disorder because it impedes problem solving, often to the extent that a person cannot see a way of overcoming or minimising the impact of whatever is upsetting them. People who ruminate tend to take problem solving too far and for too long. They will often spend hours analysing the situation, even after they've developed a plan for dealing with the situation. Sometimes, people will ruminate about the problem so much that they never develop a solution to the problem. This is when rumination heightens the risk of mental disorder. For example, if a situation is upsetting, then it is likely that the person will remain upset for as long as they ruminate.

Figure 12.14 People who ruminate are much more likely to develop problems with depression and anxiety.

American psychologist Susan Nolen-Hoeksama and her colleagues have studied rumination extensively and have found that rumination is a significant risk factor for the development of depression in particular. In addition, rumination can increase the severity

of depression and impede recovery. She describes rumination as a kind of negative thinking that not only prolongs an undesirable mood or worsens depression, but it impedes problem solving and successful mood-changing strategies, such as distraction, that can blunt the emotional effects of problems, disappointments and setbacks. In one study of people who lost a loved one to a terminal illness, it was found that those who ruminated around the time of their loss had higher levels of depressive symptoms over the 18 months after their loss than those who didn't ruminate (Nolen-Hoeksema, Parker & Larson, 1994).

When we are sad or upset, it seems reasonable to try to think through our problems and take the time to do so. However, studies have shown that when we ruminate in the context of a low mood, we are more likely to recall more negative memories from the past, interpret their current situation more negatively, and are more pessimistic and hopeless about the future. In addition, when rumination is focused on negative or unproductive thoughts, it can make someone a poorer problem-solver, not a better one. Therefore, rumination may prolong and enhance the negative thinking associated with a low mood and interfere with good problem solving. These processes may cause a low mood to evolve into a major depressive episode (Nolen-Hoeksema, 2000; Papageorgiou & Wells, 2001; Watkins & Baracaia, 2002).

studyon

Impaired reasoning and memory

Impaired reasoning and memory are two of the many cognitive problems that can contribute to the development and progression of mental disorders. These problems may be evident before the onset of other symptoms, which suggests a role in the onset of a disorder. They are also evident among people with different types of mental disorders, which emphasises a possible role in perpetuating a disorder. For example, many people with an anxiety disorder, psychotic disorder, mood disorder or personality disorder commonly demonstrate impaired reasoning through their distorted and maladaptive ways of thinking. Similarly, there are times when they may forget what they are doing in the middle of doing something, forget appointments and conversations, or have difficulty learning new skills because of memory impairments.

Impaired reasoning and memory have been studied extensively in relation to schizophrenia because of their prevalence among people with that particular disorder. It is estimated that as many as 85% of people with schizophrenia experience these types of cognitive problems. Furthermore, they tend to be evident regardless of the level of intelligence, educational background, age, sex or occupation of the person and other relevant socio-cultural factors (Medalia & Revheim, 2002).

Figure 12.15 Many activities can be used to distract from rumination and the best one to use depends on the personal preferences of the individual. For example, some potentially effective activities include reading a book, playing a game, exercising, talking to a friend (but not about the problem!), or watching a movie (Selby, 2010).

Impaired reasoning

Reasoning involves goal-directed thinking in which inferences are made or conclusions are drawn from known or assumed facts or pieces of information. When we are engaged in reasoning, we use what we already know or assume to be true and draw conclusions we believe to be correct or that best suit the available information. Reasoning enables us to solve problems, thereby allowing us to deal with the challenges of varying complexity we meet in everyday life.

Research findings indicate that impairments of varying degrees are evident in many specific types of reasoning among individuals with schizophrenia. We consider an example of impaired reasoning involving 'jumping to conclusions' when using probabilistic reasoning.

Probabilistic reasoning involves making judgments related to probability; more specifically, the likelihood of something happening or being true. This is a type of reasoning we engage in nearly every day. For example, you may find yourself wondering how likely it is to rain tomorrow, whether the fact that you have sneezed three times in the last 10 minutes means you are getting a cold, or how likely it is that you will bump into a friend if you go to the local shopping centre on Friday night.

Research evidence suggests that people with schizophrenia often have an impairment in probabilistic reasoning that affects how they interpret social situations. This type of reasoning impairment has also been implicated as a contributing factor in the development and persistence of the delusions associated with schizophrenia and other psychotic disorders. A *delusion* is a fixed, false belief that is held with absolute certainty, even when there is strong factual evidence against it. For example, someone may believe, regardless of whatever they are told or shown, that scientists are trying to poison them with radioactive particles delivered through their tap water. Delusions are a key symptom of schizophrenia, occurring in approximately three-quarters of cases, and have been consistently shown by research evidence to be associated with reduced data gathering, belief inflexibility and an impaired short-term working memory (Broome, et al., 2007).

British psychologists Phillipa Garety and David Hemsley and psychiatrist Simon Wessely (1991) conducted one of the best-known studies providing evidence that individuals experiencing delusions are likely to have a probabilistic reasoning impairment (see Box 12.3). This impairment is a type of cognitive bias, or tendency to process information in a particular way, called 'jumping to conclusions'.

As the term suggests, *jumping to conclusions* involves making hasty judgments or decisions on the basis of inadequate or ambiguous information, typically resulting in unjustifiable or incorrect conclusions. Usually there is more information available than is actually used and the conclusion is reached without accessing the additional information that may have resulted in a different or accurate conclusion. When judgments and decisions are reached in this way, the person with schizophrenia usually holds them with greater confidence and inflexibility than others would. People experiencing delusional beliefs tend to reach unwarranted conclusions about the causes of events very quickly, do so on the basis of reduced data-gathering and stick to the first explanation for an event that comes to mind.

Figure 12.16 Impaired reasoning may be evident in a person with schizophrenia who sees a drone flying overhead and immediately jumps to a conclusion that ASIO agents must be spying on them.

BOX 12.3 The beads task

British psychologist Phillipa Garety and her colleagues (1991) obtained evidence for a probabilistic reasoning impairment among people with delusions in an experiment in which four groups of participants were used. There were two groups of participants who had reported experiencing delusions (N=27) and two control groups (N=27). The groups were organised as follows:

- Group 1 — 13 participants with schizophrenia (and who reported experiencing delusions)
- Group 2 — 14 participants with delusional disorders
- Group 3 — 14 participants with a diagnosable anxiety disorder (referred to as 'anxious controls')
- Group 4 — 13 participants with no history of psychiatric treatment (referred to as 'normal controls').

Participants with schizophrenia were selected from both inpatients and outpatients at a psychiatric hospital. The 'normal control' participants were selected from nursing and clerical staff at the hospital. All participants in the 'anxious control' group were receiving treatment of some kind for their disorder, such as medication or psychological therapy.

The groups were compared on a test of probabilistic reasoning. The test, known as the 'beads task', is commonly used in research on probabilistic reasoning.

In a typical 'beads task', two jars are used, each with 100 beads of two different colours. One jar contains a higher proportion of beads of one colour (e.g. 85 red and 15 blue) and the other contains the reverse (85 blue and 15 red). Participants are informed of the proportions, then both jars are removed from view. One of the jars is then chosen, still hidden from view, and a bead is drawn from it and shown to the participant. The experiment is continued, with beads being drawn sequentially and always replaced. Although the participants are told that beads are being selected randomly, the sequence of colours is predetermined according to the ratio of the two colours.

The participant's task is to work out which jar the experimenter is drawing a bead from. After each bead is drawn, participants are asked if they would like to see more beads (i.e. if they would like more information) or if they can say, with certainty, from which of the jars the beads are being drawn. The dependent variable is the number of beads drawn before making a decision.

Garety and her colleagues found that participants who experienced delusions (Groups 1 and 2) requested significantly less information before reaching a decision on the reasoning task than did participants in the control conditions who did not experience delusions (Groups 3 and 4). Furthermore, 11 (41%) of the participants who experienced delusions (Groups 1 and 2) reached a firm decision (with 85% certainty) as to the identity of the jar after the very first bead was presented, compared with only one (3%) participant in the control conditions (Groups 3 and 4).

These findings have been replicated by many other studies. For example, a study by a team of Australian psychologists compared 35 people with schizophrenia (and a history of delusions) with 34 'healthy' controls on the beads task. The results showed that while four people from the control group (11.8%) reached a decision after only one draw, the proportion of people with schizophrenia doing so was significantly greater (34.3%) (Langdon, Ward & Coltheart, 2010).

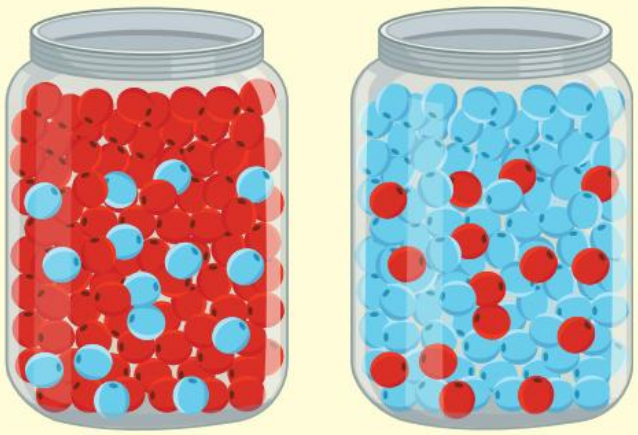

Figure 12.17 A typical 'beads task' uses two jars, each containing 100 beads of two different colours, but with reversed proportions of the two colours in each jar.

LEARNING ACTIVITY 12.6

Evaluation of research on impaired reasoning

Evaluate the experiment conducted by Garety, Hemsley and Wessely (1991) in Box 12.3 above. Answer the following questions.

1. What was the aim of the research?
2. Construct a research hypothesis that could have been tested by the procedures.
3. Identify the research sample and its population.
4. Name the type of experimental design.
5. (a) Identify the experimental and control conditions.
   (b) Why might the researchers have used two control groups?
6. Identify the operationalised independent and dependent variables.
7. Explain whether the results support the hypothesis.
8. What is a possible limitation of the results? Explain your answer.

Impaired memory

Researchers have found that impairments in memory are associated with a range of mental disorders. As shown in Table 12.3 below, these impairments may be in different types of explicit and implicit long-term memories, as well as in short-term working memory. The most pervasive memory impairments within this group of disorders are evident in schizophrenia.

Research studies have established that people with schizophrenia usually have some degree of memory impairment and tend to perform poorly on a wide range of memory tasks. In order to determine the extent and pattern of memory impairment in schizophrenia, American psychologist André Aleman (1999) analysed the results of 70 research studies on memory impairment which compared the performance of people diagnosed with schizophrenia with the performance of a control group of 'healthy normal' participants. The results revealed memory impairment to be wide-ranging in people with schizophrenia, with significant impairments of both short-term working memory and long-term memory.

More recent studies have focused on impairments of different types of long-term memory. Although both explicit and implicit long-term memories are impaired, episodic memories of past events and personal experiences tend to show the greatest loss. For example, when they read a story, people with schizophrenia tend to learn and recall much less of the details than control group participants. If the story is repeated, they also tend to gain less information from repeated exposure than control group participants, showing reduced learning and retention. In other studies of episodic memory, participants may be required to recall specific information about past events they have experienced. The researchers then verify the accuracy of the information by checking with relatives and friends. These studies have also found that people with schizophrenia tend to make more errors or omissions than control group participants (Danion, et al., 2007; Harvey & Sharma, 2002). Furthermore, a study by a team of Australian researchers found that episodic memory impairment also tends to be present *before* the presence of obvious psychotic symptoms (Brewer, et al., 2006).

Impairments in episodic memory can be very disabling. Individuals with episodic memory impairment may experience difficulties recalling their personal histories with reference to events, times, places and even the emotions they felt during events. For example, they may not be able to remember what they did yesterday and where they left their house keys earlier in the day.

People with an episodic memory impairment may also lose the ability to associate themselves with personally significant past events or plan for the future on the basis of past experiences. In cases of severe episodic memory impairment, they can become 'trapped in the present'. Along with other impairments of memory and reasoning, episodic memory impairment contributes to some of the key symptoms associated with schizophrenia, particularly disorganised behaviour and the impairments apparent in day-to-day functioning.

TABLE 12.3 Some memory impairments occurring with various mental disorders

	Short-term (working) memory	Episodic memory	Semantic memory	Visual memory	Verbal memory	Procedural memory
Schizophrenia	+++	+++	++	++	+++	
Major depressive disorder	++	++			++	
Autism spectrum disorder		++	++			
Bipolar disorder	++	++			++	
Obsessive-compulsive disorder	++					++
Posttraumatic stress disorder		++			++	

Key: ++, a common marked characteristic; +++ a core, severe and virtually universal characteristic of the disorder.

Source: Millan, et. al. (2012). Cognitive dysfunction in psychiatric disorders: characteristics, causes and the quest for improved therapy. *Nature reviews drug discovery, 11*(2), 141–168.

Figure 12.18 Research studies have found that impairments in memory are associated with several 'non-neurodegenerative' mental disorders, including schizophrenia and major depressive disorder.

Stress

Stress has long been recognised as a risk factor for the development and progression of a wide range of mental disorders. For example, in the 1960s two British psychiatrists found that 50% of the participants who had been diagnosed with schizophrenia had experienced at least one major, stressful life event at some time during the three weeks before their diagnosis (Brown & Birley, 1968). This finding influenced other researchers to investigate the role of stress in schizophrenia and it was found to play a potentially significant role. A number of models were also devised to explain its role; in particular, how stress contributes to the onset and course of schizophrenia.

The most influential model emphasised how stress increased vulnerability to the development of schizophrenia. The model has since been applied to other major mental disorders. Although there are now different versions of the model, they tend to have the same basic structure, but vary in the emphasis given to different elements.

Generally, the stress-vulnerability model explains why some people may develop a mental disorder when they experience stress and others do not. According to the *stress-vulnerability model*, all people have some level of vulnerability for any given mental disorder and the risk of developing the disorder varies in relation to the combined effect of an individual's level of vulnerability, the level of stress that is experienced and their ability to cope. The level of stress may be influenced by a single stressor or the combined effect of a number of stressors. Furthermore, depending on coping skills, individuals with a higher level of vulnerability are more likely to develop a mental disorder in response to a lower level of stress than will someone with a lower vulnerability (who is likely to require a higher level of stress to develop a disorder).

In terms of this model, *vulnerability* is a predisposition that increases the likelihood of developing a specific mental disorder. Because possessing vulnerability places someone at a higher risk for developing a disorder, it is sometimes described as a sub-category of a risk. In addition, the earlier versions of the model tended to consider vulnerability as genetic (e.g. having a family history of mental disorder), but contemporary versions tend to allow for other biological vulnerabilities (e.g. infection during pregnancy, birth trauma, neurodevelopmental disorders) as well as psychological and social vulnerabilities.

The Mental Illness Fellowship of Victoria (now called Wellways) (2013) has devised a contemporary version of the stress-vulnerability model to incorporate risk and protective factors within a biopsychosocial framework. According to this version, risk factors make it more likely that mental disorder symptoms will emerge and protective factors make it less likely that symptoms will emerge. Both risk and protective factors may include aspects of a person's biology (biological factors), personal attributes (psychological factors), and/or environment (social factors). Consistent with the biopsychosocial model, it is the interaction of these risk and protective factors that influence the likelihood of symptoms occurring in a vulnerable person.

As shown in Figure 12.19 on the next page, stressors are incorporated as social factors. An individual's stress reaction has also been included, taking account of the effects on the body (biological risk factor) and the mind (psychological factor). It is emphasised that none of the risk factors, including stress, should be considered the 'whole cause' of a mental disorder. When a person has a number of risk factors then that person is more vulnerable to mental disorder and when someone has all possible risk factors, there is still only a 40% chance that they will develop a mental disorder. In addition, protective factors do not only safeguard against the onset of a mental disorder, they also assist recovery and minimise relapse.

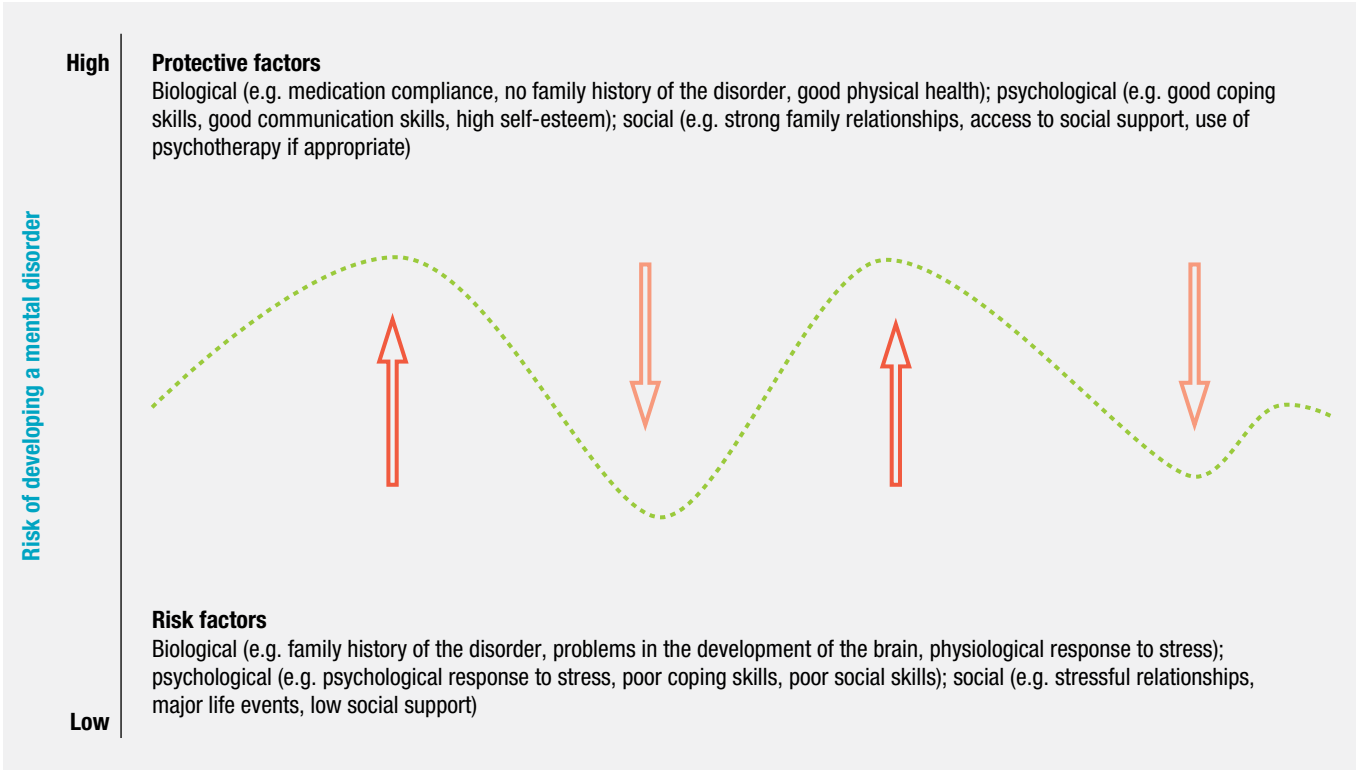

Figure 12.19 An example of a stress-vulnerability model that incorporates risk and protective factors within a biopsychosocial framework

Source: Based on Mental Illness Fellowship of Victoria (2013). *Recognising possible triggers of mental illness onset or relapse: The stress-vulnerability-coping model of mental illness*. Retrieved February 20, 2016, from http://www.mifellowship.org/sites/default/files/styles/Fact%20Sheets/Stress%20Vulnerability%20Coping%20Model.pdf

Poor self-efficacy

How do you view your ability to select, influence and control the circumstances of your life? If you have a strong sense of self-efficacy, you believe you can generally succeed, regardless of past failures and current obstacles.

Self-efficacy refers to an individual's belief in their capacity to execute behaviours necessary to succeed in a specific situation or accomplish a specific task. It is essentially a feeling of competence on which we base our expectation of success in various situations we encounter in everyday life. This also influences the challenges we accept and the effort we may expend in achieving a goal. For example, if you have a strong sense of self-efficacy, you are more likely to approach a difficult task as a challenge to be mastered. You are also likely to exert strong motivational effort, persist in the face of obstacles and find ways of overcoming them in order to succeed.

The concept of self-efficacy was originally proposed by Albert Bandura (1977b, 1986) as part of his social learning theory. Bandura described it as specific to a situation and therefore not transferable to all areas of life. It is a state of mind that varies from one specific task or situation to another. For example, a business executive may have a strong sense of self-efficacy in terms of their organisational abilities but have poor self-efficacy in terms of their parenting abilities. Similarly, self-defence training may have a significant effect on improving your belief to deal with a potential assailant, but this increased self-efficacy about your ability to fight off or escape from a dangerous person does not necessarily transfer to other areas of your life. For example, it will not significantly increase your self-efficacy about your ability to snowboard, play the piano, write an essay or to do well on an end-of-year exam.

Self-efficacy may seem to be the same as self-esteem but they are considered different concepts. *Self-esteem* refers to our overall feeling of self-worth. In contrast, self-efficacy is not concerned with the global perspective of what a person thinks about themself. Instead, it is about the perception or judgment of being able to accomplish certain tasks. In sum, self-esteem is a judgment of self-worth, whereas self-efficacy is a judgment of capability.

According to Bandura (1977b), self-efficacy is a product of learning through experience, either directly through personal engagement or indirectly through observing other people's performances (i.e. vicariously). The more we experience success

on a task, the more likely we are to feel competent and perform well on that task (or a very similar task). Performing a task successfully therefore strengthens a person's sense of self-efficacy. Conversely, failing to adequately deal with a task or challenge can undermine or weaken self-efficacy.

Self-efficacy affects how vulnerable a person is to experiencing stress, anxiety and depression, with poor self-efficacy increasing the chance of developing a mental disorder and impairing our ability to overcome challenges that arise when we experience difficulties. For example, people with poor self-efficacy who believe that potential stressors are unmanageable tend to view many aspects of their environment as dangerous and unsafe. They tend to dwell on their inability to cope, magnify the severity of possible threats and worry about things that rarely happen. In contrast, people who believe they can successfully cope with potential stressors tend to be less affected by them (Bandura, 1988; Maciejewski, Prigerson & Mazure, 2000).

Self-efficacy can also contribute to the development of anxiety disorders or depression through 'thought control efficacy'. Bandura describes this as how much control a person believes they have over their ruminative, negative and disturbing thoughts. According to Bandura (1991), it is not the frequency of a person's ruminative thoughts that causes anxiety or depression, but rather, it is their perceived inability to 'turn them off' that is the major source of distress. Therefore, people with poor self-efficacy about their ability to control or 'turn off' ruminative, negative and disturbing thoughts are more likely to experience anxiety or depression than those with high self-efficacy about this ability.

Bandura (1995) has also linked poor self-efficacy to a person's functioning and emotional wellbeing, He proposes that people with poor self-efficacy tend to shy away from difficult tasks as they view them as personal threats. They are also likely to have low aspirations and weak commitment to the goals they choose to pursue. When faced with difficult tasks, they are likely to dwell on their personal deficiencies, the obstacles they will encounter and all kinds of adverse outcomes, instead of concentrating on how to perform successfully. Furthermore, people with poor self-efficacy tend to slacken their efforts and give up quickly in the face of difficulties. They are also slow to recover their sense of efficacy following failure or setbacks. And because they tend to view bad performance as being due to their lack of ability or competence, it does not require much failure for them to lose faith in their capabilities. They are consequently more vulnerable to experiencing stress, anxiety and depression.

Figure 12.20 Self-defence training may have a significant effect on improving your belief to deal with a potential assailant, but this increased self-efficacy about your ability to fight off a dangerous person does not necessarily transfer to other areas of your life, such as your ability to snowboard or play the piano.

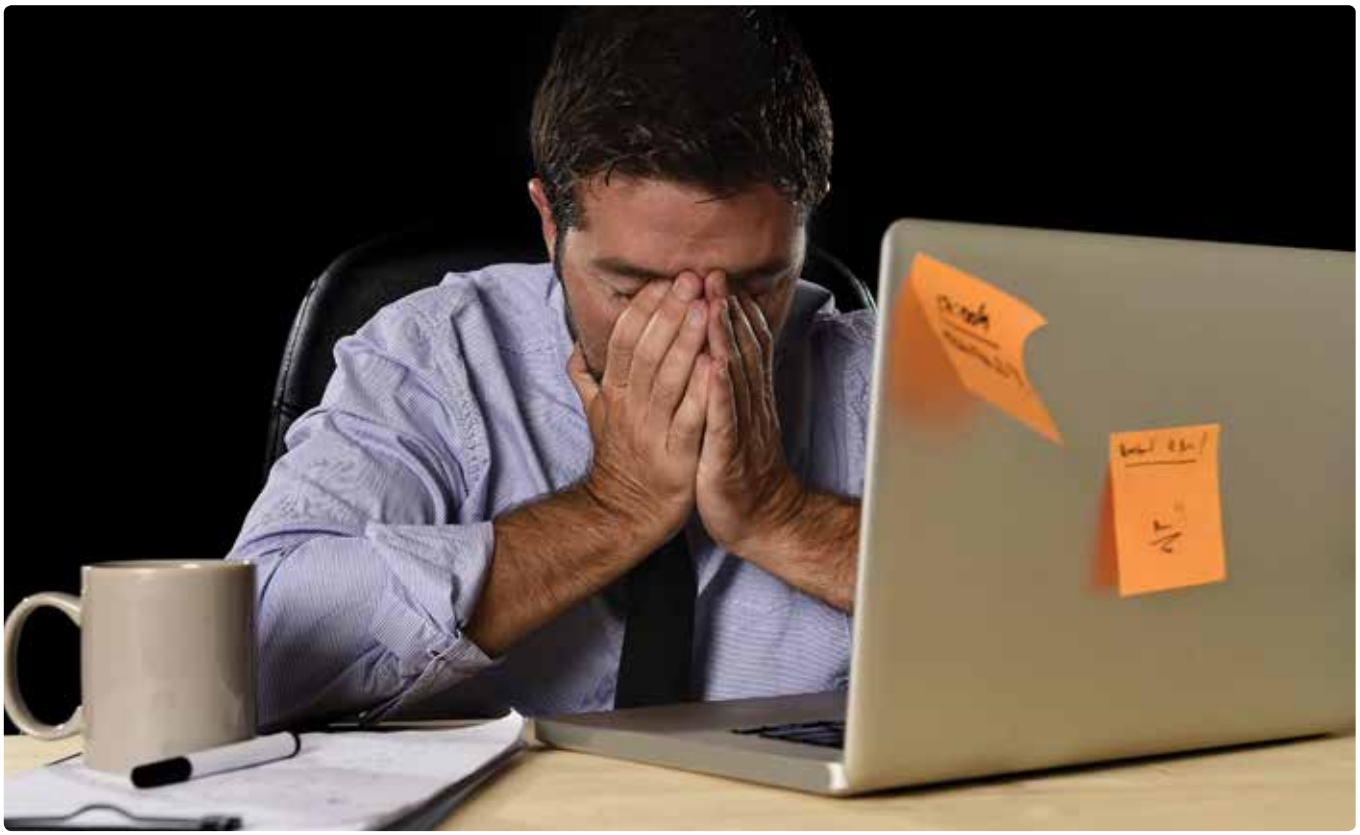

Figure 12.21 When faced with a difficult situation, individuals with poor self-efficacy tend to give in easily, attribute failure to internal qualities and are more vulnerable to experiencing stress, worry, anxiety and depressive symptoms.

LEARNING ACTIVITY 12.7

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Review questions

1. Complete the following table to summarise psychological risk factors for mental health disorder.

Psychological risk factor	Description of risk factor	Example	Explanation of the risk
rumination			
impaired reasoning and memory			
stress			
poor self-efficacy			

2. In what way is rumination like and unlike worrying?
3. (a) Give an example of a reasoning or memory impairment that could be associated with either depression or an anxiety disorder (e.g. phobia).
(b) Explain how this impairment could contribute to the development or progression of the disorder.
4. What feature primarily distinguishes psychological risk factors from other types of risk factors?
5. (a) To what extent may each of the psychological risk factors co-exist with a mental disorder?
(b) What does this suggest about cause–effect for each factor?
6. To what extent can the impact of psychological risk factors be controlled?

LEARNING ACTIVITY 12.8

Reflection

Describe a situation in which high self-efficacy enabled you to overcome one or more obstacles and succeed.

SOCIAL RISK FACTORS

Social risk factors for mental disorders originate or develop in the external environment and interact with biological and psychological factors in influencing our mental health state. In this section, we examine the possible influence of disorganised attachment, loss of a significant relationship and the role of stigma on the development and progression of mental disorders.

Disorganised attachment

Attachment is a relationship between two people in which either or both persons feel strongly about the other. In relation to human development, **attachment** refers to the emotional bond which forms between an infant and another person, usually the primary caregiver such as their mother and father. Infants are also capable of developing different and separate attachments with other people who have significant involvement in their lives, for example, an older sibling, a grandparent or a childcare worker at a daycare centre where they may spend time.

Attachment can vary in terms of how strong the connection is and the kind of connection. The strength of each attachment also depends to a large extent on how sensitive and responsive the primary caregiver is to the infant's needs. The infant's responsiveness is also a factor in the nature and type of attachment that is formed.

The pattern of thoughts, feelings and behaviour associated with each type of attachment tends not to change over time unless there are significant changes in life circumstances for either the caregiver or the infant. If the caregiver substantially changes the way in which they interact with the infant, particularly the way in which they respond to the infant's expressed needs, then the nature of the attachment may change (Ainsworth, 1982). Given the importance and durability of an attachment relationship, an unhealthy attachment formed early in life is considered a risk factor for the development and progression of mental health disorder.

When an infant has a secure, healthy attachment, the parent (or other primary caregiver) provides a secure base from which the infant can venture out and independently explore their environment, knowing that they will always return to a safe place. The parent is a source of comfort and positive feelings. If the parent returns after absence, the infant is enthusiastic and seeks close physical contact with them. Securely attached infants feel safe, loved and confident that their parent(s) will provide care and support when required. Adults who formed secure attachments as infants tend to have good self-esteem, seek social support when they need it, have trusting, lasting relationships and are comfortable sharing feelings with their friends and partners (Ainsworth, 1982; Bachman & Zakahi, 2000).

When a parent (or other primary caregiver) is continually neglectful or abusive in other ways, even if unintentional, the infant may experience fear or feel threatened. Although the attachment figure may provide care at various times, they are also a source of distress because they are 'scary'. Fear can create a need for 'flight', but care is also provided from the very person who is frightening. This dilemma can be unsettling and confusing. It is likely that there will often be apprehension about approaching the person when care or comfort is needed because their reaction can be unpredictable. In these conditions, some infants and children disassociate, as if withdrawing or disconnecting from their inner self. They may also feel detached from what's happening to them. What they're experiencing may be blocked from their consciousness. When an infant or child is in this conflicted state, they have developed a disorganised attachment with their primary caregiver(s) (Catlett, 2016; Main & Solomon, 1986).

Disorganised attachment is a type of attachment that is characterised by inconsistent or contradictory behaviour patterns in the presence of a primary caregiver. For example, when reunited with a caregiver following a period of separation, a child with a disorganised attachment typically expresses odd or ambivalent ('contradictory') behaviour toward them. When seeking close contact, they may do so by moving slowly towards the caregiver or approach with their head turned in another direction as if avoiding eye contact. In some cases, they may impulsively start to run up to the caregiver, then immediately pull away. Infants who have formed a disorganised attachment also tend to respond to reunions with their caregiver with fearful or odd behaviours such as rocking themselves, ear pulling, 'freezing' or going into a trance-like state. They tend to lack organised strategies for achieving physical proximity with a caregiver, particularly when distressed or frightened (Main & Solomon, 1986; 1990).

In 1986 American psychologists Mary Main and Judith Solomon identified the disorganised attachment type and formally called it *disorganized/disoriented attachment*. It is now commonly referred to more simply as disorganised attachment. Table 12.4 below summarises behavioural characteristics that may indicate disorganised attachment.

TABLE 12.4 Indices of disorganisation/disorientation

Index	Behavioural characteristic
I	Sequential display of contradictory behaviour patterns
II	Simultaneous display of contradictory behaviour patterns
III	Undirected, misdirected, incomplete, and interrupted movements
IV	Stereotypies, asymmetrical movements, mistimed movements, and anomalous postures
V	Freezing, stilling, and slowed movements and expressions
VI	Direct indices of apprehension regarding the parent
VII	Direct indices of disorganisation or disorientation

Source: Main & Solomon (1990). Procedures for identifying infants as disorganised/disoriented during the Ainsworth Strange Situation. In M. T. Greenberg, D. Cicchetti, & E. M. Cummings (Eds.), *Attachment in the preschool years* (pp. 121–160). Chicago: University of Chicago Press.

Figure 12.22 Disorganised attachment is characterised by inconsistent or contradictory behaviour patterns in the presence of a primary caregiver. For example, a child may be apprehensive and avoid approaching the caregiver when reunited after a period of separation.

Researchers who investigated early life experiences associated with disorganised attachment have linked it to variables such as abuse, hostile caregiving, unresponsive caregiving, post-natal depression and the mother having an unresolved trauma or experienced loss through separation, divorce and death. However, research studies have also found disorganised attachment among infants in families where none of these variables is evident and the 'middle-class family' lifestyle appears 'normal'. So, psychologically inappropriate parenting practices do not fully explain disorganised attachment in an infant. The origins of this attachment type seem to be highly complex and much research remains to be done (Meins, 2011).

Disorganised attachment is not considered to be a mental disorder, but it is considered a social risk factor for the development and progression of mental health disorder. There is considerable research evidence that the attachment(s) formed during infancy, particularly in the first 12 months of life, influences the individual's socio-emotional development, both in the short term and into adulthood.

For example, a secure and therefore healthy attachment is linked to the development of trust and security, whereas disorganised attachment can result in anxiety and inner turmoil that become risk factors for developing a mental disorder. Individual differences in emotional intelligence between children of the same age have also been linked to different attachment types. Children who have formed a healthy attachment tend to be more skilled in reading and interpreting emotions in others (e.g. from facial expressions) when compared to children with a disorganised attachment. Similarly, children with secure attachments tend to have more emotional control, to be more emotionally resilient than others and therefore more able to easily adjust to and recover from events that cause upset, stress or anxiety. In contrast, children classified as having a disorganised attachment at the age of 12 months are more likely to develop elevated levels of aggression at age 2, have a higher rate of disruptive behaviour at age 5, and to be more impulsive and have difficulty regulating their emotions. These early differences can persist throughout the lifespan (Bachman & Zakahi, 2000; Fearon, et al. 2010; Meins, 2011).

In adulthood, people with a disorganised attachment tend to find it difficult to form close relationships, to open up to others or to seek out help or other forms of social support. They often have difficulty trusting people, as they were unable to trust those they relied on for care and safety when growing up. They may struggle in their relationships or when parenting their own children because of their personal experiences and lack of exposure to a suitable role model. They may also find it difficult to form and sustain solid relationships because they struggle with poor social or emotional regulation skills. They often have difficulty managing stress and may even demonstrate hostile or aggressive behaviours. Because of their negative early life experiences, they may see the world as an unsafe place. These types of characteristics can significantly influence the development and progression of mental health disorder (Catlett, 2016).

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Loss of a significant relationship

We form many relationships throughout our lives, with some being more significant than others. A *significant relationship* is a relationship perceived by an individual as being of considerable importance to them. This type of relationship is primarily formed between two or more people but is not necessarily limited to people. Significant relationships include parents, siblings, friends, bosses, even pets and especially intimate others (Brenner, 2011).

Psychologists have tended to focus on the study of interpersonal relationships — those involving people, especially relationships within families, groups and between people who are friends, dating partners or in long-term cohabiting ('living together') relationships. These types of relationships are considered significant because they tend to involve elements such as feelings of attachment, affection and/or love, the fulfilments of needs, some degree of dependence or interdependence, and the ability to have a meaningful influence on another person (Kassin, Fein & Markus, 2008).

Loss of a relationship that has these types of elements can therefore have serious or even devastating consequences for the person experiencing that loss. When the loss is due to serious illness, a break up or death, the loss is inevitably a challenging and potentially very stressful life event.

Following loss of a significant relationship, most people typically experience grief. *Grief* is the total reaction to the experience of loss, comprising a mix of thought, feelings and behaviours. Two of the more common reactions are sadness and separation anxiety. Other reactions may include stress, general anxiety, confusion, exhaustion, anger, guilt, shame and blame. It is not uncommon for grief to cause sleep loss, especially due to sleep onset insomnia. Physical reactions such as nausea, headaches, loss of appetite and various other responses associated with stress or anxiety may also be experienced. Sometimes there is increased alcohol, smoking or drug use, both legal and illegal drugs (Hall, 2011; Lifeline, 2018).

Grief is a normal, natural and inevitable reaction to loss. However, there is no 'right or wrong' way to grieve. Everyone grieves in a different way, regardless of their cultural background. The intensity of the grief, how long it lasts and the reactions to it will differ from person to person. It can be short-lived but it is often an enduring process that has peaks and troughs. There may be times when it seems like grief will never really go away completely.

Although grief affects a person's mental health, it is not considered a mental health problem or disorder in itself. For most people, grief resolves naturally on its own over time. Sometimes, however, the loss of a significant relationship can be overwhelming and have a prolonged impact on a person's mental health. Prolonged grief or 'non-closure' may result in the grieving person remaining stuck in their negative state with unresolved grief and an inability to move forward (Brenner, 2011). There may also be changes in one's life — pleasurable things that were once done together, for example, are no longer done. In such cases, loss of a significant relationship can precipitate the development of depression in particular. About one-third of people experiencing grief develop depression, but it is usually weeks or months later (Black Dog Institute, 2013). For example, in one study, it was found that at one month after a loss, about one-third (30–40%) of people experiencing grief also experienced depression, 15% remain depressed a year later and at two years the rate of depression was about 7% (Black Dog Institute, 2015; Hughes, 2011).

Researchers have also found that the loss of a significant relationship among vulnerable individuals in particular may precipitate depression or a substance use disorder in the same way that other major stressors, such as losing your job, can precipitate the disorder. Other studies have found that people who have a previous history of depression or substance abuse may be at a higher risk of experiencing a relapse of their disorder due to their loss (Black Dog Institute, 2015; Hughes, 2011).

Figure 12.23 Some people experiencing grief following loss of a significant relationship go on to develop depression.

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Weblinks
Managing loss and grief

Role of stigma as a barrier to accessing treatment

Mental health support in Australia is provided through a combination of primary health care services, principally by general practitioners, specialised public mental health services managed by states and territories, private sector services delivered by psychologists and psychiatrists, and hospital services.

Despite the availability of services, almost two-thirds of people do not seek or have access to treatment. For example, a significant number of people with mental disorders are unemployed and/or homeless, which are barriers to treatment that make access extremely difficult, if not impossible. Of those who can access support, many report that help is too expensive or they didn't know where to get it, or that they thought they could manage on their own or with the help of friends or family (ABS, 2008; SANE, 2018b).

There is considerable research evidence that many people also avoid getting the help they need because of the fear of being stigmatised. Consequently, stigma is considered to be a barrier to accessing treatment. The word 'stigma' is derived from the Latin *stigmat* and was used to refer to the mark or scar left when the body of a slave, traitor or criminal was 'branded' to publicise that there was something bad or unusual about them and therefore should be avoided. The contemporary meaning of stigma is based on this original meaning.

Stigma is a sign of shame, disgrace or disapproval typically associated with a particular characteristic or attribute that sets a person apart, such as skin colour, cultural background, a disability or a mental health disorder. Negative labelling, name calling, being treated without the same level of respect as others and marginalisation are forms of stigma. To *stigmatise* means to regard a person as unworthy or disgraceful. When someone is stigmatised they are viewed in a negative way because of some characteristic, including one or more ways in which they may act or behave. When someone is actually treated in a negative way because of their mental disorder, then this is discrimination. Stigmatisation often involves discrimination. Three out of four people with a mental disorder report that they have experienced stigmatisation (beyondblue, 2015a; SANE, 2018b).

Globally, stigma is considered a major cause of discrimination and exclusion. According to the World Health Organization (2018), stigma affects people's self-esteem, disrupts their family relationships and limits their ability to socialise and obtain housing and jobs. It hampers the prevention of mental health disorders, the promotion of mental wellbeing and the provision of effective treatment and care. It also contributes to the abuse of human rights.

Different types of stigma are associated with mental health disorders. Some are based on negative attitudes or beliefs, others are due to a lack of understanding or information (SANE, 2016b). Two of the most common types are called social stigma and self-stigma.

Figure 12.24 People experiencing self-stigma may be so embarrassed or ashamed by their symptoms that they try to conceal them and consequently do not seek treatment.

The term *social stigma* refers to any aspect of an individual's identity that is devalued in a social context. In relation to mental disorders, this involves the negative attitudes, beliefs and behaviour in the community that motivate people to exclude, reject, avoid, fear and discriminate against people with a mental disorder. For example, a social stigmatising view about people with depression is, 'People with depression should be able to snap out of it'.

Self-stigma refers to the stigmatising views that individuals hold about themselves. In relation to mental disorders, it occurs when individuals with a mental disorder accept negative attitudes and beliefs held by others and internalise or apply them to themselves. For example, a self-stigmatising view by someone with depression is, 'I should be able to snap out of my depression'.

Some of the effects of stigma include:

- feelings of shame, self-doubt, poor self-esteem, low self-efficacy, hopelessness and isolation
- distress
- lack of understanding by family, friends or others
- misrepresentation in the media
- fewer opportunities for social interaction and employment
- bullying, physical violence or harassment.

In addition, there is considerable research evidence that stigma discourages help-seeking. Like any other illness or disorder, a mental health disorder is usually easier to treat if diagnosed early. However, many people with early symptoms of a mental disorder are reluctant to seek help because they associate mental disorder with negative and inaccurate beliefs, attitudes or stereotypes. For example, a person may decide to conceal their symptoms as best they can rather than expose them for possible trivialisation, ridicule or some other unwanted response. Because stigma can lead to a reluctance to seek and/or accept necessary help, it is a barrier to accessing treatment.

Stigma can also perpetuate a mental disorder and delay recovery or make recovery harder. For example, staying active and engaged, living a productive life, and feeling accepted by others as part of the community are important elements of mental wellbeing. However, the experience of stigma can erode self-confidence and make people with a mental disorder shy away from engaging with others to avoid misunderstanding and ridicule. Many people with depression and anxiety disorders report that the stigma and discrimination they experience may be worse than their mental health condition(s) (beyondblue, 2015a; SANE, 2018b).

According to beyondblue (2015a), some people with depression and anxiety disorders have also reported experiencing stigmatising attitudes from mental health professionals. For example, they report that they feel patronised, punished or humiliated in dealing with professionals. Stigmatising attitudes and behaviours from health professionals may be unintentional, as the health care providers may be unaware that their language and actions can be harmful.

Despite this, there can be significant consequences. Stigma may contribute to feelings of embarrassment and shame, which may decrease the likelihood of seeking help, increase psychological distress and reduce treatment adherence. 'Diagnostic overshadowing', in which people with depression and anxiety receive poorer physical healthcare than others, can also be attributed to stigma. These negative consequences may contribute to the increased risk of suicide and the higher mortality rates among people with mental health conditions.

Research studies have also identified certain groups for whom stigma has an even stronger effect on preventing people seeking treatment. These include young people, men, people from ethnic or cultural minorities, and people in the military and health professions. For example, as many as 60% of military personnel who experience mental health problems do not seek help due to concerns about stigma for reasons such as 'My unit leadership might treat me differently' and 'I would be seen as weak' (Clement, et al., 2015; Sharp, et al., 2015).

BOX 12.4 Elements of stigma

According to research conducted by beyondblue (2015a), the most common elements of stigma include:

- **perceptions that a person is 'weak, not sick'** — *'My father and my sister don't believe in mental illness. If you can't cope with something it's a weakness of character, not an actual illness.'* (Person with depression)
- **perceived dangerousness** — *'All mentally ill are tainted by reports of the extremely unusual "crazy and dangerous". As if at any time, they could become horrific mass murderers!'* (beyondblue blueVoices member)
- **beliefs that a person is responsible and can control his/her condition** — *'Most people seem to think depression is . . . something that is within your character to control.'* (Person with a mental health condition)
- **feelings of guilt, shame and embarrassment** — *'You keep it to yourself because you're ashamed of it.'* (Person with depression)

(continued)

(continued from previous page)

- **a reluctance to disclose a diagnosis, due to concerns about discrimination and harassment** — *'When he [husband] was looking at applying for jobs, his psychiatrist said, "I wouldn't mention he's got a mental illness. They don't need to know".'* (Carer)
- **a desire for social distance** — *'I lost quite a few friends because they were scared of me or didn't know how to treat me.'* (Person with depression and anxiety)

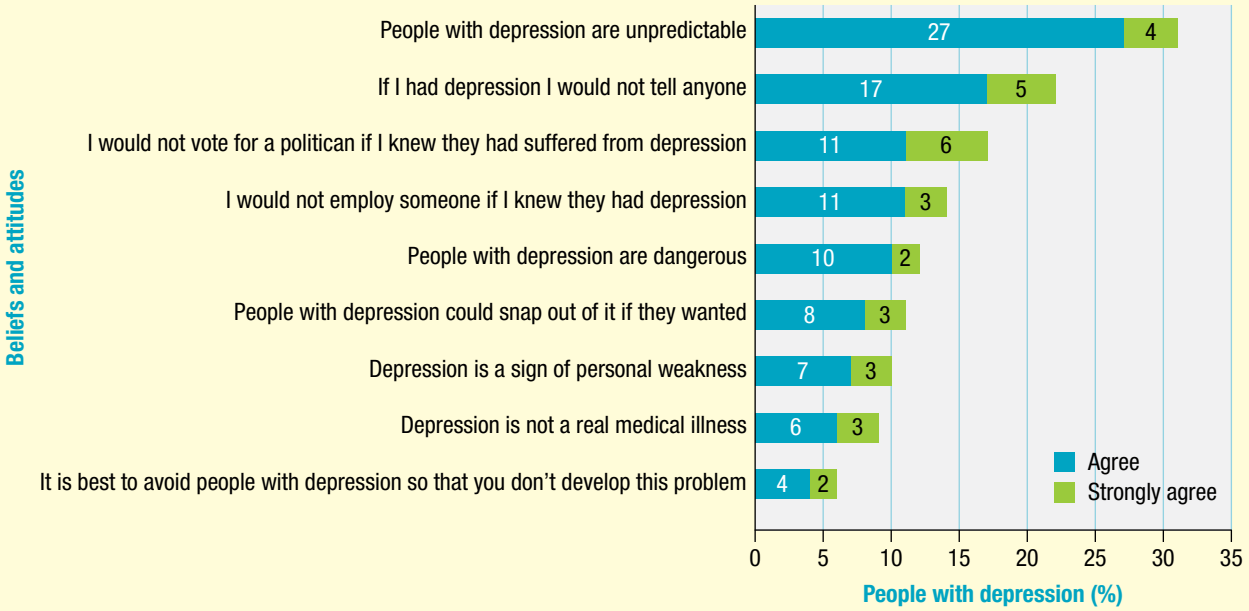

Figure 12.25 Research findings on levels of stigma experienced by people with depression

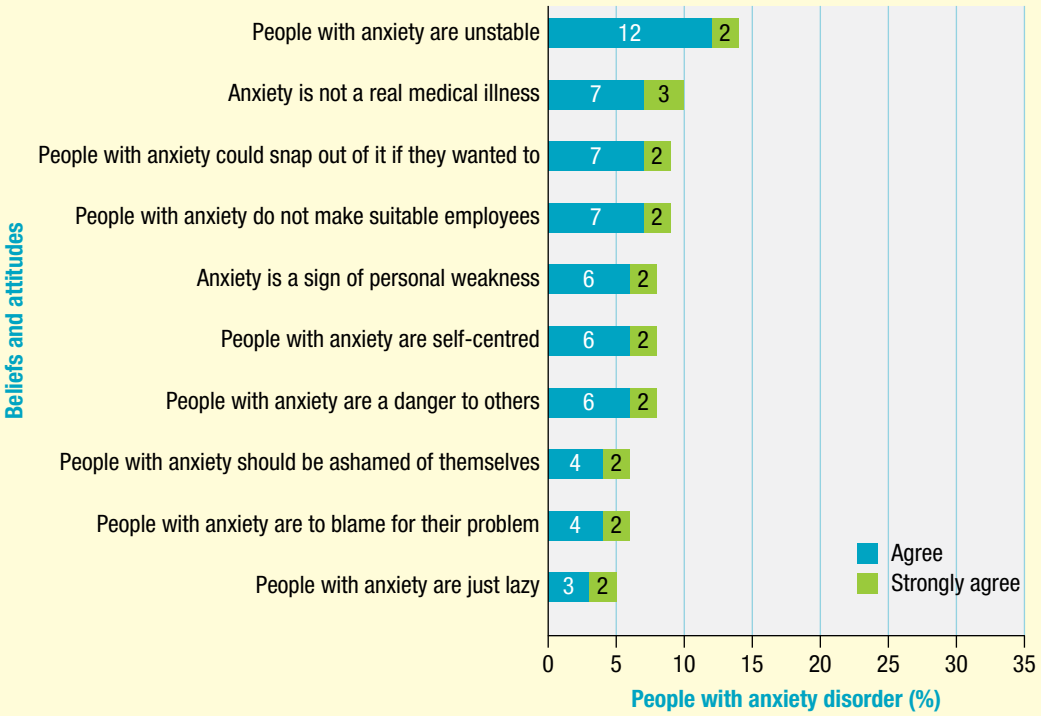

Figure 12.26 Research findings on levels of stigma experienced by people with generalised anxiety disorder

Source: beyondblue (2015). *beyondblue* Information Paper: Stigma and discrimination associated with depression and anxiety. Retrieved from https://www.beyondblue.org.au/docs/default-source/policy-submissions/stigma-and-discrimination-associated-with-depression-and-anxiety.pdf?sfvrsn=0

LEARNING ACTIVITY 12.9

Analysis of data

Examine figures 12.25 and 12.26 in Box 12.4 opposite and answer the following questions with reference to relevant data.

1. Explain whether the data provide evidence for the presence of stigma in the community.
2. Explain whether the *level* of stigma is higher with depression or generalised anxiety disorder.
3. Compare and contrast the examples of stigma-associated beliefs and attitudes experienced by people with each disorder, ensuring you refer to a similarity and a difference.
4. Explain whether the data indicate that stigma is a barrier to treatment for mental health disorder.

One in five think anxiety sufferers 'putting it on'

By Eryk Bagshaw

Sitting at his desk at work, Oliver Shawyer would get so anxious he thought he was having a heart attack.

'I'd get uncontrollable perspiration, an increased heart rate and then horrible chest pain', the 30-year-old Sydney advertising executive said.

'The only way I could deal with it at the time was by inflicting pain to distract my mind. To stop myself from crying, I would just dig my fingers right into my legs.'

Mr Shawyer is one of up to 2 million Australians who have anxiety, the most common mental health condition in the country.

New research has revealed that one in five Australians believes people with anxiety are 'putting it on'.

The research, which is to be released by charity beyondblue on Monday, also shows more than 10 per cent of Australians aged between 30 and 34 believe people with anxiety are untrustworthy.

Beyondblue chief executive Georgie Harman said anxiety was not just feeling stressed or worried.

'It is when these feelings don't subside and are ongoing without any particular reason or cause. Everyone feels anxious from time to time, but for someone experiencing anxiety, these feelings can't be easily controlled', she said.

The survey of more than 1200 Australians reveals that damaging attitudes and discrimination against those suffering from anxiety remain.

Almost half agree that people with anxiety are judged or discriminated against. More than 15 per cent of males do not want to work with someone with anxiety, the research has found.

'It's alarming', said Mr Shawyer, who after years of treatment has brought his anxiety under control.

'I can remember some mornings when I felt like I was going to die, and sometimes that feels like it might be better, but in the end you can get to a place where you can have a fulfilling life', he said.

Australian actor Guy Pearce knows Mr Shawyer's story well, having also suffered from anxiety.

'I have lived with anxiety ever since being a child and know how easy it is to be overwhelmed by the physical and mental symptoms,' he said.

'I know it can affect anyone regardless of their age, their employment or where they live.'

Ms Harman said beyondblue was working towards tackling negative perceptions in the third year of its campaign.

'It is not just the relatively small number of harmful and incorrect attitudes we are working to change, but the larger proportion of the public who are unaware that anxiety can be effectively managed and treated', she said.

Despite some positive changes, Mr Shawyer said there was a lot more to do before Australia could shed the macho stigma that surrounded anxiety and a perception of weakness.

'As a nation, our acceptance is a lot further downstream than what it was, but there is [a] very long way to go.'

Source: *The Age*, 18 April 2016, p. 11.

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Weblinks
Media items on mental health stigma

LEARNING ACTIVITY 12.10

Media analysis/response

Read the newspaper article by Eryk Bagshaw above reporting on stigma experienced by 'anxiety sufferers' and answer the following questions.

1. List the examples of stigma in the article.
2. How accurate is the reporter's description and explanation of stigma?
3. Compare and contrast the examples of stigma in the article and the data in Figure 12.26, then draw three conclusions.
4. (a) To what extent can media items of this type help reduce the stigma about mental health disorder?
   (b) What else could be done to reduce the stigma and discrimination experienced by people with mental disorders? You may wish to refer to other sources such as:
   - *StigmaWatch* at https://www.sane.org/changing-attitudes/1942-stigmawatch
   - the *SANE Guide for reducing stigma* at https://www.sane.org/mental-health-and-illness/facts-and-guides/reducing-stigma
   - the *Everymind website* at https://everymind.org.au/mental-health/understanding-mental-health/language-and-stigma (for examples of preferred language to avoid stigma when communicating about mental disorder).

CUMULATIVE RISK

Biological, psychological and social risk factors that may contribute to the development or progression of mental disorders rarely operate in isolation. They often coexist and interact with one another in influencing our thoughts, feelings and behaviour. Sometimes a risk factor may in itself not be particularly influential, but has a significant effect within the context of other influences. An individual risk factor may also provide the breaking or tipping point, resulting in onset of mental health disorder. For example, a person may be coping with daily hassles while dealing with the stressful loss of a significant relationship, but they reach a point where a daily hassle initiates break down because they are sufficiently worn down from the cumulative effects of the other stressors (Swaminathan, 2015).

Research findings indicate that it is typically the presence of a number of risk factors, rather than the presence of a single risk factor, that ultimately influences whether an individual develops a mental disorder. **Cumulative risk** refers to the aggregate ('cumulative') risk to mental health from the combined effects of exposure to multiple biological, psychological and/or social risk factors. According to the concept of cumulative risk, it is the *accumulation* of risk factors that impacts on people's mental health. Generally, the more risk factors to which we are exposed the greater our vulnerability to a mental health disorder. The overall effect of individual risk factors on mental health accumulates or builds up, somewhat like a snowballing effect (Appleyard, et al., 2005; Raviv, et al., 2010).

A number of models have been proposed to explain how the accumulation of risk increases the likelihood of mental health disorder. Two of these models are commonly called additive and threshold models.

Additive models propose that as the number of risk factors increases, there is also a corresponding increase in the likelihood of developing a mental disorder. The relationship between risk factors and mental disorder therefore tends to be 'linear'. For example, an individual who is exposed to five risk factors will be more likely to develop a mental disorder than an individual exposed to two risk factors. Similarly, the lower the number of risk factors, the lower the likelihood of developing a disorder.

Threshold models propose that the risk of developing a mental disorder is far more likely after exposure to a certain number of concurrent (simultaneously occurring) risk factors and that the risk is in excess of the total of their separate effects. According to these models, risk factors have a multiplier effect as they accumulate, so there is a 'multiplicative' relationship rather than 'additive' relationship among the risk factors. For example, in one study of 4-year-olds who had been exposed to varying numbers of risks, children exposed to four or more risks had *six* times the likelihood of experiencing behavioural disorder than did children with no risks (Sameroff, Seifer, & McDonough, 2004).

TABLE 12.5 Examples of risk and protective factors for children's mental health

Risk factors	Protective factors
Childhood factors	
• birth injury/disability/low birth weight • insecure attachment • poor social skills	• social skills • attachment to family • school achievement
Family factors	
• poor parental supervision and discipline • parental substance abuse • family conflict and domestic violence • social isolation/lack of support networks	• supportive caring parents • parental employment • access to support networks
School factors	
• school failure • negative peer group influences • bullying • poor attachment to school	• positive school climate • sense of belonging/bonding • opportunities for some success at school and recognition of achievement
Community factors	
• neighbourhood violence and crime • lack of support services • social or cultural discrimination	• access to support services • community networking • participation in community groups

Source: NSW Department of Community Services (2007, November). *Risk, protection and resilience in children and families* [Research to Practice notes]. Retrieved from http://www.community.nsw.gov.au/__data/assets/pdf_file/0018/321633/researchnotes_resilience.pdf

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Research studies examining cumulative risk have consistently found that the accumulation of risk factors increases the likelihood of mental health disorder, either through an additive or threshold effect. Furthermore, the *number* of risk factors (i.e. cumulative risk) tends to be a better predictor of a variety of mental health outcomes than any *single* risk factor (Raviv, et al., 2010). The cumulative effect in relation to risk factors has also been found to apply to protective factors. For example, as the number of protective factors increases, there is an increase in the likelihood of a positive mental health outcome, whereas the likelihood of developing a mental health disorder decreases (Rutter, 1999).

LEARNING ACTIVITY 12.11

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Word copy of table

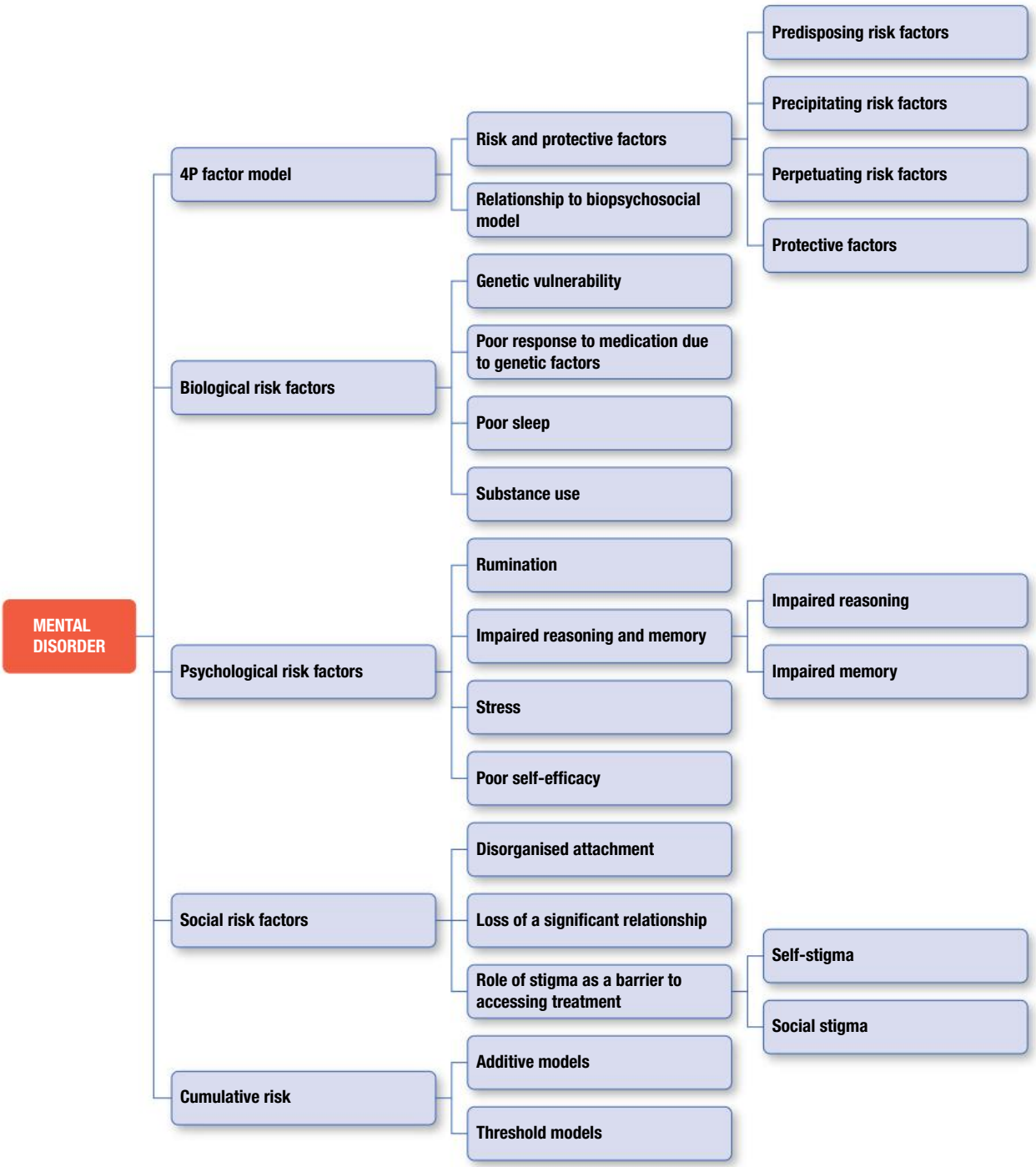
Review questions

1. Complete the following table to summarise social risk factors for mental health disorder.

Social risk factor	Description of risk factor	Example	Explanation of the risk
disorganised attachment			
loss of a significant relationship			
stigma			

2. What characteristic primarily distinguishes social risk factors from other types of risk factors?
3. (a) To what extent may each of the social risk factors co-exist with a mental disorder?
(b) What does this suggest about cause–effect for each factor?
4. To what extent can the impact of social risk factors be controlled?
5. (a) Explain the meaning of cumulative risk in relation to vulnerability to mental health disorder.
(b) Distinguish between the additive and threshold models of cumulative risk.

CHAPTER SUMMARY



KEY TERMS

4P factor model p. 587
additive model (cumulative risk) p. 614
adoption studies p. 592
attachment p. 607
biological risk factor p. 590
cumulative risk p. 614
disorganised attachment p. 607
genetic vulnerability p. 590
impaired memory p. 602
impaired reasoning p. 600
perpetuating risk factor p. 589
precipitating risk factor p. 589
predisposing risk factor p. 589
protective factor pp. 587, 589
psychological risk factor p. 598
risk factor p. 587
rumination p. 598
self-efficacy p. 604
self-stigma p. 611
significant relationship p. 609
social risk factor p. 607
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threshold model (cumulative risk) p. 614
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LEARNING CHECKLIST

Complete the self-assessment checklist below, using ticks and crosses to indicate your understanding of this chapter's key knowledge (a) before and (b) after you attempt the chapter test. Use the 'Comments' column to add notes about your understanding.

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Word copy of checklist

Key knowledge I need to know about mental disorder	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
4P factor model			
Risk vs protective factors			
The 4P factors			
• Predisposing risk factors			
• Precipitating risk factors			
• Perpetuating risk factors			
• Protective factors			
Relationship to biopsychosocial model			
Biological risk factors			
Genetic vulnerability			
Poor response to medication due to genetic factors			
Poor sleep			
Substance use			
Psychological risk factors			
Rumination			
Impaired reasoning and memory			
• Impaired reasoning			
• Impaired memory			
Stress			
Poor self-efficacy			

(continued)

Key knowledge I need to know about mental disorder	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
Social risk factors			
Disorganised attachment			
Loss of a significant relationship			
Role of stigma as a barrier to accessing treatment			
• Self-stigma			
• Social stigma			
Cumulative risk			

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Unit 4 > Area of study 2 > Topic 2

Concept screens and practice questions

CHAPTER 12 TEST

SECTION A — Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Question 1

Which of the following is best classified as a psychological risk factor for developing a mental health disorder?

A. poor self-efficacy
B. poor sleep
C. substance use
D. substance abuse

Question 2

A poor response to medication by someone with a mental health disorder means that

A. a psychotropic medication has been prescribed.
B. a psychotropic medication has not been prescribed.
C. an individual has an inappropriate attitude toward using medication.
D. there is little to no reduction in the number or severity of symptoms despite taking medication as prescribed.

Question 3

E. B. has been dwelling on the negative aspects of a distressing break-up with her boyfriend for over a week without doing anything to cope with her stress and therefore improve her situation. E. B.'s response to a major stressor is best described as

A. stigma.
B. rumination.
C. self-efficacy.
D. loss of a significant relationship.

Question 4

Each of the statements below describes how four infants behaved when they were distressed and frightened. Which of the following infants most likely has a disorganised attachment?

A. Started crying and approached his primary caregiver for comfort.
B. Approached her primary caregiver and gave her a hug.
C. Began crying and started to approach her caregiver, then suddenly turned away and crawled under a table.
D. Crawled towards his caregiver and put his arms up in the air.

Question 5

Social risk factors for a mental health disorder are generally considered to be sourced in an individual's

A. internal environment.
B. external environment.
C. interpersonal perceptions.
D. cognitive behaviour strategies.

Question 6

Consistently jumping to a conclusion before all available information is presented is most likely attributable to

A. poor self-efficacy.
B. a poor response to stress.
C. a poor response to medication.
D. a reasoning impairment.

Question 7

If someone has a high genetic vulnerability to an anxiety disorder, it is most likely that they

A. have the single gene responsible for anxiety disorders.
B. know someone with an anxiety disorder.
C. have a close biological relative with an anxiety disorder.
D. have been adopted by someone with an anxiety disorder who may also be a biological relative.

Question 8

The role of genes as a contributory factor in depression is primarily based on research evidence showing

A. a genetic vulnerability to high levels of a specific neurotransmitter in the brain.
B. the significantly higher incidence of depression among identical twins when compared with non-identical twins.
C. the significant link between daily hassles and the onset of depression.
D. the effectiveness of antidepressant medications in treating and/or managing depression.

Question 9

When unexpectedly challenged by a major stressor, an individual with poor self-efficacy will tend to

A. believe the challenge can be overcome.
B. look for creative ways of overcoming the stressor.
C. draw on a previous success in overcoming a similar stressor.
D. feel that they do not have the resources to cope.

Question 10

An abnormality of the central nervous system that influences behaviour, thinking, or feeling is a _____ risk factor.

A. biological
B. psychological
C. social
D. protective

Question 11

In the 4P factor model, a perpetuating risk factor

A. increases the likelihood of recovery from a mental health disorder.
B. maintains the occurrence of the symptoms of a mental health disorder and inhibits recovery.
C. strengthens the effects of a protective factor.
D. interacts with a protective factor to minimise onset of disorder.

Question 12

Which of the following is most likely to be a protective factor for a mental health disorder?

A. poor coping skills
B. poor sleep
C. loss of a significant relationship
D. close friendships

SECTION B

Answer **all** questions in the spaces provided. Write using blue or black pen.

Question 1 (2 marks)

'Simeon' is 29 years old. His fiancé 'Helena' was killed in a car accident four weeks ago. Since then, Simeon has been feeling very sad, experiencing extreme anger and anxiety about his future, feeling lethargic, has stopped going out with his friends and has difficulties concentrating at work.

How likely is it that Simeon has a mental health disorder? Explain your answer.

Question 2 (3 marks)

(a) Define disorganised attachment. 1 mark

(b) Explain why it is considered a risk factor for the development and progression of a mental health disorder. 2 marks

Question 3 (2 marks)

Explain how poor self-efficacy could make an individual more vulnerable to the development of a stress-induced mental health disorder.

Question 4 (4 marks)

Distinguish between predisposing and precipitating risk factors with reference to an example of each type of factor.

Question 5 (3 marks)

Explain how a poor response to medication due to genetic factors may contribute to the development or progression of a mental health disorder.

Question 6 (2 marks)

Explain why substance use and poor sleep are considered risk factors for mental health disorder.

Question 7 (4 marks)

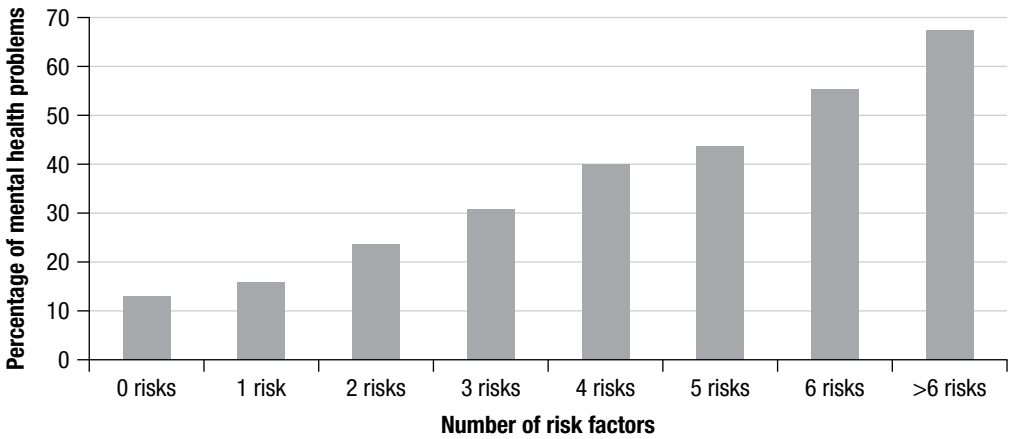
Ten-year-old 'Samir' has recently been diagnosed with a specific phobia of water. He is described as an intelligent, friendly and well-liked boy who is a talented soccer player. Samir developed a specific phobia of water a few months after nearly drowning in a swimming pool while on holiday in Bali. Both Samir's parents were present when he fell into the pool and his father jumped in and rescued him. Samir's parents are supportive and caring people, however since the pool incident, they have stopped Samir from using any swimming pool, as they don't want to risk it happening again. They also remind him constantly how 'dangerous' water can be. Samir is very close to his grandmother, who gets anxious quite easily, has occasional panic attacks when feeling overwhelmed or stressed, and is likely to have an undiagnosed anxiety disorder.

Use the following table to analyse the development or progression of Samir's water phobia in terms of the 4P factor model.

The 'P' factors	Samir's factors
predisposing	
precipitating	
perpetuating	
protective	

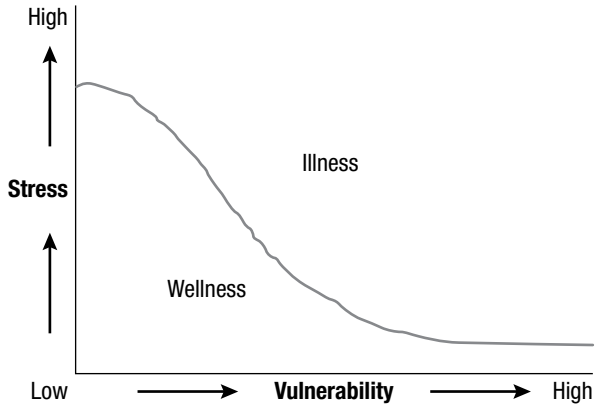
Question 8 (3 marks)

Explain the data in the graph below with reference to the concept of cumulative risk.



Question 9 (4 marks)

Use the graph below to explain the role of stress as a contributory factor to the development and progression of a mental health disorder, ensuring you refer to where someone would be 'plotted' on the graph if they had a high risk of depression as opposed to a low risk.



Question 10 (4 marks)

(a) Explain the meaning of stigma in relation to mental health with reference to the above cartoon. 2 marks

(b) In what way can stigma serve as a barrier to treatment? 2 marks

Question 11 (9 marks)

Researchers conducted an experiment to investigate the effects of viewing a documentary about schizophrenia on stigma. In particular, they wanted to find out if viewing a documentary that depicts individuals with schizophrenia can reduce stigma.

As part of their course requirements, 163 first-year university psychology students participated in the study. The sample was 55% female and 45% male. The mean age of participants was 18.85 years.

The participants were randomly assigned to one of four conditions: no documentary video, a documentary about polar bears, a documentary about people with obesity, and a documentary about people with schizophrenia.

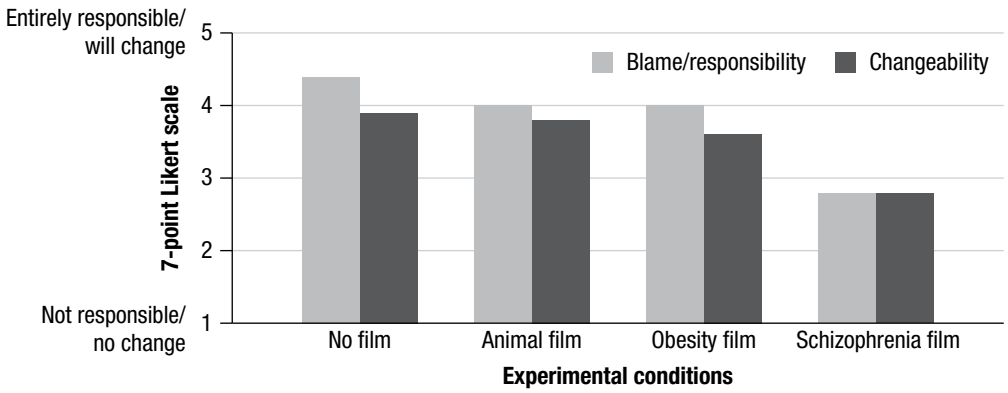
The effects of the documentaries were examined on a range of stigma-related variables including whether a person with schizophrenia should be blamed or deemed responsible for their disorder (blame/responsibility) and whether schizophrenia can change over time (changeability).

These variables were measured by responses to items in a seven-point Likert scale. The items and scales were:

- blame (1 = not at all to blame, to 7 = entirely to blame)
- responsibility (1 = not at all responsible, to 7 = entirely responsible)
- changeability (1 = not at all likely to change, to 7 = will change).

Higher scores reflected higher levels of blame and responsibility, and lower levels of changeability. The graph below shows the results for the first two stigma-related variables.

The study also examined beliefs about how likely people with schizophrenia are to be a danger to others. In terms of the 'dangerousness' measure, participants who viewed the schizophrenia film generally perceived individuals with schizophrenia as less dangerous than did participants in the other conditions. However, the mean differences were not statistically significant, suggesting that the schizophrenia film was unable to affect general attitudes reflecting social stigma.



Source: Penn, D.L., Chamberlin, C., & Mueser, K.M. (2003). The effects of a documentary film about schizophrenia on psychiatric stigma. *Schizophrenia Bulletin, 29*(2), 383–391.

(a) Formulate a research hypothesis for the experiment. 1 mark

(b) Name the experimental design. 1 mark

(c) Identify the operationalised independent and dependent variables. 2 marks

(d) Identify the experimental and control conditions. 2 marks

(e) What conclusion can be drawn on the basis of the results obtained? 1 mark

(f) Suggest a possible limitation of the experiment. 1 mark

(g) Suggest a possible implication of the research for addressing stigma. 1 mark

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The answers to the Section A multiple-choice questions are in the answer section at the end of this book and in eBookPLUS.
The answers to the Section B questions are in eBookPLUS.

13 SPECIFIC PHOBIA

KEY KNOWLEDGE

- the distinctions between stress, phobia and anxiety; variation for individuals with stress, phobia and anxiety on a mental health continuum
- the relative influences of contributing factors to the development of specific phobia with reference to: gamma amino butyric acid (GABA) dysfunction, the role of stress response and long-term potentiation (biological); behavioural models involving precipitation by classical conditioning and perpetuation by operant conditioning, cognitive bias including memory bias and catastrophic thinking (psychological); specific environmental triggers and stigma around seeking treatment (social)
- evidence-based interventions and their use for specific phobia with reference to: the use of short-acting anti-anxiety benzodiazepine agents (gamma-amino butyric acid [GABA] agonists) in the management of phobic anxiety and relaxation techniques including breathing retraining and exercise (biological); the use of cognitive behavioural therapy (CBT) and systematic desensitisation as psychotherapeutic treatments of phobia (psychological); psychoeducation for families/supporters with reference to challenging unrealistic or anxious thoughts and not encouraging avoidance behaviours (social).

Source: ©VCAA, VCE Psychology Study Design (June 2017 update), p. 30.

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Seventeen-year-old 'Carina' has had an intense fear of cats for as long as she can remember. The earliest incident she can recall was at the age of five, when a cat suddenly ran out on the road in front of her father's car on the way to Luna Park. Her father swerved and nearly crashed into a parked car. He subsequently cancelled their 'fun day' because he was so upset by the incident.

Carina has another vivid memory of being very frightened by a cat when she was older. This time, she was at her grandmother's house and a cat 'appeared from nowhere' and ran towards her when she was in the passageway. She felt trapped, closed her eyes and stood frozen in terror waiting for the cat to jump on her, but it ran straight past and disappeared. She recalls feeling entirely helpless, being 'scared to death' and taking a long time to 'get over it'.

Another time, her brother placed a bit of fur in between her sheets when their parents went out and she remembers screaming hysterically and bolting across the street in her nightie to get a neighbour to come over and get rid of it. Since then, she has become obsessive about checking between her sheets before getting into bed. She also avoids getting up to go to the toilet unless her bladder is bursting. If she must go, the light must be on and she always checks her bedding before getting back into bed.

Some of Carina's neighbours now have a cat, which is problematic as she has to walk to and from the train station to get to school. She is very anxious that she might come across this cat so her daily walk is usually a distressing experience. She avoids streets where there may be a cat and, in those streets that she must use, always walks on the roadside edge of the footpath in case a cat is roaming in the front garden of a house. Carina can't wait to get her driver's licence so that she can travel everywhere by car.

Carina will not, if she can possibly help it, go to any place where there could be a cat. She will not go into her backyard alone because of the risk of a cat encounter. She also refuses to visit friends or relatives who have a cat. When visiting someone, she will always ring or text beforehand to check if they have got a cat since her last visit. On arrival, she always double-checks that there is no cat inside. Once inside, she cannot relax as she is hypervigilant in case a cat has entered the premises since her arrival.

Carina's thoughts are preoccupied with a fear of cat encounters. Images of cats in books, in Facebook links, on television or in movies are typically frightening, upsetting, and, as she says, 'make me feel like I'm having a heart attack'. She often interprets an unexpected movement, shadow or noise as being a cat. She can't avoid cats when asleep because she often has terrifying nightmares about them. On awakening most mornings, her first thought is often about cats she might encounter during the day. Anxiety is now a dominant part of her life.

Figure 13.1 A person with a cat phobia would be terrified of this cat if encountered on their way home and make every effort to avoid it, even if it meant taking an alternative, much longer route.

STRESS, ANXIETY AND PHOBIA

Everyone experiences stress and it is considered a normal part of life. **Stress** is a state of physiological and psychological arousal produced by internal or external stressors that are perceived by the individual as challenging or exceeding their ability or resources to cope. Potential stressors may range from daily pressures (or hassles) which tend to be perceived as challenges that can usually be overcome, through to traumatic events which are very disturbing and far more challenging experiences.

Anxiety is also a common human response often accompanied by physiological changes not unlike those that occur when we are stressed. **Anxiety** is a state of arousal involving feelings of apprehension, worry or uneasiness that something is wrong or something unpleasant is about to happen. It is normal to experience anxiety in certain situations. For example, many students will experience a brief burst of anxiety when an unexpected test is announced or just before making an oral presentation in front of others. Feeling anxious in these situations is appropriate, and usually we feel anxious for only a limited time.

In everyday life, anxiety tends to be an adaptive response. A severe anxiety response can be very useful in the short-term to deal with threatening, dangerous or emergency situations. Physiologically, it is like a fight–flight–freeze response and therefore makes us more alert and our reactions faster. Mild to moderate levels of anxiety can also make us more alert and improve our ability to cope. For example, it is anxiety that can prompt us to slow down when running on a slippery surface, to avoid other dangerous situations, to study for an exam or to have a medical check-up when feeling ill.

Although we can all experience anxiety in certain situations, it should generally be brief and temporary, and its intensity ought to be related to the significance of the situation. If anxiety is severe or exaggerated and does not subside, it can be counterproductive and disabling. It can reduce our ability to concentrate, learn, remember, think clearly, logically plan, make accurate judgments and perform motor tasks such as crossing a busy road or shooting for goal from a difficult angle. While most people feel mild to moderately anxious from time to time, some people experience severe anxiety most of the time.

Severe anxiety is generally accompanied by intense physiological sensations and responses, such as shortness of breath, sweating, trembling, nausea, stomach cramps, dizziness, feelings of suffocating, feelings of losing control and/or feelings of impending doom, depending on the stimulus and the individual involved. For people experiencing severe anxiety that is unwanted and persistent, anxiety is not an adaptive response. It can affect the way a person thinks, feels and behaves, and, if not managed effectively, can cause considerable distress and disruption to the person's life.

Figure 13.2 Anxiety should be brief and temporary, and at an intensity related to the significance of the situation. If it is not, anxiety can become counterproductive and disabling. In this example, excessive anxiety may impair performance on a SAC presentation in class.

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Experiencing severe anxiety can indicate the presence of an anxiety disorder. The term *anxiety disorder* is used to describe a group of mental disorders that are characterised by chronic feelings of anxiety, distress, nervousness and apprehension or fear about the future, with a negative effect. Anxiety disorders are not so severe that individuals lose touch with reality or consistently behave in socially unacceptable ways. However, people are likely to be diagnosed with an anxiety disorder when their level of anxiety is so severe that it significantly interferes with their daily life and stops them doing what they want to do. Many different types of anxiety disorders have been identified, one of which is phobias.

A **phobia** is characterised by excessive or unreasonable fear of a particular object or situation. Fear is a rational response when confronted by some things or when in certain situations. However, a fear response by someone with a phobia is typically out of proportion to the actual danger posed by the object or situation. There is also a compelling desire to avoid the object or situation. Sometimes, even the thought of the feared stimulus

is enough to cause a phobic reaction. Having a phobia causes significant anxiety and distress, and interferes with everyday functioning. It is therefore considered a diagnosable mental disorder.

The term 'phobia' is Greek for 'fear' or 'dread'. People with a phobia often become fearful even when they think about the object or situation they dread. However, they can usually keep their fear reactions at a manageable level as long as they avoid the object or situation, including not thinking about it. The specific object or situation producing the fear associated with a phobia is commonly referred to as the *phobic stimulus*. There is considerable variation between individuals in how they react to a phobic stimulus. An individual's reaction may also vary at different times under different conditions. However, the experience of a phobia typically involves both stress and anxiety at significant levels.

Stress, anxiety and a phobia have a number of psychological and physiological characteristics in common and are therefore often difficult to distinguish in real-life contexts. There are many variations in how they are experienced by individuals and they seldom fit neatly within precise categories with clear dividing lines between them. For example, a phobia has a mix of stress and anxiety, stress often causes anxiety and stress may also be considered a type of anxiety response. In addition, as shown in Figure 13.3 below, all three can vary in amount or degree within and between individuals at any point in time.

Some psychologists represent stress, anxiety and a phobia on continuums like the one used for mental health to describe how they can vary independently and collectively in relation to one another. For example, when we 'feel' stressed this may be with some anxiety, but our coping strategies may ensure there is not enough of either stress or anxiety to be of any significant mental health concern. At these times, we can still function effectively in everyday life, so our mental wellbeing would be mapped somewhere on the left of a mental health continuum like that in Figure 13.3a. If, however, we experience stress and do not manage it effectively, we may become increasingly anxious and more vulnerable to developing a mental health disorder. When this occurs, our mental wellbeing would be mapped somewhere on the right of a mental health continuum. Similarly, if we experience excessive fear or anxiety whenever exposed to some stimulus and find that this encounter or the possibility of an encounter is interfering with daily functioning, then our mental wellbeing may be plotted towards the far right of the mental health continuum in Figure 13.3a below where mental disorder is located.

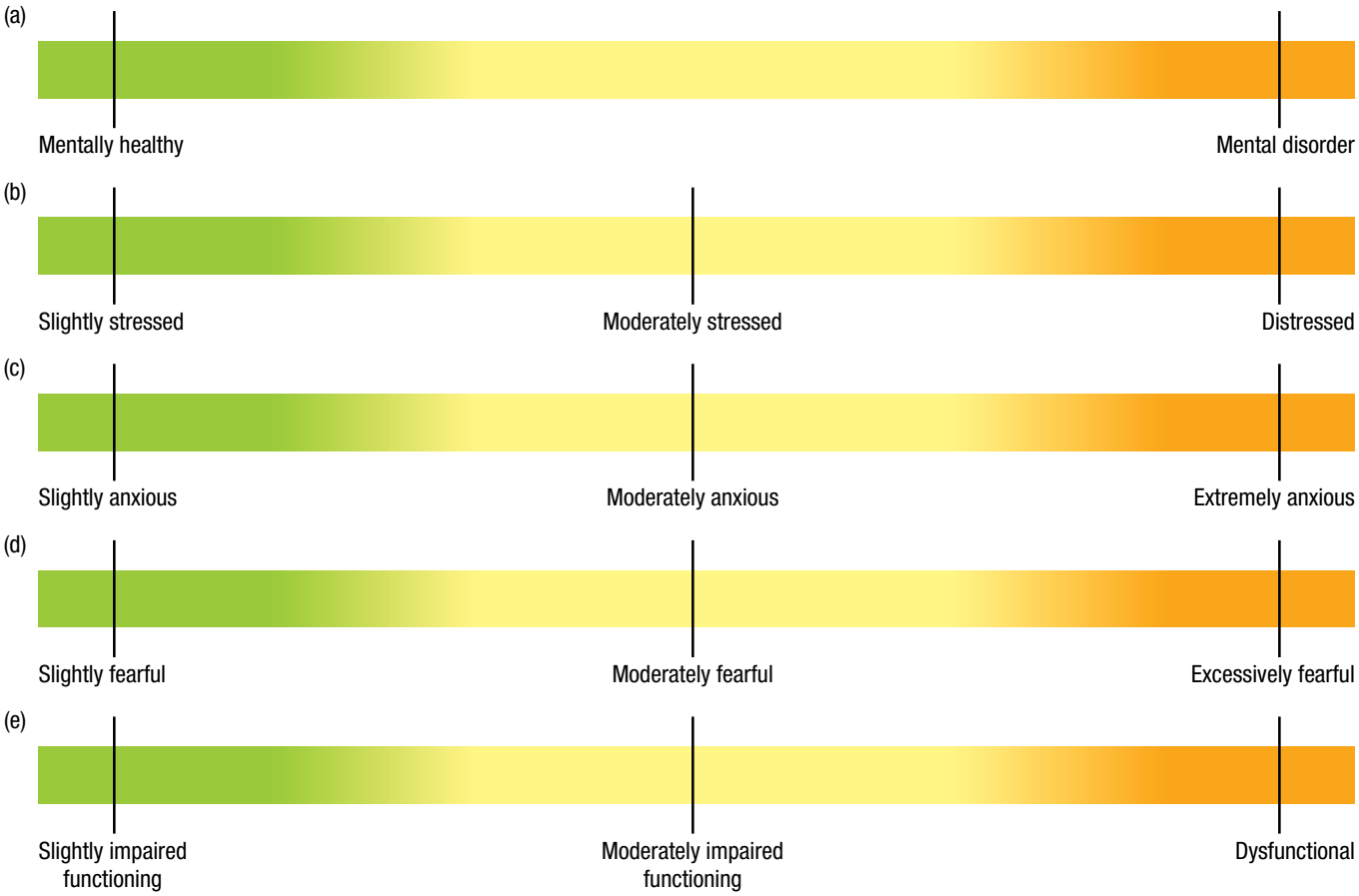

Figure 13.3 Examples of continuums for mental health and associated characteristics

Although stress, anxiety and phobias share characteristics and may co-occur in varying degrees, they can be distinguished in a number of ways. One important distinction is that stress and anxiety can independently or in combination contribute to the development of a mental disorder, but they are not in themselves considered to be mental disorders. In contrast, any type of phobia is considered a mental disorder (assuming it meets the diagnostic criteria).

Furthermore, both stress and anxiety are generally considered normal human responses that are usually adaptive and beneficial (unless excessive and chronic). Phobias, however, inevitably cause distress and interfere with a person's day-to-day functioning through avoidance behaviour and other responses associated with fear. Having a phobia is therefore never beneficial.

Table 13.1 below compares stress, anxiety and phobia and includes a range of distinguishing characteristics.

Figure 13.4 Stress and anxiety can be adaptive and beneficial, whereas having a phobia is never beneficial.

TABLE 13.1 Comparison of stress, anxiety and phobia

Stress	Anxiety	Phobia
Considered 'normal' to experience stress in certain situations and everyone experiences it at some time	Considered 'normal' to experience anxiety in certain situations and everyone experiences it at some time	Not considered 'normal'
Potential contributory factor to mental health disorder	Potential contributory factor to mental health disorder	A diagnosable mental disorder
Can develop into a mental health disorder if not managed	Can develop into a mental health disorder if not managed	A diagnosable mental disorder
Can impact on a person's functioning if not managed	Can impact on a person's functioning if not managed	Significantly impacts on a person's functioning
Mild amounts can be adaptive and helpful	Mild amounts can be adaptive and helpful.	Not considered adaptive or helpful
May be eustress or distress	Distress only	Distress only
Can be experienced in response to a wide range of stimuli	Can be experienced in response to a wide range of stimuli	Typically only experienced in response to specific stimuli
Accompanied by physiological changes; may involve fight–flight–freeze	Accompanied by physiological changes; may involve fight–flight–freeze	Accompanied by physiological changes; may involve fight–flight–freeze
May be associated with avoidance of certain objects or situations	May be associated with avoidance of certain objects or situations	Characterised by avoidance of certain objects or situations
Source/cause of a stress response is usually known (e.g. a specific stressor)	Source/cause of an anxiety response is not always apparent	Source/cause of a phobic response is usually known (e.g. feared object or situation)
Influenced by biological, psychological and social factors	Influenced by biological, psychological and social factors	Influenced by biological, psychological and social factors

LEARNING ACTIVITY 13.1

Review questions

1. Construct a Venn diagram to summarise similarities and differences between stress, anxiety and phobia. Ensure you include a definition of each concept in your diagram.
2. List three characteristics that you believe best distinguish stress, anxiety and phobia and explain each choice.
3. Give an example of how stress, anxiety and phobia may interact in response to the same stimulus.
4. (a) Explain why a continuum is a useful and appropriate way of representing stress, anxiety and phobia.
   (b) Give an example of how individuals may vary in stress, anxiety and phobia if mapped on a mental health continuum.
5. Can stress, anxiety and phobia all be mapped on the same single continuum? Explain your answer.

LEARNING ACTIVITY 13.2

Reflection

Both fear and anxiety signal danger or threat, trigger appropriate adaptive responses and share various physiological reactions. Some psychologists therefore argue that fear and anxiety are indistinguishable, whereas others believe that they are distinct phenomena. What do you think?

SPECIFIC PHOBIA

We all have fears, but they are not necessarily severe enough to interfere with our daily lives. For example, we may not feel comfortable around bees, spiders or dogs, but 'some discomfort' is quite different to having a phobia. A **specific phobia** is a disorder characterised by marked fear or anxiety about a specific object or situation, often leading to avoidance behaviour. The first symptoms of a specific phobia usually arise in childhood or early adolescence. It is estimated that as many as 10% of Australians may have some type of phobia (APA, 2013; beyondblue 2016a).

'Carina's' fear of cats, described at the beginning of the chapter, is an example of a specific phobia. Another specific phobia is an extreme fear of being in an elevator. Some people will not enter an elevator despite the inconvenience or hardship they experience as a result, such as walking up many flights of stairs. They unreasonably believe that the elevator's cables could break, that the ventilation could fail or that they could get stuck midair waiting for repairs. These possible problems are not uncommon, but it does not make sense for most people to walk up and down several flights of stairs on every occasion to avoid elevators.

Numerous types of specific phobia have been described, each with a different fear object or situation. Generally, the phobias fall within one of the following five categories (APA, 2013):

- *animal* e.g. spiders, snakes, dogs, insects, birds, fish, mice
- *situational* e.g. aeroplanes, elevators, enclosed spaces, tunnels
- *natural environment* e.g. heights, storms, darkness, thunder, lightning, being near water
- *blood–injection–injury* e.g. seeing blood, having blood taken, having an injection, getting a cut, any invasive medical procedure
- *other phobias* e.g. choking, vomiting, loud noises, costumed characters, falling down, becoming ill, dying.

Traditionally, specific phobias are named using Greek prefixes that stand for the object or situation that is feared; for example, *xeno*phobia (fear of foreigners), *necro*phobia (fear of death) and *acro*phobia (fear of heights). However, there is almost no limit to what people may fear and such a list could therefore be very long.

When someone has a specific phobia, exposure to a phobic stimulus typically triggers an acute stress response involving physiological changes like those of the fight–flight–freeze response. In some cases, the person's reaction is so intense that it takes the form of a panic attack.

A *panic attack* is period of sudden onset of intense fear or terror, often associated with feelings of impending doom. During the attack, there are physiological or psychological changes such as shortness of breath or smothering sensations; a racing or pounding heart; sweating; trembling; tightness in the chest; feeling dizzy, unsteady, lightheaded or faint; nausea; and feelings of going crazy, losing control or even dying. An attack may be expected (i.e. an obvious cue or 'trigger') or unexpected (i.e. not associated with an obvious cue and seems to occur 'out of the blue'). Furthermore, a panic attack can occur when in a calm state or an anxious state (APA, 2013).

Adolescents and adults who have a specific phobia are able to recognise that their level of fear is excessive or unreasonable (but children may not be able to). They usually know that their fear is grossly in excess of any real danger posed by the phobic stimulus. Consequently, they are often embarrassed and feel 'stupid' because of their fear, and the way the fear interferes with their lives. The experience of a phobia

can be contrasted with that of watching a very scary horror movie. This type of movie can frighten us, but, deep down, we know that we are safe. When a phobic stimulus frightens someone with a phobia, deep down they feel unsafe, despite the fact that they know their fear and insecurity are irrational (Butler & Hope, 2007).

Fear also typically results in a need to avoid any phobic stimulus. Someone with a phobia will usually organise their life around avoiding the phobic stimulus; for example, they will catch a train to avoid flying or not enter a park where there may be bees. When it is not possible to avoid a feared object or situation, it is endured with intense anxiety or distress. The possibility of encountering a phobic stimulus also causes a type of phobic anxiety called anticipatory anxiety.

Anticipatory anxiety is the gradual rise in anxiety level as a person thinks about, or 'anticipates', being exposed to a phobic stimulus in the future. Most people have experienced a mild form of anticipatory anxiety when they have an 'attack of nerves' before making a presentation to an audience. For many, it is handled with little worse than 'rubbery knees' or a slight quavering of the voice. For those with a phobia, however, their anxiety may rise to a level where they are incapacitated by it.

Figure 13.5 There is virtually no limit to what people may fear. A costumed character or being in a boat or at the beach may be a phobic stimulus, with any type of exposure or even a thought triggering intense fear or anxiety.

TABLE 13.2 Types of phobic disorders

Name of phobic disorder	Description
Specific phobia	Excessive, persistent and unreasonable fear of a specific object or situation, such as spiders, flying, heights, dental treatment, receiving an injection and seeing blood. The phobic object or situation almost always triggers fear or anxiety and is intentionally avoided or endured with intense anxiety or stress if avoidance isn't possible. The level of fear or anxiety is out of proportion to the actual danger posed and causes significant distress.
Social Anxiety Disorder (Social phobia)	Excessive, persistent and unreasonable fear of social and performance situations, primarily due to concern about being negatively judged by others (e.g. as anxious, weak, stupid, boring, unlikeable), and fear of behaving in a way that offends others or is embarrassing or humiliating (e.g. sweating, trembling)
Agoraphobia	Excessive, persistent and unreasonable fear of a situation in which it is believed something bad may happen and that escape might be difficult or help might not be available if needed. Such situations may include using public transport, being in an open space area (e.g. in a car park, on a bridge), being in an enclosed space (e.g. shop, movie theatre), standing in a line or being in a crowd, and being outside of the home alone (e.g. in the backyard). These situations are avoided, require the presence of a companion or are endured with intense fear and anxiety.

Source: American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, Virginia: Author.

LEARNING ACTIVITY 13.3

Review questions

1. What is specific phobia and how does it differ from ordinary fear?

2. (a) List three key characteristics of specific phobia.

(b) 37-year-old B.L. has been haunted by a fear of illness for as long as he can remember. His father died of a heart attack when B.L. was quite young and B.L. also had to nurse his mother through a terminal brain cancer when he was in his twenties. His wife is four years younger and in generally good health. B.L. frequently consults his doctor with complaints of erratic heart activity, sudden attacks of breathlessness, various pains, rashes, small swellings, and so on. He is not actually suffering from any diagnosable physical illness, but is continually afraid that he will have a heart attack or contract cancer or some seriously disabling illness at some time. He is especially afraid of having a heart attack when out walking or driving alone. This often confines him to his home and also means that he cannot hold a job. Although his doctor tries to reassure him with frequent examinations and blood tests, B.L. will go back again whenever a symptom draws attention to the possibility of an illness.

Explain whether B.L. may have a phobia of becoming ill with reference to key characteristics of specific phobia.

(c) Five-year-old J.M. was very apprehensive and distressed on his first day of school. This was the first time he had been separated from his mother and he was particularly anxious about how he would cope without her and the possibility that she could became ill or forgetful and therefore unable to pick him up after school. He was also anxious about how he would fit in with a new teacher and classmates. It is now three weeks into term 1 and J.M. has been increasingly reluctant to attend school. He is irritable and weepy, getting poor sleep because of difficulty falling asleep, and complaining about nausea and abdominal pain in the mornings before school. His mother has to drag or carry him to the car each school morning, then struggle to get him out of the car and into the school grounds when they get there.

Explain whether J.M. may have a phobia of school with reference to key characteristics of specific phobia.

3. Explain the meaning of each of the following in relation to specific phobia:

(a) panic attack

(b) anticipatory anxiety.

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FACTORS CONTRIBUTING TO THE DEVELOPMENT OF A SPECIFIC PHOBIA

As with any other mental health disorder, the development of a specific phobia is influenced by a combination of biological, psychological and social factors, and the best treatment interventions are also based on a biopsychosocial approach (as shown in Figure 13.6).

In this section, we focus on the influence of the neurotransmitter called GABA, the stress response and long-term potentiation (biological factors), classical conditioning, operant conditioning and cognitive bias (psychological factors) and environmental triggers and stigma (social factors). We also examine evidence-based interventions used in the treatment of specific phobias from a biopsychosocial perspective. These include use of benzodiazepine medications, breathing retraining and exercise (biological interventions), CBT and systematic desensitisation (psychological intervention), and psychoeducation for family members and others with whom the individual with a specific phobia has close contact (social intervention).

Table 13.3 organises all these potential influences as '4P' risk and protective factors. This shows the integration of the 4P factor and biopsychosocial models to assist understanding of the development and progression of specific phobia, including treatment interventions to help alleviate symptoms or overcome a phobia.

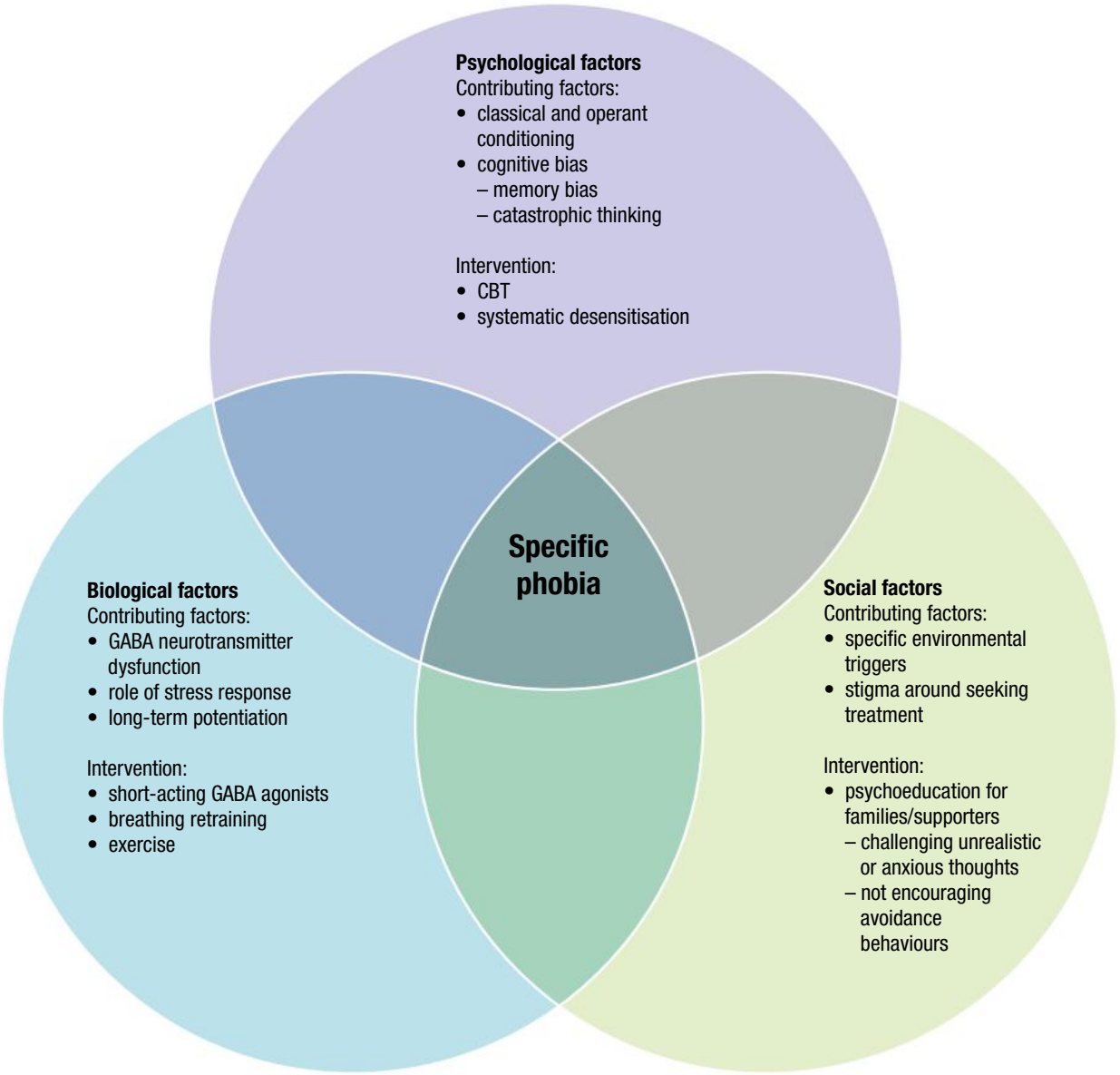

Figure 13.6 The biopsychosocial approach applied to specific phobia

TABLE 13.3 Integration of the 4P factor and biopsychosocial models for specific phobia (as applied in VCE Psychology)

4P factor model	Biopsychosocial approach		
	Biological factors	**Psychological factors**	**Social factors**
Predisposing risk factors	Neurotransmitter dysfunction (GABA)		
Precipitating risk factors	Role of the stress response	Classical conditioning (behavioural model)	Specific environmental triggers
Perpetuating risk factors	Long-term potentiation (biological association through constant pairing of CS/fear stimulus and CR/fear response)	Operant conditioning (behavioural model). Cognitive bias including memory bias and catastrophic thinking (cognitive model).	Stigma related to receiving treatment
Protective factors	Use of GABA agonists Controlled breathing Physical exercise	CBT strategies Graduated exposure to phobic stimuli (systematic desensitisation)	Psychoeducation for families/supporters – challenging unrealistic or anxious thoughts, – not encouraging avoidance behaviours

Biological factors

The origin of any phobia is a complex phenomenon and to designate a single factor as the sole cause is rarely possible. Various biological factors that may contribute to the development, progression or perpetuation of a specific phobia have been proposed. Each one of these may interact with each other as well as psychological and social factors.

In this section, we initially examine how dysfunctional GABA neurotransmission may make an individual more vulnerable to developing a specific phobia. We then examine the role of a fight–flight–freeze stress response to a phobic stimulus. Finally, we examine how brain plasticity through long-term potentiation can neurologically strengthen the association between a phobic stimulus and a fear response.

GABA dysfunction

Several neurotransmitters have been identified as playing a role in the experience of anxiety and one of these is GABA. **Gamma-amino butyric acid (GABA)** is the primary inhibitory neurotransmitter in the central nervous system. It works throughout the brain to make postsynaptic ('receiving') neurons less likely to to be activated (i.e. it inhibits excitation or 'firing'). One of its roles is to fine-tune neurotransmission in the brain and maintain neurotransmission and associated neuronal activity at an optimal level.

Without the inhibitory effect of GABA, activation of postsynaptic neurons might get out of control. Their uncontrolled activation could spread throughout the brain, causing seizures like those of epilepsy. For example, glutamate is the primary excitatory neurotransmitter in the central nervous system. It works throughout the brain to make postsynaptic neurons *more likely* to fire. It is involved in fast-acting neuronal transmission throughout the brain (and also aids learning and memory by strengthening synaptic connections). The inhibitory action of GABA counterbalances the excitatory activity of glutamate and vice versa. Consequently, GABA and glutamate have important roles in regulating central nervous system arousal.

GABA also plays a role in anxiety because it acts like a calming agent or 'brake' to the excitatory neurotransmitters that contribute to anxiety. There is evidence that some people experience the anxiety associated with phobias because the neurotransmission of GABA becomes dysfunctional. For example, there may be a failure to produce, release or receive the correct amount of GABA needed to regulate neuronal transmission in the brain. GABA dysfunction can therefore result in low levels of GABA in the brain, as shown by studies of people with a specific phobia (and other anxiety disorders) who are more likely to have a significantly lower GABA level than control group placebo participants with no specific phobia (Nuss, 2015; Sadock, Kaplan & Sadock, 2007).

Some psychologists have proposed that individuals with a low level of GABA are more vulnerable to anxiety. In addition, their flight–flight–freeze response may also be more easily triggered by a variety of stimuli, which in turn may presdispose them to developing a specific phobia when compared with people who do not have a low level of GABA (Andrews, et al., 2003; Carr, 2003).

The level of GABA in a person's brain may be affected by a wide range of factors. For example, research studies have implicated factors such as genetic inheritance, central nervous system damage, exposure to prolonged stress, nutritional deficiencies in vitamin B6 and citric acid, and high caffeine intake. These types of influences have been found in some studies to either inhibit GABA release, inhibit its ability to bind (attach) to GABA receptors on post-synaptic neurons, or to stimulate overproduction of glutamate in some way.

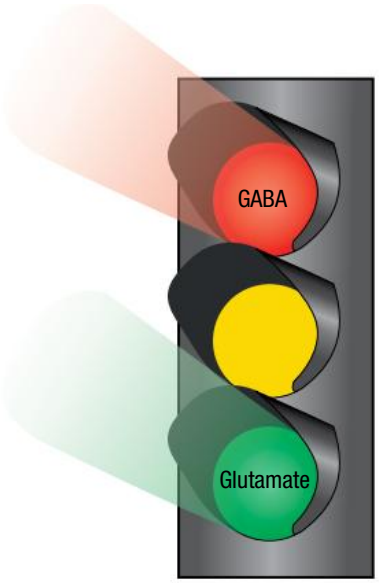

Figure 13.7 GABA and glutamate are like traffic lights regulating neuronal activity in the brain. GABA is an inhibitory neurotransmitter and makes receiving neurons less likely to fire. It is like a red traffic light for the excitatory neurotransmitters that contribute to anxiety. Glutamate is an excitatory neurotransmitter and makes receiving neurons more likely to fire. It is like a green traffic light for excitatory activity.

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Role of the stress response

Anxiety involves feelings of apprehension, worry or uneasiness that something is wrong or something unpleasant is about to happen. This is considered to be the *psychological* component of the response to a phobic stimulus. Underlying and interacting with this component is a *physiological* component that is like the physiological response to a stressor.

Because there is a perceived threat or impending harm at the sight or thought of a phobic stimulus, the fight-flight-freeze response is activated. The heart rate and strength of heartbeat increase to speed up blood flow, blood is redirected from places where it is not needed, the speed and depth of breathing increase, adrenal hormones surge into the bloodstream, and so on. These types of reactions account for many of the symptoms associated with phobic anxiety, such as palpitations resulting from a pounding heart and sweating due to increased perspiration. When breathing becomes faster and deeper than necessary, this can result in hyperventilation ('over-breathing') which can heighten the anxiety being experienced and also induce a panic attack.

Phobic anxiety becomes problematic and especially non-adaptive when the stress response is triggered in the *absence* of any real threat or danger; for example, in response to objects or situations that have very little or no potential for actual harm, such as clouds (nephophobia) or flowers (anthophobia). For a person with a specific phobia, their response to a stimulus is triggered by exposure, or anticipated exposure, to objects or situations *perceived* to be dangerous. Anxiety is therefore also problematic for someone with a specific phobia as their level of anxiety tends to be inflated or excessive because their perception of threat is unreasonable and out of proportion to what it should be. This means that the physiological stress response they experience is often very severe and can persist at this high level for at least as long as the exposure or anticipated exposure to the phobic stimulus.

The role of the stress response should not be considered in isolation of other factors. For example, GABA dysfunction may contribute to an excessive stress response or make it more likely to occur than in someone without GABA dysfunction. In addition, an excessive stress response can become 'paired' with phobic stimuli through classical conditioning processes, setting it in place as a learned response that will inevitably occur whenever a phobic stimulus is encountered.

In sum,

- a phobic stimulus which may or may not be present can trigger an acute stress response involving fight–flight–freeze type sympathetic nervous system reactions
- physiological changes associated with fight–flight–freeze may heighten the anxiety being experienced and maintain physiological symptoms of the phobic reaction
- physiological changes associated with the fight–flight–freeze stress response may become a conditioned response to a phobic stimulus.

Figure 13.8 A fight–flight–freeze stress response to a phobic stimulus is often triggered in the absence of any real threat and tends to be excessive. This is more likely to occur if there is also GABA dysfunction.

Long-term potentiation

The development of phobias is substantially influenced by learning through experience. For example, Watson's controversial experiment with 'Little Albert' almost a century ago clearly demonstrated that specific phobias can be acquired through classical conditioning. As described in Chapter 5, Watson conditioned the 11-month-old infant to be terrified of a white rat (initially a neutral stimulus that did not produce fear) through repeated association with an unpleasant loud noise (an aversive unconditioned stimulus). Albert's fear had become a conditioned response to a conditioned stimulus (the white rat). In addition, the fear generalised to other superficially similar stimuli, leading him to burst into tears at the sight of a rabbit, a dog, a Santa Claus mask and even a white fur coat.

It is likely that long-term potentiation contributed to the development and maintenance of Albert's specific phobia of furry objects. Long-term

potentiation is believed to play an important role in the learning and memory of fear by strengthening synaptic connections in the neural pathway formed during the learning process, resulting in enhanced or more effective synaptic transmission within that pathway.

As with other learning, long-term potentiation can therefore neurologically strengthen the association between a phobic stimulus and a fear or anxiety response through its activity at the synapse. The more that the connection is activated through each encounter or anticipated encounter with a phobic stimulus, the more the connection is strengthened. The more the connection is strengthened, the more the relevant neural pathway is strengthened, increasing the efficiency in transferring fear information along the pathway and decreasing the likelihood that what has been learnt will be forgotten.

BOX 13.1 Neural pathways of fear responses

The amygdala has crucial roles in our acquisition and expression of fear responses. One role involves processing of incoming sensory information about the potential threat of a stimulus in the environment. Generally, this information reaches the amygdala from either of two neural pathways, both of which start at the thalamus.

The thalamus, which is located on top of the brain stem, filters all incoming sensory information (other than smells) and relays it to relevant areas of the brain for processing, most often to the cerebral cortex. For example, while you're reading this page your thalamus sends incoming visual information to the visual cortex for processing, and when your ears receive sound to which you attend, the information is transferred to the auditory cortex. A considerable amount of information from the cerebral cortex also passes back through the thalamus to middle and lower brain structures, such as the amygdala.

Therefore, there are two potential pathways for incoming threat information to reach the amygdala. One pathway is called the *thalamo-amygdala pathway*, which takes a shortcut straight to the amygdala and is often called the short 'reactive' route. The other pathway is the *thalamo-cortico-amygdala pathway*, which goes to the amygdala via sensory areas of the cerebral cortex and is often called the long 'rational' route. These are shown in Figure 13.9.

Because the pathway directly to the amygdala is a shorter route, information that travels along this pathway is believed to reach the amygdala faster than information reaching the amygdala via the longer route from the cortex. This means that the amygdala can stimulate the hypothalamus to initiate a fight–flight–freeze stress response *before* the potential threat information has been processed by the cortex and interpreted as threatening (or not threatening). Furthermore, the existence of a short route has been proposed as an explanation of why a person with a phobia of spiders can initially experience intense fear and an acute stress response freeze when exposed to a harmless stimulus such as a bit of black fluff on the carpet, but calms down a few moments later when realising that what seemed to be a spider was actually just fluff. We physiologically react immediately and consciously determine whether there is any actual danger afterwards, much like a spinal reflex (Öhman, 2010).

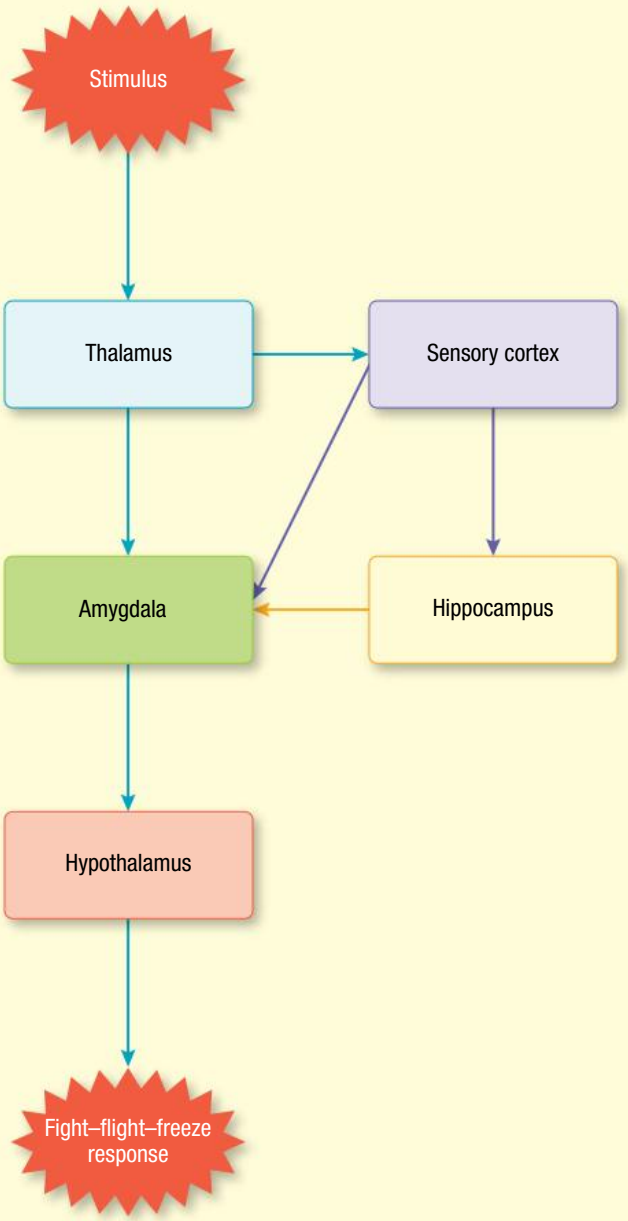

Figure 13.9 There are two pathways for incoming threat information to reach the amygdala. One is a shorter route that bypasses the sensory cortex and enables a stress response before information reaches the cortex.

LEARNING ACTIVITY 13.4

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Review questions

1. (a) What is gamma-amino butyric acid (GABA) and where is it found?
(b) What role of GABA is relevant to a specific phobia?
(c) Explain the meaning of the term 'GABA dysfunction'.
(d) Explain how GABA may contribute to phobic anxiety and make some people more or less predisposed to developing a specific phobia.

2. (a) Explain how the stress response may contribute to the development and/or perpetuation of a specific phobia.
(b) How can GABA dysfunction contribute to an excessive or exaggerated stress response to a phobic stimulus?
(c) What psychological factor may also influence whether an excessive stress response occurs as part of a phobic reaction?

3. Explain how long-term potentiation may contribute to the development and perpetuation of a specific phobia.

4. Complete the following table to summarise biological factors contributing to the development and/or maintenance of a specific phobia.

Biological factor	What is it?	How it may contribute
gamma-amino butyric acid (GABA) dysfunction		
stress response		
long-term potentiation		

Psychological factors

A number of different models and theories have been proposed to describe and explain how a specific phobia can develop or be perpetuated due to psychological factors. These include behavioural models which emphasise the role of learning and experience, and cognitive models which emphasise the roles of memory bias and other distorted ways of thinking.

Behavioural models

According to **behavioural models**, phobias are learned through experience and may be acquired, maintained or modified by environmental consequences such as rewards and punishments. In particular, a specific phobia may be precipitated through classical conditioning and perpetuated by operant conditioning. This two-part process was originally called *two-factor learning theory*. It was first proposed in the 1940s to explain avoidance learning like that occurring with phobias and continues to be applied to phobias (Mowrer, 1947, 1951).

Traditional behavioural models are based on the learning theories of Pavlov, Watson and Skinner. It should therefore not be surprising that these models assume that phobias — like most other dysfunctional ways of thinking, feeling or behaving — are learned through classical and operant conditioning processes in much the same way as 'normal' ways of thinking, feeling and behaving are learned. Generally, explanations of phobias by behavioural models propose that classical conditioning processes play a role in the precipitation (or development) of a specific phobia and operant conditioning processes play a role in the perpetuation (or maintenance) of a specific phobia.

Precipitation by classical conditioning

Since Watson's experiment with Little Albert, classical conditioning has been used to explain the acquisition of all types of phobias. The development of a specific phobia in this way is essentially the process by which a stimulus with no particular significance (i.e. a neutral or unconditioned stimulus) becomes, by association, a sign of impending threat, danger or some other unpleasant event (i.e. a conditioned stimulus). The innate, naturally occurring fear response (UCR) eventually becomes a conditioned fear response (CR). In addition, stimulus generalisation may occur to other similar objects or situations.

Due to the ethical issues surrounding the use of humans in fear conditioning research, experiments are mostly conducted with animals in laboratory situations to further understanding of the role of classical conditioning.

In a typical experiment, a rat is placed in a cage where small electrical shocks can be administered to its feet through the floor. The researchers briefly expose the rat to a light or sound (NS), then immediately administer a slight shock to its feet (UCS). After only a few repetitions of this procedure, the rat associates the light or sound with the shock and becomes afraid (CR) when it is only exposed to the stimulus (now a CS). For the rat, the initially neutral stimulus of the light or sound has become a conditioned fear. After conditioning, the new learned fear response that is automatically and involuntarily produced by the CS is called the conditioned response (CR) because it is the result of experiencing the dependent relationship between the CS and UCS.

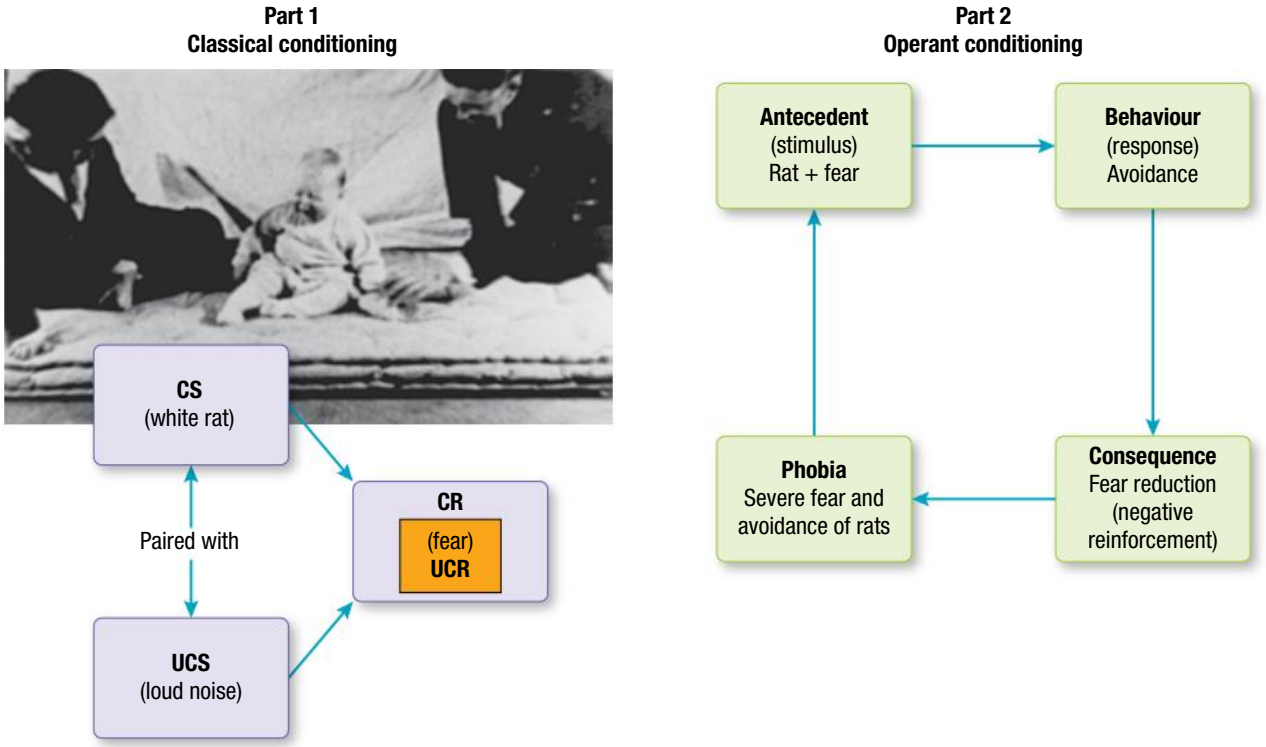

Figure 13.10 Explanation of a rat phobia by the two-factor learning theory. Part 1: Little Albert developed a specific phobia of rats through classical conditioning (i.e. precipitation by classical conditioning). Part 2: By avoiding the feared stimulus (the rat), the fear is successfully reduced and the phobia is 'rewarded' (negative reinforcement), which maintains the phobia (i.e. perpetuation through operant conditioning).

These types of laboratory experiments have shown that conditioned fear can be acquired very quickly in a variety of species, ranging from flies and molluscs to fish and monkeys. In addition, the conditioned fear response can last a very long time. It is therefore considered to involve a very strong association that is unlikely to be forgotten or disappear (i.e. extinguished) without intervention.

Acquisition of a specific phobia in the real world can occur in much the same way as it does in the laboratory. For example, consider 23-year-old 'Sam' who has a specific phobia of spiders (arachnophobia). He initially developed his fear at the age of four when he saw a photo of a big hairy spider in a book and his father used it to scare him. He subsequently became quite fearful and anxious whenever exposed to a spider in books and other media. Once day, Sam unexpectedly came across a live spider while playing in the sandpit in his backyard. It moved so quickly in his direction and gave him such a fright that he jumped up and ran away in terror. Since then, Sam has never intentionally gone near any sandpit and will not even go to the beach for fear that there may be a spider in the sand. He also avoids any other situation in which there may be a spider, even if the spider is likely to be harmless, fake or dead. For example, Sam will never read a book that may have a picture of a spider. Nor will he watch any television program or movie if he believes there is any chance whatsoever of a spider appearing.

In effect, Sam developed a conditioned response (fear) to a conditioned stimulus (the spider) that had been associated with fear-inducing unpleasant events (UCS), then generalised to similar stimuli — any spider. Many people feel scared or anxious around spiders, but Sam's fear is disproportional to any actual risk and his fear has imposed unwanted restrictions on his life. Psychologists have also found that fear conditioning can occur in people after only a single pairing if the UCS is sufficiently intense or traumatic, for example, in the case of being viciously attacked by a dog (Faneslow & Sterlace, 2014).

Perpetuation by operant conditioning

After acquisition through classical conditioning, the phobia can be maintained and therefore perpetuated through operant conditioning. In the spider phobia example, Sam begins to avoid the fear- and anxiety-producing phobic stimulus (spiders). Avoidance reduces or removes the unpleasant feelings of fear and anxiety, so avoidance is negatively reinforced. In the future, any response that reduces or removes fear or anxiety will also be negatively reinforced. Consequently, any avoidance response to any phobic stimulus will continue to be reinforced through operant conditioning.

Consider also the case of 32-year-old Hayley who has claustrophobia (a fear of enclosed spaces) and has started a new job on the fifth floor of an office building. Hayley uses the stairs to get to her office in order to avoid the terrifying experience of being in the elevator. Using the stairs reduces the unpleasant feelings of fear

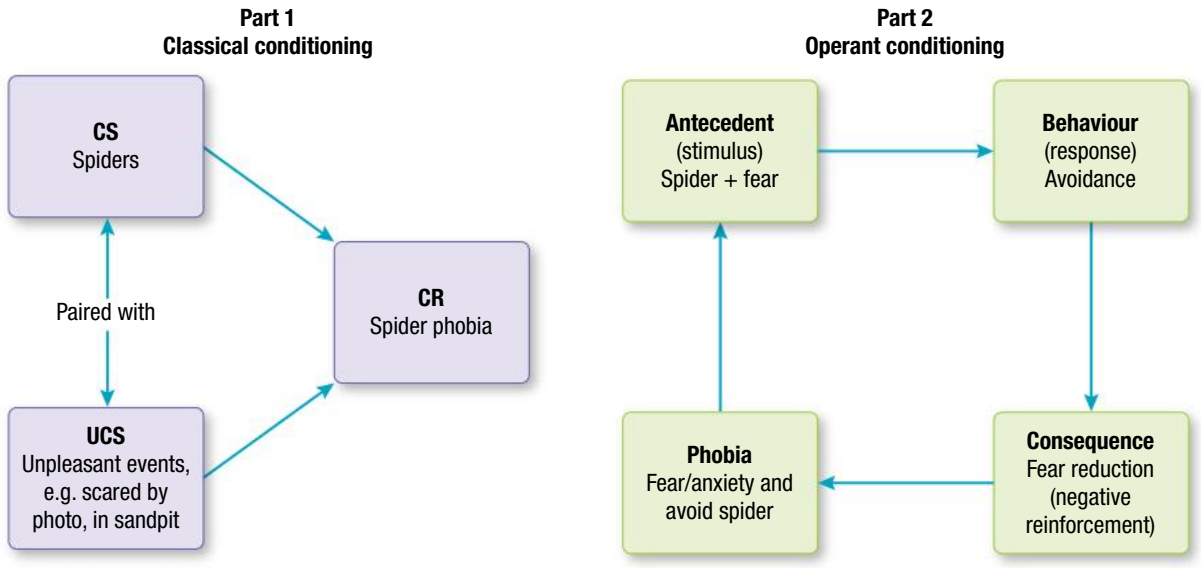

Figure 13.11 Explanation of 'Sam's' spider phobia by the two-factor learning theory. Part 1. Sam associates the spider with unpleasant events that induce fear/anxiety and develops a specific phobia through classical conditioning (i.e. precipitation by classical conditioning). Part 2. By avoiding the feared stimulus (spider), the fear is successfully reduced and Sam's phobia is 'rewarded' (negative reinforcement), which maintains the phobia (i.e. perpetuation through operant conditioning).

and anxiety (negative reinforcement) and increases the likelihood that her avoidance behaviour of using the stairs will occur again. In this way, the operant conditioning process of negative reinforcement is contributing to the persistence of her avoidance behaviour and therefore her phobic response.

Operant conditioning can also contribute to the acquisition of a phobia. For example, consider the experience of eight-year-old 'Samir' when on a camping holiday with his parents. One day, Samir and his parents went for a walk and came across a small lake. Samir 'saw something moving' in the lake and reacted with terror. He started crying, screaming and shaking all over. Samir's parents promptly reassured, hugged and kissed him. In addition, to help him 'feel better', Samir's father gave him a piggy-back all the way back to their camping ground and then drove him into town to buy Samir his favourite chocolate ice-cream. Although well-intentioned, Samir's parents may have inadvertently provided positive reinforcement for his fear response in the form of reassurance, kisses, hugs, a piggy-back and a chocolate ice-cream. The positive reinforcement could therefore strengthen Samir's fear response or increase the likelihood that he behaves fearfully the next time he encounters a lake or body of water.

Cognitive models

In explaining how a specific phobia may be acquired and persist, **cognitive models** focus on how the individual processes information about the phobic stimulus and related events. According to these models, people can actually create their own problems (and symptoms) by the way they interpret objects or situations.

Explanations of phobias from a cognitive model perspective typically examine how people with phobias tend to think about a phobic stimulus and its context, and their perceptions, memories, beliefs, attitudes, biases, appraisals, expectations and other cognitive processes that may be relevant. While there is recognition of the role of conditioning and other types of learning in the development and perpetuation of a phobia, cognitive models emphasise how and why people with a phobia have an unreasonable and excessive fear of a phobic stimulus.

A key assumption of many cognitive models is that people with a specific phobia often have one or more cognitive biases. A **cognitive bias** is a tendency to think in a way that involves errors of judgment and faulty decision-making. Essentially, a cognitive bias involves mistaken thinking, which is why it is also sometimes referred to as a *cognitive distortion*. The biased or distorted mode of thinking may be due to limitations in the cognitive abilities of the individual involved, underlying motivational factors or because information has been interpreted according to one's personal likes, dislikes and experiences in order to adapt to a specific situation (Wilke & Mata, 2012).

Cognitive biases can be habitual ways of thinking and therefore make someone more prone or vulnerable to experiencing fear or anxiety in response to a phobic stimulus. Several different types of cognitive bias have been identified as being associated with the development and/or perpetuation of a specific phobia. Two of these include memory bias and catastrophic thinking.

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Memory bias

Memory bias refers to the distorting influences of present knowledge, beliefs and feelings on the recollection of previous experiences. Often, this results in what is commonly called 'selective memory'.

American psychologist Daniel Schacter (1999) has defined different types of memory bias. These include:

- *consistency bias:* memories of past experiences are distorted through reconstruction to fit in with what is presently known or believed e.g. current fears of specific objects or situations influence memory reconstruction of those objects or situations in ways that incorporate those fears
- *change bias:* whenever we recall a past experience we exaggerate the difference between what we knew or felt then and what we currently know or feel, which can lead our phobic fears to grow over time, disproportionately from what they are in reality.

In relation to a specific phobia, these types of biases result in a tendency for memory recall of a phobic stimulus or experience to focus on or to be better for negative or threatening information than for positive or neutral information. For example, a person with a phobia of horses will tend to remember the one and only time they were chased by a horse, but forget all of the other times when horses showed no response to their presence. Similarly, someone with a spider phobia will tend to reconstruct their memory of a past experience with a spider in a way that describes it as bigger, faster or more frightening than it actually was (Eliasz, Hampson & de Raad, 2005).

Catastrophic thinking

Catastrophic thinking is a thinking style which involves overestimating, exaggerating or magnifying an object or situation and predicting the worst possible outcome. For example, a person with a specific phobia may assume that they will go crazy, lose control or even die if exposed to a relevant phobic stimulus. In the case of someone with a dog phobia, they may think that any dog they encounter will attack them and leave them with permanent facial disfigurement, or a person with a fear of driving may think that if they get into a car they will definitely have a crash and die. In the case of a person with a spider phobia, they may think that it would be completely unmanageable to have a spider touch them.

When catastrophic thinking occurs, individuals experience heightened feelings of helplessness and grossly underestimate their ability to cope with the situation. For example, a person may think, 'if this rat turns towards me, there is nothing I can do to stop it biting me'. Equally, they may believe that they will be completely unable to cope with the symptoms of anxiety they may experience; for example, 'if I have a panic attack while driving, I might crash the car and kill someone'.

As shown below in Figure 13.12, catastrophic thinking can maintain a fear or anxiety response and therefore contribute to the development and perpetuation of a specific phobia.

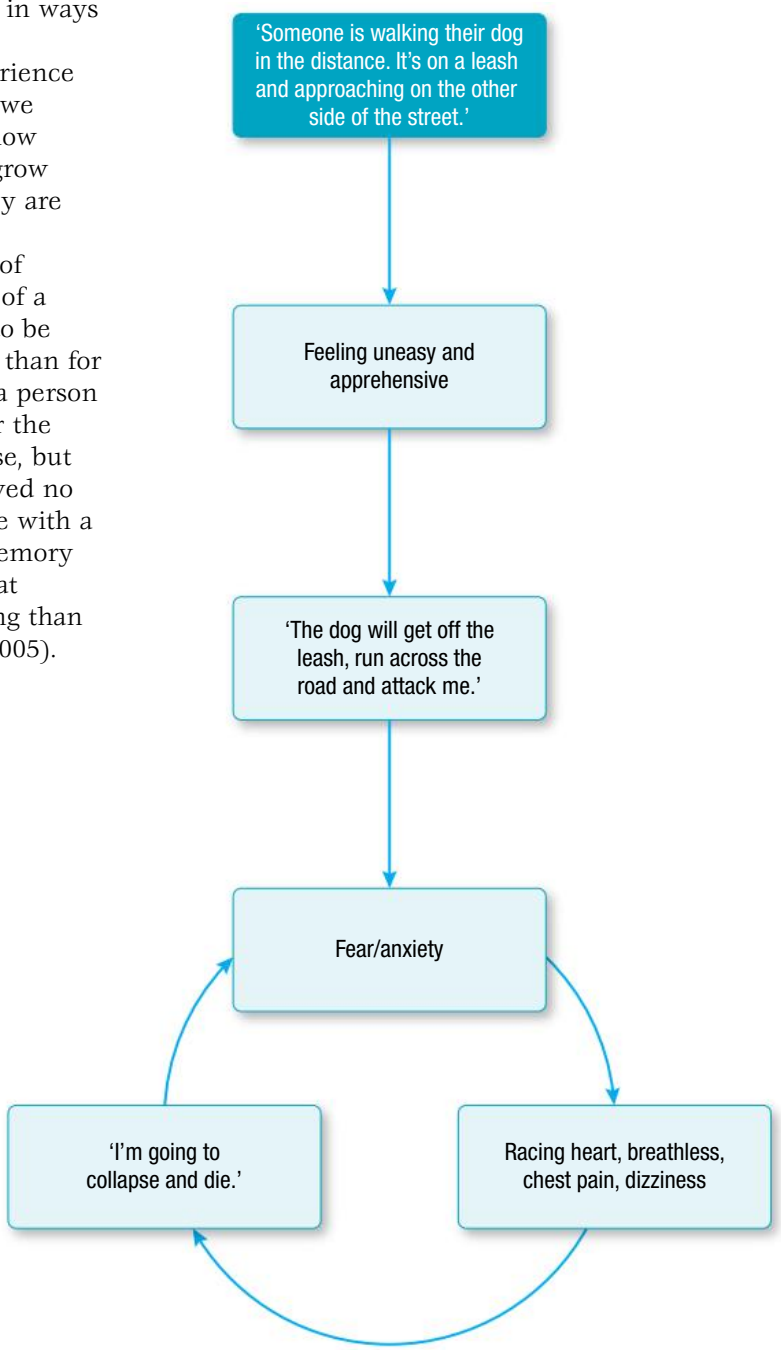

Figure 13.12 An example of how catastrophic thinking can contribute to the development and perpetuation of a phobia of dogs

BOX 13.2 Observational learning of phobias by monkeys

In a study on observational learning and the development of phobias, American psychologists Michael Cook and Susan Mineka (1989) showed videotapes to four groups of laboratory-bred rhesus monkeys. The tapes featured another monkey apparently experiencing extreme fear of a toy snake, a toy crocodile, a toy rabbit and images of flowers. Monkeys that saw these fear reactions were later afraid of the toy snake and toy crocodile, but did not acquire a fear response to the toy rabbit or flowers.

These findings suggest that phobias may be acquired through observational learning. However, the fact that the monkeys developed fear only of the snake and crocodile also suggests that monkeys may have a biological (genetic) predisposition to acquire fears of certain animals that represent natural threats to their survival.

Prominent American psychologist Martin Seligman (1971) has proposed that humans may also be biologically predisposed to develop fears of certain objects and situations (such as snakes, spiders and heights) that may have once posed a threat to our survival. According to Seligman, this may account for the fact that extreme irrational fears of snakes, spiders, heights and small enclosed spaces are relatively common, whereas few people have phobias of stairs, ladders, electrical outlets or appliances, even though these objects are more likely to be associated with a traumatic experience or harm.

More recently, other psychologists have proposed that humans may also be biologically predisposed to develop phobias towards creatures that arouse disgust, such as slugs, maggots and cockroaches. This is believed to occur because these types of creatures are associated with disease, infection or filth, and therefore represent a threat to our survival through contamination or infection (Hockenbury & Hockenbury, 2006).

Figure 13.13 One of the monkeys in the Cook and Mineka experiment, showing extreme fear of a snake.

LEARNING ACTIVITY 13.5

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Review questions

1. (a) What key assumptions do behavioural models make in explaining the development of a specific phobia?
(b) (i) Explain how development of a specific phobia may be precipitated through classical conditioning processes with reference to a diagram and an example not used in the text.
(ii) Explain how the phobia you described in part (i) above may be perpetuated through operant conditioning processes.
(c) Give an example of how a specific phobia could develop through operant conditioning.

2. (a) What do cognitive models emphasise in explaining the development of a specific phobia?
(b) What is a cognitive bias?
(c) Name and define two types of cognitive bias associated with a specific phobia. Give an example of each type of bias, other than an example used in the text, and explain how this type of bias can contribute to the development or perpetuation of a specific phobia.

3. Complete the following table to summarise psychological factors contributing to the development of a specific phobia.

Psychological factor	What is it?	How it may contribute
Behavioural models • classical conditioning • operant conditioning		
Cognitive models • memory bias • catastrophic thinking		

LEARNING ACTIVITY 13.6

Reflection

Given that fear can be acquired through classical conditioning by so many species, it may be possible that fear conditioning plays a fundamental role in the survival of species and could therefore be an adaptive response that has been preserved by evolution. What do you think?

Social factors

Many different factors sourced in the environment may contribute to the development of a phobia and perpetuate its occurrence. Two of these social contributing factors involve:

- specific environmental triggers — developing a specific phobia after a direct negative experience with an object or situation
- stigma around seeking treatment — embarrassment or shame about symptoms and concerns about being negatively judged by others may discourage people with a phobia from seeking treatment.

Specific environmental triggers

Many people diagnosed with a specific phobia report having a direct, negative and traumatic experience with a particular phobic stimulus at some time in the past and attribute this encounter as the cause of their phobia. For example, a phobia of heights may be attributed to a ride on a chairlift on a very windy day, a phobia of injections after unexpected pain when immunised at school and a phobia of the ocean after being knocked over by a big wave when wading in shallow water as a child. These 'specific' objects or situations in the 'environment' most likely produced, or 'triggered', an extreme fear response at the time, hence the use of the term *specific environmental trigger* to describe this type of factor contributing to the development of a phobia.

Often, an initial fear response to a specific environmental trigger becomes a conditioned fear response through classical conditioning processes and is produced whenever the stimulus (or a generalised version) is subsequently encountered. For example, 17-year-old 'Vanh' has had an extreme fear of dogs ever since he was bitten by a neighbour's poodle when he was five years old. Vanh will not even go shopping at the local convenience store because it is next to a pet shop, which often displays pups for sale in the front window. In effect, Vanh developed a conditioned response (fear) to a conditioned stimulus (the poodle) that has been generalised to similar stimuli — any dog.

Research findings indicate that the more severe the trauma associated with an unpleasant or harmful initial fear experience, the more likely it is that a phobia will develop. In addition, if the experience is sufficiently traumatic, one encounter may be enough to produce and maintain the fear response. For example, a single experience of being bitten by a dog might be sufficient to produce and maintain a dog phobia even if the person is never bitten again, whereas barking might not lead to a dog phobia until after a number of subsequent exposures to a barking dog (Beck, 1976).

People who develop a phobia after a single traumatic encounter with a phobic stimulus (i.e. a specific environmental trigger) are usually able to identify that particular traumatic event as causing their phobia. For example, an eight-year-old child developed a strong fear and fainting reaction triggered by hospitals, doctors and smells of anaesthesia after he had a very serious operation, and a 23-year-old woman with a phobia of high places developed her phobia when she fell from a high diving board and seriously injured herself (Sue, Sue & Sue, 2005).

A single traumatic experience does not, however, explain the origin of all phobias through direct experience. It is possible that two individuals may have a traumatic experience with the same object or situation and one subsequently develops a specific phobia while the other does not. For example, an individual who has grown up with dogs may be less likely to develop a phobia of dogs after being bitten, compared to an individual who is bitten the first time they encounter a dog. Subsequent exposure to the object or situation after the negative or traumatic experience occurs can also influence development of a phobia. For example, an individual who resumes driving as soon as possible after a car accident will be less likely to develop a phobia of driving than someone who avoids driving for a time after the accident.

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Figure 13.14 The specific environmental trigger for a phobia of flying may be a single experience of having been on a flight during severe turbulence or an electrical storm.

Stigma around seeking treatment

All mental health disorders tend to attract some degree of stigma. However, the nature of specific phobia and its symptoms mean that individuals with a phobia are particularly vulnerable to experiencing stigma, which in turn affects their willingness to tell family and friends, let alone to seek treatment from a professional. Furthermore, as discussed in Chapter 12, failing to seek treatment only serves to perpetuate the phobia.

For example, consider 17-year old 'Jackson' who has had a phobia of thunder for as long as he can remember. Jackson feels very anxious during a thunderstorm even though he knows that the threat is actually minimal. His reactions are worse when lightning accompanies thunder. As well as feeling scared and uneasy, his heart pounds as if it will burst out of his chest, he trembles, often breaks out into a sweat and sometimes has what he believes is a panic attack, especially if he is caught in the open where he can't easily escape, hide or find shelter, or if the thunder is persistent or so loud that he can't smother its sound by covering his ears. As a child, he often cried, hid under his bed or in a cupboard, and sometimes wet himself whenever there was persistent thunder.

Jackson typically avoids going outside without checking the weather first. He does this visually and through the three different weather apps he has downloaded to his mobile phone. If it looks like being a 'bad (weather) day' and he must go out, he will constantly monitor the weather forecast via his phone apps.

Despite his long-standing phobia, Jackson has not sought any treatment. When he told some friends about his fear of thunder, they ridiculed and made fun of him and his fear. Once, he couldn't hide his fear or anxiety when the sky suddenly blackened during a sports day and he felt embarrassed and ashamed. That experience keeps haunting him. He feels like no-one believes his fear is real, even his family, who think he is 'overreacting', 'exaggerating' and should just 'grow up' or 'snap out of it'. Jackson is not sure he'll ever work up the courage to talk to anyone about it again as he doesn't think he can trust anyone to take him seriously and not think he's just 'being childish'.

All specific phobias are based on fears, that are, by definition, 'irrational'. This is one reason why it can be difficult to understand or empathise with people who have them. This is more likely for people with a phobia involving objects or situations that are known to be harmless, such as balloons, buttons, butterflies, feathers, flowers and walking in a park on a sunny day. Despite their terrifying fear of such objects or situations, telling someone may result in ridicule, belittling comments, not being taken seriously and sometimes discrimination through differential treatment.

Furthermore, because the fear associated with specific phobias is typically limited to the phobic stimuli and many people with a phobia seem to function 'normally' outside of the phobic situation (as long as their phobia stimuli are avoided), it is common to believe that specific phobias are 'less severe' than other anxiety disorders and may not even be a real 'disorder' at all. These beliefs may be held by people with and without a phobia. In addition, some people have personal or cultural beliefs that inhibit them. For example, they may feel strong enough to cope on their own or they may feel that the treatment process in itself may be humiliating.

In one study of stigma associated with phobias, a significant number of participants reported that attitudes towards them were profoundly detrimental and the anticipation of such reactions made them wary of disclosing their phobia or seeking treatment. Of those who did reveal their phobia to others, most found that few actually *understood* what a phobia is, and what it means for the sufferer's life. Participants in this study also reported that due to the extent of the negative reactions they routinely face, many disguise the reality of their disorder and explain their avoidance of particular objects in other non-phobic terms. For example, one participant with a phobia of jewellery felt unable to reveal this so she publicly claimed to suffer from an allergic reaction to jewellery, rather than expose herself to the ridicule and loss of respect she anticipated would accompany an admission of the source of her fear, particularly in her workplace (Davidson, 2005).

Figure 13.15 People with a specific phobia involving an object or situation that is apparently harmless to others, such as balloons, are particularly vulnerable to stigma.

LEARNING ACTIVITY 13.7

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Review questions

1. (a) What is meant by the term 'specific environmental trigger' in relation to the development of a specific phobia?
(b) Give an example of a specific phobia that may have developed due to a specific environmental trigger other than examples given in the text.
(c) What is the relationship between the severity of the traumatic event and the likelihood of developing a specific phobia?
(d) It is possible that two individuals may have a traumatic experience involving the same object or situation and one subsequently develops a specific phobia while the other does not. What are two factors that may account for this?
(e) (i) If a single experience is sufficient to induce development of a specific phobia, does this mean phobias may be acquired through a type of learning that could be called 'one trial learning'? Explain your answer.
(ii) Explain whether 'one trial learning' could be considered a form of classical conditioning.

2. (a) Why might people with specific phobias be particularly vulnerable to stigmatisation?
(b) What are three possible reasons that may lead individuals with a specific phobia not to seek treatment?
(c) Explain how stigma around seeking treatment can contribute to:
(i) development of a specific phobia
(ii) perpetuation of a specific phobia.

3. Complete the following table to summarise social factors contributing to the development of a specific phobia. After you have done so, you may combine information in the table with that completed for biological and psychological factors to create a single table.

Social factor	What is it?	How it may contribute
specific environmental trigger		
stigma surrounding treatment		

LEARNING ACTIVITY 13.8

Analysis of the development of specific phobia

Construct a concept map or another diagram to show the interaction of biopsychosocial factors relevant to the development of a specific phobia of interest to you.

EVIDENCE-BASED INTERVENTIONS IN THE TREATMENT OF SPECIFIC PHOBIA

Evidence-based interventions are treatments that have been found to be effective on the basis of valid and reliable research studies. Consequently, treatments developed and/or tested in this way are likely to be effective for different people with various types of phobias if used appropriately.

According to the Australian Psychological Society (2010, p. 2), 'evidence-based practice has become a central issue in the delivery of health care in Australia and internationally. Best practice is based on a thorough evaluation of evidence from published research studies that identifies interventions to maximise the chance of benefit, minimise the risk of harm and deliver treatment at an acceptable cost'.

This approach ensures that treatments vary according to the particular disorder and the individual's ('client's') specific symptoms. For example, just as treatment for tonsillitis differs from that for a heart disorder, treatments for a specific phobia will differ from those for an eating disorder. In addition, this approach ensures that interventions lacking scientific evidence of effectiveness are recognised and avoided. For example, it is important to recognise the difference between evidence-based interventions and 'fringe' or pseudoscientific interventions because the latter can prevent people from getting effective treatment and in some cases may be dangerous.

In this section, we examine evidence-based interventions for a specific phobia from a biopsychosocial perspective. These include biological interventions involving the use of benzodiazepines, breathing retraining and exercise, psychological interventions involving the use of cognitive behavioural therapy and systematic desensitisation, and a social intervention involving psychoeducation for families and others who may be close to or provide social support for someone with a specific phobia.

Biological interventions

Biological interventions target bodily ('biological') mechanisms believed to be contributing to a phobia or its symptoms. These can involve the use of medications that target GABA dysfunction and can minimise the onset or severity of symptoms, and/or relaxation techniques involving activities such as breathing and exercise that are under the control of the individual and which can also help in the management of symptoms.

Use of benzodiazepine agents

Benzodiazepines are a group of drugs ('agents') that work on the central nervous system, acting selectively on GABA receptors in the brain to increase GABA's inhibitory effects and make post-synaptic neurons resistant to excitation. While psychological interventions are usually the first option for the treatment of a specific phobia, the effectiveness of benzodiazepines in the treatment of anxiety provides evidence for the role of GABA in phobic anxiety.

Benzodiazepines have both anti-anxiety and sleep-inducing properties. They are commonly referred to as sedatives, mild tranquillisers or depressants, because they slow down CNS activity. Generally, they relieve symptoms of anxiety by reducing physiological arousal and promoting relaxation. However, they also induce drowsiness, can be highly addictive and their long-term use is not recommended.

As shown in Table 13.4 below, there are many different types of benzodiazepines, each of which is sold under a different brand name. The most common benzodiazepines prescribed in Australia are temazepam, nitrazepam, diazepam, oxazepam and alprazolam. These have brand names such as Valium, Serepax and Xanax, and are usually taken orally (beyondblue, 2016b).

TABLE 13.4 Some of the different generic and brand names of benzodiazepines prescribed and sold in Australia

Generic name	Brand name	Type of benzodiazepine
diazepam	Ducene®, Valium®	long-acting
oxazepam	Alepam®, Murelax®, Serepax®	short-acting
nitrazepam	Alodorm®, Mogadon®	intermediate-acting
temazepam	Euhypnos®, Normison®	short-acting
alprazolam	Xanax®, Kalma®, Alprax®	short-acting

Alcohol and Drug Foundation (2018). *Benzodiazepines*. [Drug facts]. Retrieved from https://adf.org.au/drug-facts/benzodiazepine/

Generally, drugs and other medications work either by stimulating a neurotransmitter's activity (called *agonists*) or by inhibiting a neurotransmitter's activity (called *antagonists*). Benzodiazepines are GABA agonists. This means they stimulate activity at the site of a postsynaptic neuron where GABA is received from a presynaptic neuron. In this way, benzodiazepines have inhibitory effects on postsynaptic neurons throughout the brain and reduce the symptoms of anxiety by imitating GABA's inhibitory effects. When a benzodiazepine attaches to a GABA receptor, it changes the shape of the receptor to make it more receptive to the activity of GABA and consequently more resistant to excitation. Reducing the excitability of neurons reduces the communication between neurons and, therefore, has a calming effect on many of the functions of the brain. If there is no GABA at a receptor on a postsynaptic neuron, a benzodiazepine has very little effect on the neuron. If GABA is present, then the benzodiazepine will usually amplify the impact of GABA (Diamond, 2009).

Studies of antagonists have found them to have the opposite effect on phobic anxiety. Antagonists reduce GABA activity and can therefore produce or increase the severity of anxiety symptoms. For example, studies with apes and other primates have found that physiological symptoms of anxiety can be induced when a benzodiazepine antagonist is administered. This provides further evidence of the role of GABA in anxiety (Sadock, Kaplan & Sadock, 2007).

Different benzodiazepines are processed by the digestive system and eliminated from the body at different rates. Therefore, as shown in Table 13.4, a benzodiazepine may be described as short-acting, intermediate-acting or long-acting.

Short-acting means that benzodiazepine remains in the bloodstream and is cleared from the body in a short period of time. In contrast, a *long-acting* benzodiazepine may accumulate in the bloodstream or take a much longer period of time to leave the body. For example, the effects of one of the more common short-acting benzodiazepines, temazepam (e.g. Normison), reach a peak after two or three hours, and the drug ceases to be effective after about six to eight hours. The effects of diazepam (e.g. Valium), however, peak after 30 to 90 minutes, while the drug remains in the blood for up to three days.

Figure 13.16 Benzodiazepines are effective in reducing anxiety symptoms by reducing physiological arousal and having an overall calming effect. They are useful for treating the symptoms but do not 'cure' a specific phobia or any other anxiety disorder. When use is discontinued, symptoms can return if other significant contributory factors have not been addressed.

Some people use a benzodiazepine intermittently to help cope with an occasional, unavoidable encounter with a phobic stimulus. For example, an individual with a fear of flying who must travel interstate for a business meeting, may be prescribed a short-acting benzodiazepine with a rapid onset of action to take an hour or so before they board to help tolerate a flight. Or, a person with a dental phobia may take a short-acting, rapid onset benzodiazepine before an appointment to enable them to endure the necessary dental procedure (Gazzaniga & Heatherton, 2006).

Although benzodiazepines tend to be highly effective in reducing anxiety with few side-effects in the short term, there are potential negative consequences associated with their long-term use as they can reduce alertness, abilities dependent on alertness (e.g. concentration, reaction time) and can be addictive. Benzodiazepines can also lower inhibitions and make some people more impulsive and likely to take risks, particularly if these medications are mixed with alcohol or other drugs. The medications can be used safely with little risk, even over long periods of time, but some people become dependent on their use.

Importantly, benzodiazepines treat the symptoms and not the cause of anxiety. Once medication is stopped, symptoms may return if the underlying cause of the anxiety — the specific phobia — has not been addressed. In addition, use of benzodiazepine alone may alleviate symptoms but does not actually teach any non-drug dependent coping skills for dealing with anxiety, so they are not widely supported as a long-term solution for a specific phobia (beyondblue, 2016b).

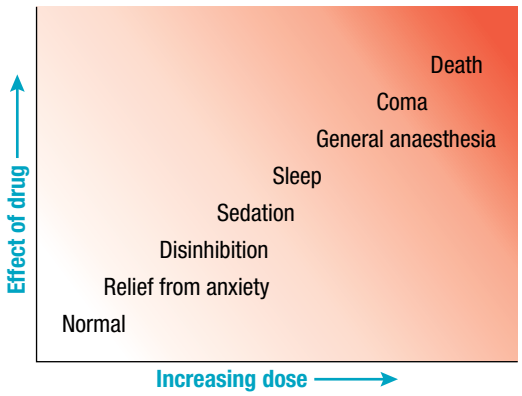

Figure 13.17 A behavioural continuum of sedation. Note the relationship between dosage and behavioural effects. A low dose of a sedative or anti-anxiety drug reduces anxiety, but very high doses are dangerous and can result in death.

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More about benzodiazepines

LEARNING ACTIVITY 13.9

Review questions

1. (a) Explain the meaning of 'evidence-based intervention'.
   (b) Give two reasons to explain why an 'evidence-based intervention' is the preferred choice for a mental health disorder.
2. What are benzodiazepines?
3. Why are they classified as agonists rather than antagonists?
4. Explain how benzodiazepines work in alleviating anxiety.
5. Explain the meaning of short-acting and long-acting in relation to benzodiazepines.
6. Give two advantages and two limitations of using benzodiazepines to treat phobic anxiety.
7. In what way do studies with drugs that are GABA antagonists provide evidence of the role of GABA in phobic anxiety?

Relaxation techniques

Two commonly used relaxation techniques that promote relaxation and help deal with phobic anxiety and other symptoms involve breathing retraining and exercise.

Breathing retraining

People experiencing a phobic reaction can over-breathe as respiration rate normally increases in the presence of a perceived threat. They may breathe faster and deeper than necessary (*hyperventilation*) or get into a pattern of uncontrolled rapid and shallow breathing (*tachypnea*). A significant problem is that an abnormal breathing pattern can become habitual and actually increase fear or anxiety. Research has found that many people with specific phobias develop abnormal breathing patterns (Reavley, et al., 2013).

Over-breathing is excessive breathing. A consequence of excessive breathing is that we take in more air than the body actually needs. This can upset the balance of oxygen and carbon dioxide, resulting in a low level of carbon dioxide in the blood. Too little carbon dioxide can cause reactions such as dizziness, light-headedness, blurred vision and pins and needles, all of which are associated with a panic attack and can heighten feelings of fear and anxiety. Over-breathing may also cause breathlessness — a sensation of shortness of breath or difficulty breathing. This is a common reaction but it can be both distressing and frightening.

An overall effect of over-breathing is that a counterproductive cycle may be created as a person can become more fearful or anxious because they feel breathless, which leads to more difficulty breathing and other fear, anxiety or panic symptoms. Sometimes, their abnormal breathing pattern may be a tipping point or actually trigger the onset of a panic attack — an extreme anxiety response to a phobic stimulus.

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Figure 13.18 Fear or anxiety can cause excessive breathing (e.g. hyperventilation) and make the person feel short of breath. This abnormal breathing pattern may increase anxiety and can become habitual.

Breathing retraining, also called *breathing training*, is an anxiety management technique that involves teaching correct breathing habits to people with a specific phobia. Breathing retraining helps people to maintain correct breathing or correct abnormal breathing patterns when anticipating or exposed to a phobic stimulus, so it may also help to reduce anxiety or alleviate some of its symptoms. Breathing retraining can give people control over their breathing and may therefore also help them feel as if they have more control of their fear or anxiety (Reavley, et al., 2013).

An appropriate breathing pattern generally involves slow, regular breaths in through the nose and out the mouth at a controlled rate as opposed to fast and/or irregular, shallow 'chest breathing' or the rapid, deep breathing of hyperventilation. The goal is to slow the respiration rate, promote a 'normal', regular breathing pattern, prevent over-breathing and maintain the correct balance of oxygen and carbon dioxide in the blood.

Our respiration rate also has an impact on our heart rate, blood pressure and other bodily functions. Slow, regular breathing promotes relaxation. It slows bodily processes, lowers arousal, and in turn can reduce anxiety and stress. Slowing the respiration rate is also an effective method of inhibiting a fight or flight reaction and returning to a normal state after it has been activated. Generally, a slow respiration rate and fight–flight are mutually exclusive, which means they can't occur at the same time.

Breathing retraining may also involve teaching the individual how to quickly restore the level of carbon dioxide in their blood if they start over-breathing. This will essentially involve learning a technique that increases carbon dioxide by taking in less oxygen. For example, this can be accomplished by breathing through pursed lips (as if blowing out a candle), or by covering the mouth and one nostril, and breathing through the other nostril.

Breathing retraining can be used by itself or in combination with other treatments. Some studies have found that it can reduce the risk of over-breathing, increase the threshold ('tipping point') for the onset of a panic attack and generally promote relaxation. It may also help individuals manage the physiological arousal and tension they experience when exposed to a phobic stimulus and to correct breathing habits that make their symptoms worse. An advantage is that a person can use their correct breathing technique in public situations without drawing much attention.

However, breathing retraining also needs to be practiced, especially when not particularly anxious, in order to make it habitual. This will make it more likely that an individual will be able to implement the technique even when highly anxious and perhaps not thinking clearly. Generally, breathing retraining is potentially beneficial, but other interventions have been found to be more effective (e.g. CBT) and there is no evidence indicating that it 'cures' specific phobias (Leahy, Holland & McGinn, 2012; Reavley, et al., 2013).

Exercise

Exercise typically involves physical activity undertaken to improve or maintain one's physical condition. It has been studied as a possible treatment option for the stress and anxiety symptoms commonly experienced by people with a specific phobia, both as an extra treatment to complement other interventions, and, to a lesser extent, as a stand-alone treatment. In addition to general health benefits, exercise has been found by some studies to provide relief from or alleviate some of the symptoms associated with fear and anxiety (Anderson & Shivakumar, 2013; Bartley, Hay & Bloch, 2013).

Generally, exercise may be helpful as an intervention in one or more of the following ways:

- promoting relaxation and thereby providing relief from anxiety
- providing distraction or 'time out' from phobic stimuli, fear and anxiety
- coping with the stress and associated physical reactions e.g. stress places demands on the body for energy and in the process uses up stress hormones
- increasing tolerance to some of the fear and anxiety symptoms e.g. exercise can cause physical reactions like those for fight–flight or a panic attack (i.e. rapid heartbeat, sweating, shortness of breath), enabling symptoms to be experienced in a controlled, non-threatening way, and possibly improving coping ability through repeated exposure if exercise is regular (Anderson & Shivakumar, 2013; Reavley, et al., 2013)
- altering brain chemistry e.g. promotes release of mood enhancing ('feel good') endorphins, thereby promoting a sense of well-being and indirectly providing relief from anxiety. Some animal studies have found that exercise may activate GABA-releasing neurons more quickly (Schoenfeld, et al. 2013).

Figure 13.19 Research findings show that specific phobias are significantly less common among those who engage in regular exercise compared with those who do not (Goodwin, 2003).

LEARNING ACTIVITY 13.10

Review questions

1. (a) What is breathing retraining?
(b) What does it aim to achieve?
(c) Give an example of an abnormal breathing pattern that may be developed by people with specific phobias and explain why this pattern needs retraining input.
(d) Give an example of a breathing pattern that may inhibit or alleviate fear or anxiety symptoms.

2. (a) Give two examples of how exercise may complement other treatment interventions, enhancing the overall effectiveness of a treatment plan. One example should be a biological benefit and another a psychological benefit.
(b) Suggest a potential social benefit of exercise.
(c) Some studies have found that exercise can induce hyperventilation and consequently a panic attack. Explain how this could occur.

Psychological interventions

For some people, a specific phobia can cause major disruption to their everyday lives because they have to go to great lengths to avoid the object or situation that triggers their fear or anxiety. For example, a tradesperson may avoid taking jobs in high places due to their fear of heights, an executive may have to turn down a promotion involving overseas travel because of their fear of flying, and someone who works on the 30th floor of a city office building may have to walk up and down the stairs each day due to an intense fear of being exposed to someone else's germs in the confined space of an elevator.

Similarly, people whose phobias are focused on everyday objects or situations will regularly encounter them, so phobic anxiety and avoidance may become central to their lives. However, if the phobic stimulus is rarely encountered, it will not continually interfere with the person's functioning or cause distress, so in these instances, the person is not likely to seek professional help. For example, a person might have a fear of being buried alive (taphephobia), but this situation is very unlikely to be encountered and is therefore not likely to cause significant disruption to a person's life.

People typically seek treatment from a professional only if a phobic stimulus is frequently encountered and is therefore constantly intruding on everyday life. Two of the most commonly used psychological interventions are the 'talking therapy' called cognitive behavioural therapy and a therapy such as systematic desensitisation which involves gradual exposure to phobic stimuli.

Cognitive behavioural therapy

Most people with a specific phobia have cognitive biases and excessive behavioural reactions to fear- or anxiety-producing stimuli. Therefore, a commonly used intervention involves the use of cognitive behavioural therapy (CBT) to change thoughts and behaviours that perpetuate the phobia and to improve coping skills. CBT for a specific phobia has been assessed in a large number of research studies and has been found to be effective in both the short term (immediately after treatment) and the long term (many years after treatment) (Reavley et al,. 2013; Wolizky-Taylor, et al., 2008).

In addressing the thought patterns underlying a specific phobia, CBT aims to assist the individual to develop a new understanding that their feared stimuli are not (or are unlikely to be) dangerous, so their avoidance and safety behaviours are unnecessary and unhelpful in the long term.

Avoidance and safety behaviours are used by people with phobias to help minimise or control their fear or anxiety. *Avoidance behaviour* involves actions that help avert any contact, exposure or engagement with a feared object or situation. Simply staying away from a phobic stimulus is an example of avoidance behaviour. Alternatively, an individual may engage in *safety behaviour* whereby they may not directly avoid a phobic stimulus but are willing to have contact with it if certain precautions are in place. For example, someone who is fearful of insects may wear a hat, heavy gloves, long trousers and boots when gardening and someone who is fearful of exposure to germs may visit a friend who has a non-infectious disease only if they are taking a preventative course of antibiotics and can minimise touching objects within their friend's house (Anderson, Saulsman, & Nathan, 2011).

Avoiding objects and situations, or using safety behaviours to cope with them, may prevent a feared outcome and reduce anxiety, but the individual tends to become reliant on them and they perpetuate the phobia. Consequently, they are considered maladaptive and are targeted for treatment.

During CBT, the individual will be encouraged to identify their fear- and anxiety-related thoughts as these are likely to reflect cognitive biases that strongly affect whether they experience fear or anxiety and how they behave when exposed to a phobic stimulus.

Figure 13.20 CBT will target thoughts and behaviours that perpetuate a phobia.

For example, if a person truly believes that all birds might attack them, it should not be surprising that they will be frightened and anxious around birds. However, once the individual can recognise unhelpful ways of thinking that are contributing to their fear and anxiety, they will be better able to make changes to replace these with new ways of thinking that reduce fear and anxiety.

Professionals may use a range of techniques in CBT to help someone identify their cognitive distortions and other unhelpful thinking patterns. For example, some may guide the individual to self-discovery of flawed thoughts underlying their maladaptive feelings and behaviour. Others, by contrast, may take a more direct and blunt approach and explain to the individual why their thinking is flawed.

The individual is then encouraged to look for evidence that supports their fear cognitions and evidence that does not support them. One way of helping a person achieve this is to encourage them to think about their thoughts as hypotheses (rather than facts) that must be subjected to testing and objective evaluation. The assumption is that once these thoughts are recognised as hypotheses and not facts, they are open to questioning and challenging.

Sometimes, a person's cognitive distortions result from a lack of information or from inaccurate information. One way of changing such thinking is to encourage the individual to gather accurate information about their phobic stimulus; for example, from experts, books or other reliable sources. Information may also be provided to the individual. For example, a person who has panic attacks and believes their symptoms are signs of an impending heart attack may be informed about the physiology of anxiety and fear and how the symptoms relate to cardiac functioning. A person may also be advised to take a course that has an 'education component' and provides accurate information about relevant phobic stimuli. For example, fear of flying is often related to misperceptions about the vibrations, movements and sounds heard during the flight. Most of these stimuli reflect the normal operation of a flying plane and aspects of flight that do not actually indicate an impending crash. Several airlines, including Qantas, offer courses for people who are afraid of flying that provide extensive information about various aspects of aeroplanes and flight to promote realistic thinking with the goal of alleviating fear or anxiety through education.

Once the individual has identified their cognitive distortions and evaluated the 'evidence', they are better able to counter them with alternative, more objective and useful thoughts. This can help them face their fears and approach fearful situations more rationally. For example, if a person thinks that birds are likely to fly away as they approach them (instead of thinking that they are likely to attack them), they are less likely to be afraid or feel compelled to avoid them. Engaging in more balanced and objective thinking about a phobic stimulus will then lead to changes in feelings and behaviour, particularly a reduction in fear, anxiety and avoidance.

Behaviour therapy is also a major component of CBT. This could include teaching a relaxation technique, breathing retraining, promoting exercise and/or encouraging activities that are rewarding, pleasant or give a sense of satisfaction. All of these can help distract from or reduce fear and anxiety. The individual is also likely to be taught a technique to help them actually cope with fearful situations. This can be achieved through a behaviour therapy called systematic desensitisation.

BOX 13.3 Fearless Flyers program

The odds of being in a plane crash or killed in a plane crash vary according to how and where you take the flight. Generally, the odds of being in a crash that results in at least one fatality are about 1 in 3.4 million and about 1 in 4.7 million for dying in a crash on a major world airline. Although most people with a phobia of flying (aerophobia) would be unaware of these statistics, many would know that there is a very low likelihood of a plane they are travelling in crashing — much lower than being killed in a car crash fatality on the way to the airport. Yet this does not reduce their anxiety about flying.

Fearless Flyers is one program helping people overcome aerophobia. Fearless Flyers Incorporated is a not-for-profit organisation that offers fee paying courses to help people conquer their fear of flying. Qantas, Airservices Australia and the Bureau of Meteorology support the program and provide volunteer aviation professionals (pilots, engineer, cabin services, air traffic controllers and meteorologists). Course topics covered include:

- understanding the physiology of fear and effective relaxation techniques
- pilots, engineers and cabin crew (their qualifications and training)
- aircraft design, testing and maintenance; what makes a plane fly
- meteorology: turbulence (what causes it and what effect it has on an aircraft); weather forecasting for aviation
- air traffic control and navigation of commercial aircraft.

The course may also include one or more tours such as

- a tour of a jet aircraft on the ground e.g. participants sit in the cockpit with a pilot, who will explain the basics of the flight deck and aircraft controls; tour around the outside of the aircraft with a maintenance engineer; tour of the aircraft cabin with a senior flight attendant
- a tour of the air traffic control tower to observe air traffic controllers at work and learn about their training
- a tour of the flight simulator training facility and the emergency procedures training facility.

At the end of the course, participants graduate with a flight, usually to a major capital city.

Source: fearless flyers inc. Retrieved from http://fearlessflyers.com.au/

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Weblinks

- Fearless Flyers program
- Virgin Atlantic flying without fear video 12m 15s
- Plane crash statistics

Figure 13.21 Course participants learn how an aircraft engine works.

Systematic desensitisation

Behaviour therapy for specific phobias relies mainly on treatment involving gradual and repeated exposure to phobic stimuli. There are a number of different approaches to this type of therapy, but they all typically involve exposing the individual to the specific objects or situations that make them fearful and anxious in a safe and controlled way. The goal is to help the individual cope with fearful objects or situations rather than avoid or escape them.

Systematic desensitisation is a commonly used and effective 'graduated exposure' technique that has helped people manage their fear of dogs, spiders, snakes, heights, dentists, mice, balloons, feathers, violins, tunnels, needles or eating in public, sometimes in a single session (Kassin, 1995). It was first developed in the 1950s by South African psychiatrist Joseph Wolpe (1958) to successfully 'treat' an adult female client with agoraphobia (fear of open spaces), but the technique has since been modified.

Systematic desensitisation is a kind of behaviour therapy that aims to replace an anxiety response with a relaxation response when an individual with a specific phobia encounters a fear stimulus. The technique applies classical conditioning principles in a process that involves *unlearning* the connection between anxiety and a specific object or situation and *reassociating* feelings of relaxation (and safety) with that particular object or situation. Generally, the three-step process requires the individual to learn to relax while gradually facing increasingly anxiety-producing phobic stimuli. Over time, the individual associates being relaxed with their phobic stimuli instead of anxiety. Because it is physiologically impossible to be anxious and relaxed at the same time, the individual gradually, or 'systematically', becomes desensitised to anxiety caused by the phobic stimulus (Antony & Swinson, 2000).

The first step in systematic desensitisation involves teaching the individual a relaxation technique that they can use to decrease the physiological symptoms of anxiety when confronted by a phobic stimulus. This may include breathing retraining to learn a slow breathing technique, progressive muscle relaxation and/or visual imagery. As its name suggests, a slow breathing technique involves learning to slow down the respiration rate, either when over-breathing (e.g. hyperventilating) or, preferably, before its onset. An example of the technique is summarised below.

- Hold your breath for six seconds.
- Breathe in and out on a 6-second cycle, saying the word 'relax' as you breathe out.
- After 1 minute, hold your breath again, then continue to breathe on a 6-second cycle.
- Repeat the sequence until anxiety has diminished.

The second step in systematic desensitisation involves breaking down the anxiety-arousing object or situation into a sequence arranged from least to most anxiety-producing. This is called a fear hierarchy. A **fear hierarchy**, also called an *anxiety hierarchy*, is a list of feared objects or situations, ranked from least to most anxiety-producing. Working with the therapist, the individual identifies different phobic stimuli and constructs a 'step ladder' of anxiety-producing objects and/or situations, with the steps gradually increasing in difficulty.

Ideally, fear hierarchies should consist of 10 to 15 specific situations, each of which is rated and then ranked ('ordered'), often on a 100-point scale. For example, the least anxiety-producing situation may be rated at 30 on a 100-point scale and the most anxiety-producing situation may be rated at 100. Each situation should be quite detailed, including relevant variables such as time of day, duration of exposure and presence of other people.

The third step involves the systematic, graduated pairing of items in the hierarchy with relaxation by working upwards through items in the hierarchy, one 'step' at a time. This can be achieved either *in vivo* (in real life) or using *visual imagery* ('imagination') and, more recently, using virtual reality technology during which the individual is exposed to computer-generated scenarios involving the phobic stimulus.

At every step, the individual is encouraged to relax and no advancement is made to the next step until relaxation is achieved. Systematic desensitisation sessions continue until the individual can respond to the most anxiety-producing situation in the fear hierarchy in a relaxed state. For example, an anxiety-producing situation such as travelling in an elevator could be broken down into a sequence of steps starting with looking at elevators (watching them come and go); standing in a stationary elevator with a support person; standing in a stationary elevator alone; travelling up or down one floor with a support person then gradually extending the number of floors travelled, first with a support person and then alone with the support person waiting outside the elevator; and finally travelling on an elevator alone without a support person nearby. The individual is then asked to visualise the least frightening of the steps while in a relaxed state. If the individual can successfully visualise the fear-producing stimulus and remain relaxed, the next step is tackled.

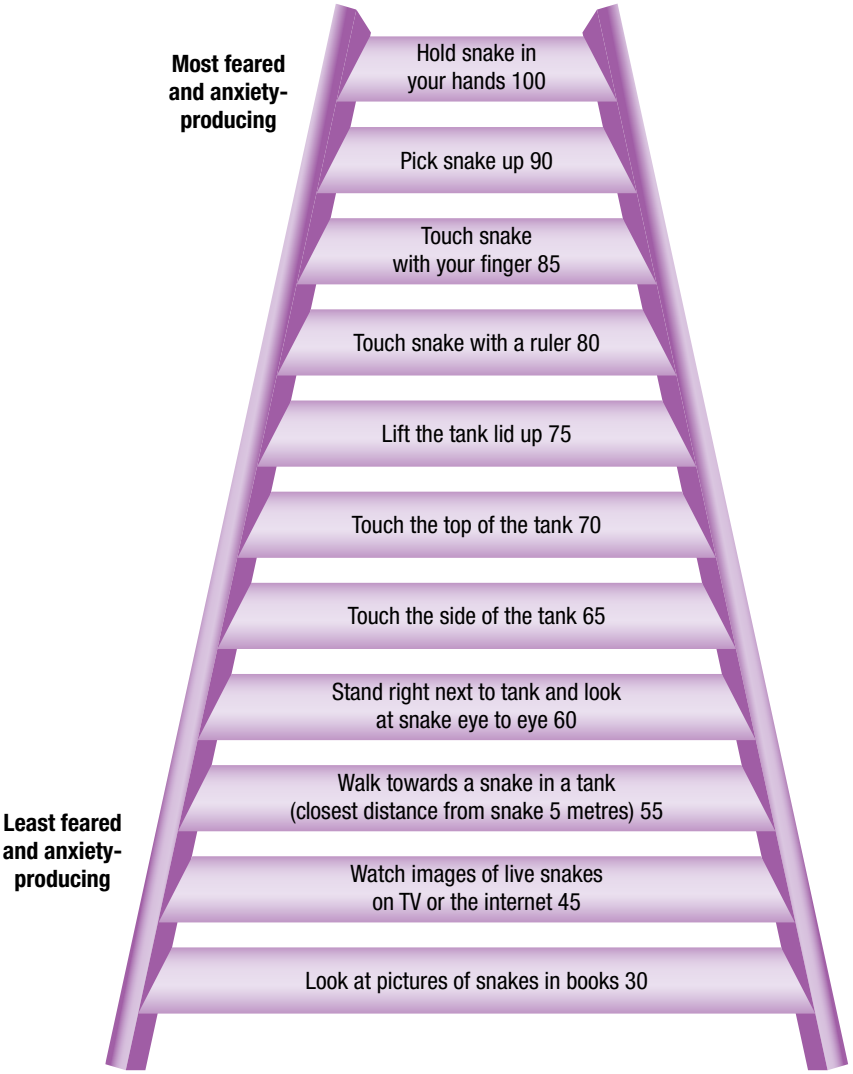

Figure 13.22 An example of a fear hierarchy for a snake phobia (ophidiophobia)

Figure 13.23 Virtual reality exposure therapy can use computer technology to re-create the sights and sounds of phobic stimuli in a 'virtual' environment. Clients enter this simulated environment by putting on a head-mount display (like those used in virtual reality games). The therapist may use a computer keyboard to control everything the client sees and hears.

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Weblink
Video on use of virtual reality in psychological therapy 6m 05s

BOX 13.4 Using counter-conditioning to extinguish a specific phobia

Joseph Wolpe is well known for developing systematic desensitisation. However, Wolpe was not the first therapist to use this type of technique. American psychologist Mary Cover Jones had already used a similar technique in treating specific phobias in young children. Jones's best known work was a case she reported in 1924. This involved the successful treatment of a specific phobia of rabbits and other furry objects in a boy called Peter, which she conducted in consultation with John B. Watson.

Peter was a three-year-old boy who was especially afraid of a tame rabbit, so Jones focused on eliminating the rabbit phobia. Jones (1924a) described Peter as 'almost to be Albert grown a bit older'. The method used by Jones (1924b) to eliminate Peter's fear is called counter-conditioning. *Counter-conditioning* involves learning a new conditioned response that is incompatible with a previously learned response. In treating Peter, this specifically involved pairing the rabbit that produced a fear response in Peter with another stimulus (milk and biscuits) that produced a different response (positive feelings), and one that was incompatible with the conditioned response (fear).

At first, Peter was placed in a room with the rabbit in a cage some distance from him, and was given the milk and biscuits. This helped to ensure that his fear would remain at a low level. Otherwise, Peter might have learned to fear milk and biscuits. Gradually, over a period of about three months (which involved many pairings of the rabbit with the milk and biscuits), the rabbit was brought closer and closer to Peter. Eventually, he was able to sit with the rabbit in his lap without fear, playing with it with one hand while he ate and drank with the other.

Along with counter-conditioning, Jones (1924a) used observational learning (modelling) techniques to help eliminate Peter's fear of rabbits. As part of the treatment, Peter observed other children petting or holding the tame rabbit. Eventually, Peter imitated the actions of the non-fearful children. For her pioneering efforts in the treatment of children's fears, Jones is widely regarded as the first behaviour therapist (Hockenbury & Hockenbury, 2006).

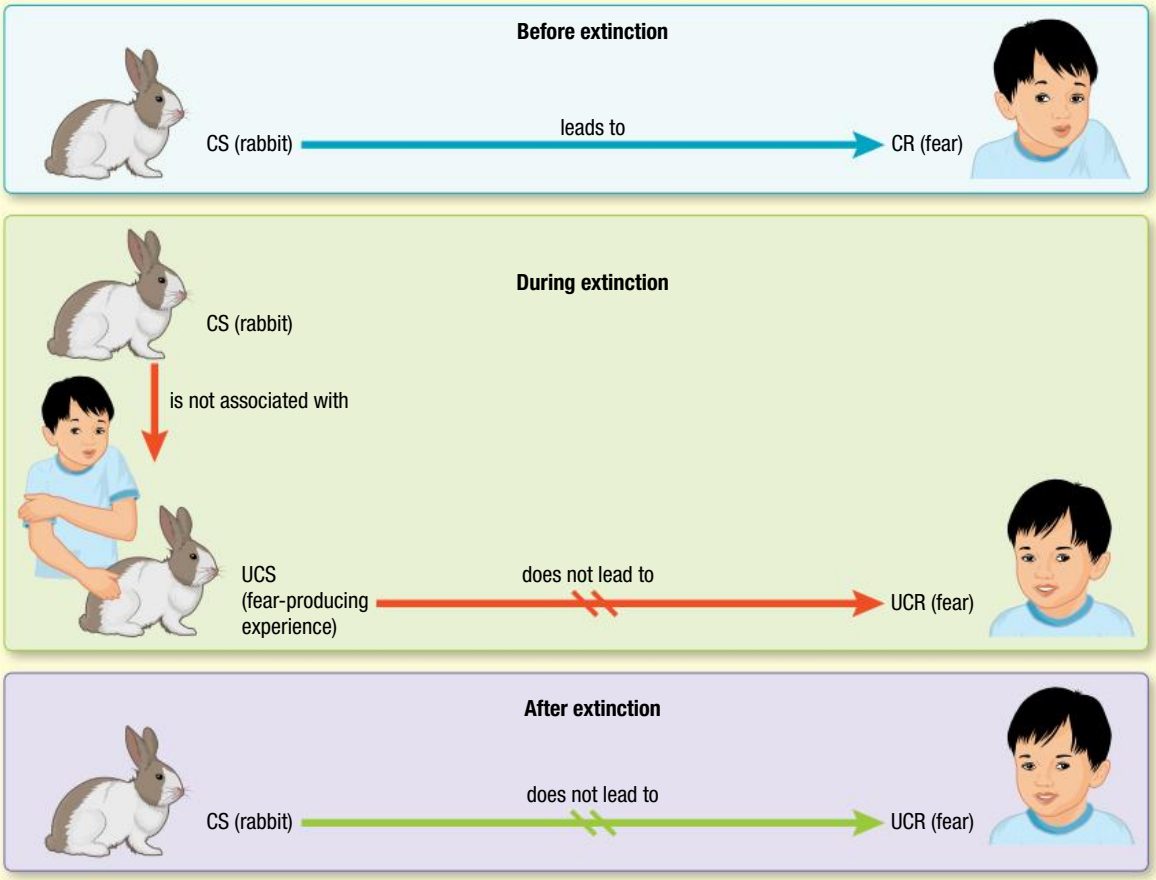

Figure 13.24 Extinction of Peter's specific phobia using counter-conditioning

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Applied tension technique for treating a specific phobia

BOX 13.5 Comparing computer-aided vicarious exposure and systematic desensitisation in the treatment of spider phobia

Australian psychologists Lisa Gilroy and her colleagues (2000) conducted a research study to compare the effectiveness of two treatment methods for spider phobia (arachnophobia). These interventions involved computer-aided vicarious exposure to spiders and systematic desensitisation.

There were 45 female participants, with a mean age of 33.11 years, all diagnosed as having a specific phobia of spiders. Each participant was randomly assigned to one of three treatment conditions: Group 1 — computer-aided vicarious ('indirect') exposure; Group 2 — therapist delivered systematic desensitisation; and Group 3 — progressive muscle relaxation placebo.

Group 1 participants (computer-aided vicarious exposure) used a 'point-and-click' method with the computer mouse to guide a 'person' (screen figure) through a house. The participant could direct the 'person' into various scenarios depicting a spider picture, a plastic spider, a dead spider and a live spider in different rooms. For example, in one scenario, the participant could direct the screen figure towards a dead spider on top of a refrigerator. An 'anxiety thermometer' that was also on screen was used to indicate their level of anxiety in each situation. This was programmed to rise with increasing proximity to the spider.

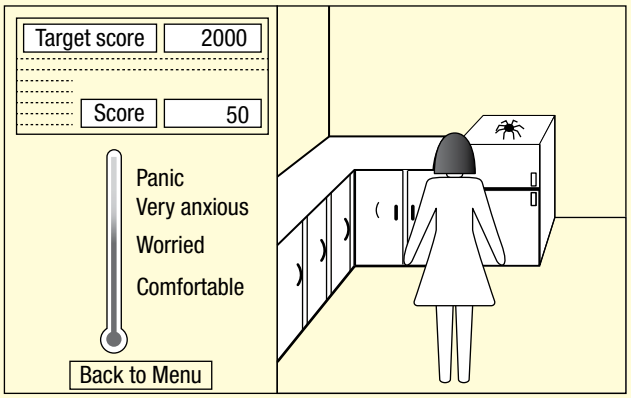

Figure 13.25 In this sample screen from a phobia simulation program, the client has directed the figure towards a dead spider on top of the fridge.

Source: Gilroy, L.J., et al. (2000). Controlled comparison of computer-aided vicarious exposure versus live exposure in the treatment of spider phobia. *Behavior Therapy,* 31, 733–744.

In the first session, a researcher stayed with each participant until they were comfortable using the program. The therapist then left the participant to work through the program on their own (usually after about 5 minutes).

Each group received three 45-minute sessions. Phobic symptom severity was measured pre-treatment, post-treatment and three months after the treatment had been completed. This was done using several subjective and behavioural measures, including the Behavioural Assessment Test (BAT). The BAT involves 11 increasingly difficult tasks in approaching a live huntsman spider measuring 10 to 12 centimetres. The score ranges from 0 (no steps attempted) to 22 (completed all of the 11 steps).

Gilroy and her colleagues hypothesised that both the computer treatment condition (Group 1) and live exposure condition (Group 2) would lead to significant decreases in spider phobia, but that the relaxation condition (Group 3) would remain at around the pre-treatment level. It was also hypothesised that any observed improvement in phobic symptoms would be maintained until the three-month follow-up session.

At the conclusion of the experiment it was found that participants in both Groups 1 and 2 showed a substantial reduction in their phobic symptoms and behavioural avoidance of spiders (but with no significant difference between Groups 1 and 2) for up to three months after the conclusion of the three treatment sessions. These results were recorded for all dependent variables at both the post-treatment and three-month follow-up, except for BAT scores. On this dependent variable measure, Group 2 participants performed significantly better than Group 1 participants post-treatment. Group 2 had a BAT mean of step 7 ('Put the container on the table and open it without removing the lid completely'), whereas Group 1 had a BAT mean of step 5 ('Lift the container and hold it using both hands'). However, this difference on BAT scores was not observed during the three-month follow-up.

Group 3 participants (relaxation condition) also showed significant improvements from pre-treatment to follow-up on a number of the dependent variable measures. But these improvements were much less than in the two active treatment groups.

Both the computer-aided and live systematic desensitisation treatments were therefore significantly more effective in treating spider phobia than the relaxation placebo treatment.

Nearly three years later, in 2003, the researchers conducted a follow-up study: 42 of the 45 participants were assessed again using the same measures. This time, the researchers were unaware of which treatment group the participants had been in. The results showed that the improvements from pre-treatment to 33-month follow-up had been maintained. There was, however, a clear trend for the live systematic desensitisation to be superior to the computer-aided treatment and progressive muscle relaxation, and the computer-aided treatment to be superior to the progressive muscle relaxation group across both subjective and behavioural measures.

LEARNING ACTIVITY 13.11

Review questions

1. (a) From a CBT perspective, explain why avoidance and safety behaviours are not helpful to a person with a specific phobia.
(b) What are two possible goals of a CBT treatment plan for a specific phobia?
(c) Give two examples of how a distorted phobic thought could be changed to a more appropriate one through CBT intervention.

2. (a) What is systematic desensitisation?
(b) Explain what a fear hierarchy is and how it is used with reference to treating someone who has a phobia of dogs.
(c) Construct a simple flowchart to summarise the three steps in systematic desensitisation.
(d) In what way does systematic desensitisation apply classical conditioning principles?
(e) 'Helena' has a fear of flying. Together with her therapist, she has constructed a fear hierarchy. Put the steps of her fear hierarchy in the most likely order that she would approach them using systematic desensitisation.

- The plane doors closing
- Checking in
- Boarding the plane
- The plane taxiing to the runway
- Thinking about travelling by plane
- Taking off
- Arriving at the airport
- Travelling to the airport in a taxi
- Being asked to fasten her seatbelt
- Packing her luggage
- Booking her plane ticket on the internet
- Going to the departure lounge
- Watching the flight attendants demonstrate the safety drill

eGuide*plus*

Weblink
Fear hierarchy templates

LEARNING ACTIVITY 13.12

Evaluation of research on treatments for spider phobia

Read the research study conducted by Gilroy and her colleagues (2000) described in Box 13.5 at left and answer the following questions.

1. What was the aim of the research?
2. What are the research hypotheses?
3. (a) Who were the participants in the research?
(b) Why might the researchers have chosen this particular sample?
4. Identify the operationalised independent and dependent variables.
5. Identify the experimental and control groups.
6. Did the results of the research support the hypotheses? Explain your answer.
7. What is a possible explanation for why Group 2 did so much better on the BAT than Group 1 did post-treatment?
8. The treatment given to Group 3 was a placebo.
(a) What does this mean?
(b) What were the Group 3 participants likely to have been told by the researchers about the treatment they were receiving?
(c) What ethical issue is of specific relevance to this particular research?
9. Why was the double-blind procedure used in the 2003 follow-up study?

Social interventions

To complement one or more biological and psychological interventions, treatment for a specific phobia may also involve a social intervention such as psychoeducation for family, friends or others who are close to the person with a specific phobia and therefore part of their social support network.

Psychoeducation for families and supporters

Psychoeducation is not a type of therapy but rather, a specific form of education. **Psychoeducation** involves the provision and explanation of information about a mental disorder to individuals diagnosed with the disorder to increase knowledge and understanding of their disorder and its treatment. Individuals are helped to understand their disorder to enhance their therapy and assist them to live more productive and fulfilled lives (APS, 2010). In some cases, psychoeducation may be broadened to include family members and others outside the immediate family who can provide social support.

Psychoeducation is based on the assumption that increased understanding of symptoms, treatment options, services available and recovery patterns enables individuals with a mental disorder to cope more effectively (APS, 2010).

Psychoeducation can be implemented in a number of different formats and settings, but it rarely involves classroom-type teaching. The format depends on such factors as the disorder, the individual's symptoms, their age, access to social support and other aspects of their circumstances and needs. Psychoeducation programs can be provided in an individual or group format.

studyon

Figure 13.26 Psychoeducation involves the provision and explanation of information about a mental disorder to increase knowledge and understanding of one's disorder and its treatment.

A psychoeducation program for a specific phobia may include information about some or all of the following:

- the nature of the disorder and its diagnosis e.g. development, perpetuation and recovery from biopsychosocial and 4P factor perspectives
- role of phobic stimuli
- what having a specific phobia is like for the individual, both psychologically and physiologically e.g. avoidance and safety behaviours, anticipatory anxiety, panic attacks, fight–flight–freeze reactions
- impact on family, friends and others
- types of psychotherapies and treatment interventions that are available, what works, what doesn't and costs
- challenging unrealistic or anxious thoughts
- how family, friends and others may encourage avoidance behaviours
- medication e.g. what it does, how it works, benefits and side effects, potential consequences of misuse or abuse
- role and importance of breathing retraining, exercise, relaxation techniques and a healthy lifestyle in general
- role and importance of support networks
- dealing with stigma surrounding phobias.

There is considerable research evidence showing that the more educated a person is about their mental disorder and how it affects their own life and the lives of others, the more control that person tends to have over their disorder and the more likely they are to actively participate in self-management of their disorder. Participation and self-management are further enhanced if the individual has access to appropriate support from families, friends and others (Cohen, et al., 2008; Hansson, Bodlund & Chotai, 2008).

In this section we examine psychoeducation for families, friends and other supporters with reference to challenging unrealistic or anxious thoughts and not encouraging avoidance behaviours.

Challenging unrealistic or anxious thoughts

People with a specific phobia typically have anxious thoughts about their phobic stimulus. For example, a person with a needle phobia may think, 'If I have a needle, it could hit a bone, lead to an infection and then I might die', or, 'I fainted once while getting an injection, so, I'll never be able to get an injection again without passing out'.

The anxious thoughts that trigger and fuel phobias are usually negative and unrealistic. Often, the individual tends to overestimate how bad it will be if exposed to the object or situation they fear. At the same time, they underestimate their ability to cope. Unrealistic thoughts are unhelpful thoughts. As well as being triggered by anxious thoughts, they can trigger anxious thoughts, which are also unhelpful as they also fuel and perpetuate the phobia.

Learning to challenge unhelpful thoughts is an important step in overcoming a phobia, but this can be difficult when anxious or distressed. Families and other supporters can therefore play an important role in helping a person to cope with or overcome a phobia by encouraging them to recognise and challenge unrealistic or anxious thoughts.

Consider, for example, the case of 13-year old 'Asha' who has a moth phobia (mottephobia). Asha feels very afraid, nauseous and panicky at the sight of any moth, regardless of its size or the situation. She believes that all moths are evil and that if she encounters a live moth, it will fly directly at her and cause some kind of physical harm. It may even get caught up in her hair or clothing, which could cause her to stop breathing or have a heart attack. One day, 'Asha' and her mother are sitting outside and Asha thinks she sees a moth in the distance. She quickly becomes distressed and panicky and says to her mother, 'There's a moth over there. It's going to come and get me. Oh no, my hair is out! The moth is going to get stuck in it.'

During psychoeducation, Asha's mother learnt that this was an opportunity to help guide Asha towards challenging her unrealistic and anxious thoughts about moth behaviour and the amount of harm a moth can actually cause her. Asha's mother therefore stayed calm, acknowledged Asha's worries but then gently challenged her distorted thinking. She reminded her that they are anxiety-influenced thoughts based on wrong assumptions and therefore without any real basis, and not necessarily facts. She encouraged Asha to consider the possibility that all moths would actually want to avoid her, and especially not to get tangled in her hair. Additionally, if by some remote chance a moth bumped into her or became entangled in her hair, clothing or something else, it would be impossible to be physically harmed because of its small size and fragility.

Families and supporters can also help by encouraging the person with a phobia to test or evaluate their unrealistic or anxious thoughts when not exposed to a phobic stimulus and by supporting them through this

process. For example, Asha might be encouraged to write down some of the negative thoughts she has yet to verbalise. After she has identified them in this way, she could be encouraged and assisted to evaluate them, with the goal of learning that they are merely thoughts, shaped by anxiety and fear, without any real basis, and that they should be questioned as they are often based on wrong assumptions.

American psychologist Melinda Smith and her colleagues (2017) have described an example of how a negative unrealistic or anxious thought can be challenged by someone with a phobia. The individual involved has a specific phobia of enclosed places (claustrophobia).

Negative thought: 'The elevator will break down and I'll get trapped and suffocate.'

Is there any evidence that contradicts this thought?

- 'I see many people using the elevator and it has never broken down.'
- 'I cannot remember ever hearing of anyone dying from suffocation in an elevator.'
- 'I have never actually been in an elevator that has broken down.'
- 'There are air vents in an elevator which will stop the air running out.'

Could you do anything to resolve this situation if it does occur?

- 'I guess I could press the alarm button or use the telephone to call for assistance.'

Are you making a thinking error?

- 'Yes. I'm fortune telling, as I have no evidence to suggest that the elevator will break down.'

What would you say to a friend who has this fear?

- 'I would probably say that the chances of it happening are very slim as you don't see or hear about it very often.'

Not encouraging avoidance behaviours

It's only natural to want to avoid objects or situations we fear, especially when they cause anxiety or distress. However, as demonstrated by the effectiveness of a behavioural exposure therapy such as systematic desensitisation, an important requirement for overcoming a phobia is to face what is feared. While avoidance can make the individual feel better in the short-term, it prevents them from learning that their phobia may not be as frightening or overwhelming as they think. They also never get the chance to learn how to cope with their fears and experience control over fearful situations. As a result, the phobia is not only perpetuated, but it can become increasingly fearful and more psychologically overwhelming. In addition, avoidance of certain objects or situations because of a phobia can also interfere with an individual's normal routine, which can make the overall experience of a phobia even more distressing (Smith, Segal & Segal, 2017).

It is therefore important that family members and supporters understand what avoidance behaviour is, the role it plays in perpetuating a phobia and how it can impact on daily functioning.

Often, family members and supporters encourage or reinforce avoidance behaviours out of concern for the person and because observing phobic reactions in a loved one can be personally distressing. However, this is counterproductive so it is important for them to recognise that this may actually be contributing to the phobia unintentionally and that they should consequently not be encouraging or reinforcing avoidance behaviours.

This does not mean that family members and supporters should deliberately force a person with a phobia to be exposed to or engage with objects or situations that arouse fear or anxiety. This can lead to extreme distress and possibly anger. Instead, through psychoeducation, family members and supporters may learn about the importance of gently and calmly encouraging and supporting the individual to not engage in avoidance behaviour, possibly also challenging the behaviour. They can help the individual to realise that through repeated experiences of facing their fear, they will begin to realise that the worst isn't going to happen, or that they're not going to die or 'lose it'. (Smith, Segal & Segal, 2017).

Consider again the example of 13-year-old Asha. When Asha reports seeing the moth, her mother may encourage her to remain sitting outside and not to run inside. Asha's mother could provide comfort and reassurance and say something like, 'It is important for you to face your fears so that you can learn that moths are not going to harm you. Although it can be scary at first, over time you will feel less anxious. You will also start to feel more confident and in control. If we stay outside now, moths will begin to lose their power to make you avoid them.' If Asha manages to stay outside, it would be important to continue to provide comfort, positive reinforcement through praise (e.g. 'great job!') and possibly even provide a reward for 'bravery' (e.g. small inexpensive items, extra TV time, making a favourite dinner).

Figure 13.27 It can be counterproductive for family members and supporters to encourage avoidance behaviours.

BOX 13.6 The Dental Anxiety Scale

The *Dental Anxiety Scale* was developed by American psychologist Norman Corah (1969), a widely recognised authority on measuring, evaluating and treating anxiety related to dental care. The scale, used by researchers and dental practitioners worldwide, specifically measures the levels of anxiety individuals experience when faced with a visit to the dentist. The scale consists of four multiple-choice questions about different dental situations.

1. If you had to go to the dentist tomorrow for a check-up, how would you feel about it?
- A I would look forward to it as a reasonably enjoyable experience.
- B I wouldn't care one way or the other.
- C I would be a little uneasy about it.
- D I would be afraid that it would be unpleasant and painful.
- E I would be very frightened of what the dentist would do.

2. When you are waiting in the dentist's office for your turn in the chair, how do you feel?
- A Relaxed
- B A little uneasy
- C Tense
- D Anxious
- E So anxious that I sometimes break out in a sweat or almost feel physically sick

3. When you are in the dentist's chair waiting while the dentist gets the drill ready to begin working on your teeth, how do you feel?
- A Relaxed
- B A little uneasy
- C Tense
- D Anxious
- E So anxious that I sometimes break out in a sweat or almost feel physically sick

4. Imagine you are in the dentist's chair to have your teeth cleaned. While you are waiting and the dentist or hygienist is getting out the instruments that will be used to scrape your teeth around the gums, how do you feel?
- A Relaxed
- B A little uneasy
- C Tense
- D Anxious
- E So anxious that I sometimes break out in a sweat or almost feel physically sick

Scoring the scale

A = 1, B = 2, C = 3, D = 4, E = 5 (total possible = 20)

Anxiety rating:

- 9–12 = moderate anxiety
- 13–14 = high anxiety
- 15–20 = severe anxiety (or dental phobia); might require the help of a mental health professional

In 1969, Corah reported that he had administered the scale to five people with diagnosed dental phobias and a sample of 1232 female university students. The people with dental phobias achieved scores ranging from 17 to 20, whereas the mean score of the university students was 8.89.

Source: Corah, N.L. (1969). Development of a dental anxiety scale. *Journal of Dental Research*, *48*(4), 596.

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Weblink
The Modified Dental Anxiety Scale

LEARNING ACTIVITY 13.13

Review questions

1. (a) What is psychoeducation?
(b) What is its key assumption?
(c) What topics might be included in a psychoeducation program for
(i) an individual with a specific phobia?
(ii) family and supporters of someone with a specific phobia?

2. (a) Give three reasons to explain why it is important for families and supporters not to encourage avoidance behaviour by people with specific phobias.
(b) Give an example of an appropriate and an inappropriate way of discouraging avoidance behaviour.
(c) Explain whether it is appropriate for family members or friends to challenge unrealistic or anxious thoughts.

3. (a) Why is it important for people with a phobia to challenge their unrealistic or anxious thoughts?
(b) Give an example of an appropriate and an inappropriate challenge or way of self-challenging such thoughts.

LEARNING ACTIVITY 13.14

Reflection

Some pharmacies and online outlets stock 'off-the shelf' (non-prescription) anxiety 'relief' products. Examples are listed below (note: some website links my change over time).

- Caruso's Natural Health Stress and Anxiety Spray (Go to: carusosnaturalhealth.com.au/stress-and-anxiety-spray)
- Bach Rescue Pastilles (Go to: www.bachflower.com/bach-rescue-pastilles)
- RidgeCrest Herbals Anxiety Free Stress Relief Complex (Go to: www.rcherbals.com/rch/details/320/Anxiety+Free%E2%84%A2)
- Australian Naturalcare Anxiety Relief (Go to: www.ausnaturalcare.com.au/anxiety-relief-60-tabs)
- Liddell Laboratories Letting Go Anx: Anxiety + Tension oral spray (Go to: www.liddell.net/product/anxiety-tension)

Locate information about one of these products, and then answer the following questions.

1. Name the product you investigated and where it can be purchased. Include an image of the product and the relevant weblink.
2. What anxiety relief or management outcomes are claimed to be achievable through the product?
3. Are the claims on the packaging and/or advertising materials evidence-based? If so, does the evidence seem to be scientific e.g. a replicable study with valid and reliable results, published in a psychological or medical journal for peer review?
4. What are the product's ingredients?
5. Do the ingredients seem to target unwanted activity of hormones, neurotransmitters or nervous system activity implicated in anxiety? If not, what is targeted and what are the advertised effects?
6. How effective do you believe the active ingredients are likely to be? How likely is it that the product could have a beneficial placebo effect?
7. Comment on whether use of the product for anxiety is advisable without first consulting a doctor or mental health professional.

LEARNING ACTIVITY 13.15

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Word copy of table

Summarising interventions for the treatment of a specific phobia

Complete the following table to summarise evidence-based interventions for the treatment of a specific phobia.

Intervention	What is it?	How it may contribute
Biological • use of benzodiazepine agents • breathing retraining • exercise		
Psychological • cognitive behavioural therapy • systematic desensitisation		
Social • psychoeducation for families and supporters • challenging unrealistic or anxious thoughts • not encouraging avoidance behaviours		

CHAPTER SUMMARY

KEY TERMS

agonist p. 647
anticipatory anxiety p. 633
anxiety p. 629
anxiety disorder p. 629
anxiety hierarchy p. 653
avoidance behavior p. 651
behavioural model (in relation to phobia development) p. 639
benzodiazepine p. 647
benzodiazepine agent p. 647
biological intervention p. 647
breathing retraining p. 649
catastrophic thinking p. 642
cognitive behavioural therapy (CBT) p. 651
cognitive bias p. 641
cognitive model (in relation to treatment) p. 641
environmental trigger (in relation to phobia) p. 644
evidence-based intervention p. 646
exercise (in relation to specific phobia) p. 650
fear hierarchy p. 653
gamma-amino butyric acid (GABA) p. 636
GABA dysfunction p. 636
graduated exposure p. 653
hyperventilation p. 649
long-acting (drug) p. 647
long-term potentiation (in relation to phobia) p. 637
memory bias p. 642
panic attack p. 632
phobia p. 629
phobic stimulus p. 630
psychoeducation p. 657
psychological intervention p. 651
relaxation technique p. 649
safety behavior p. 651
short-acting (drug) p. 647
social intervention p. 657
specific environmental trigger p. 644
specific phobia p. 632
stigma p. 645
stress p. 629
stress response (in relation to phobia) p. 637
systematic desensitisation p. 653

LEARNING CHECKLIST

Complete the self-assessment checklist below, using ticks and crosses to indicate your understanding of this chapter's key knowledge (a) before and (b) after you attempt the chapter test. Use the 'Comments' column to add notes about your understanding.

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Word copy of checklist

Key knowledge I need to know about a specific phobia	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
Stress, anxiety and phobia			
Common characteristics			
Distinguishing characteristics			
Mental health continuum			
Specific phobia			
Key characteristics			
Factors contributing to the development of a specific phobia			
Biological factors			
• GABA dysfunction			
• role of the stress response			
• long-term potentiation			
Psychological factors			
• Behavioural models			
– precipitation by classical conditioning			
– perpetuation by operant conditioning			
• Cognitive models			
– memory bias			
– catastrophic thinking			

(continued)

Key knowledge I need to know about a specific phobia	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
Social factors			
• specific environmental triggers			
• stigma around seeking treatment			
Evidence-based interventions in the treatment of a specific phobia			
Why evidence-based			
Biological interventions			
– agonist			
– short-acting			
– effects			
• Use of benzodiazepine agents			
• Relaxation techniques			
– breathing retraining			
– exercise			
Psychological interventions			
• cognitive behavioural therapy			
• systematic desensitisation			
Social interventions			
• Psychoeducation for families and supporters			
– challenging unrealistic or anxious thoughts			
– not encouraging avoidance behaviours			

studyon

Unit 4 > Area of study 2 > Topic 3

Concept screens and practice questions

CHAPTER 13 TEST

SECTION A — Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Question 1

The stress response may contribute to the perpetuation of a specific phobia by

A. increasing psychological arousal in the presence of a phobic stimulus.
B. transmitting threat information.
C. initiating a fight–flight–freeze reaction to a phobic stimulus.
D. becoming a conditioned response to a phobic stimulus.

Question 2

When using cognitive behavioural therapy for a specific phobia, the mental health professional will primarily target _____ for treatment.

A. inappropriate thoughts
B. long-term potentiation
C. abnormal breathing patterns
D. medications that alleviate anxiety

Question 3

'Jake' has a specific phobia of injections and gets anxious whenever he sees a syringe. He reports a crucial incident as a child when he saw his mother have an injection, then faint. For a while, he thought his mother was dead.

In relation to Jake's phobia, a syringe or injection is best described as

A. safety behaviour.
B. avoidance behaviour.
C. a stress response.
D. a specific environmental trigger.

Question 4

Most adults diagnosed with a specific phobia

A. fear that their response to a phobic stimulus may become a specific environmental trigger for children.
B. realise that their fear is grossly in excess of any real danger posed by a phobic stimulus.
C. experience a gradual reduction in anxiety level as they contemplate being exposed to a phobic stimulus.
D. manage their phobic anxiety and can therefore function effectively in everyday life.

Question 5

The tendency for people with a specific phobia to recall threatening information about a phobic stimulus more than positive information, is called _____ bias.

A. selective
B. memory
C. attentional
D. interpretive

Question 6

The first step in systematic desensitisation as an intervention for a specific phobia is likely to involve

A. teaching a relaxation strategy that can be used to manage fear responses.
B. breaking down the fear-arousing event or situation into a logical sequence of steps and creating a 'stepladder' or fear hierarchy.
C. systematic, graduated pairing of items in a fear hierarchy with relaxation by going up the steps on the ladder, one at a time.
D. identifying cognitive biases or distortions, underlying feelings and/or behaviour associated with the phobic stimulus.

Question 7

Long-term potentiation may contribute to the development of a specific phobia by

A. strengthening synapses in neural pathways for relevant fear information.
B. transmitting threat information.
C. initiating the fight–flight–freeze response.
D. storing threat information in long-term memory.

Question 8

Stigma associated with having a phobia will probably result in an individual with a phobia

A. avoiding powerful negative emotions.
B. increasing their resilience.
C. coping as best they can.
D. seeking treatment from a professional.

Question 9

The best example of a cognitive bias likely to be associated with specific phobias is

A. hopelessness.
B. lack of social support.
C. more attention to signs of threat.
D. thinking about potential threats without settling on the means of avoidance.

Question 10

The first step in the two-factor learning theory of how phobias may develop or be perpetuated involves _____, and the second step involves _____.

A. a phobic stimulus, avoidance behaviour
B. classical conditioning, operant conditioning
C. a phobic stimulus, the stress response
D. avoidance behaviour, a phobic stimulus

Question 11

Drugs that have the effect of stimulating or promoting the excitatory effects of one or more neurotransmitters are called

A. agents.
B. antagonists.
C. agonists.
D. benzodiazepines.

Question 12

When compared with a long-acting medication, a short-acting medication will

A. have a shorter effect.
B. clear from the body more quickly.
C. have a faster effect.
D. accumulate in the bloodstream.

Question 13

A potential consequence of hyperventilation in response to a phobic stimulus is that the individual may

A. take in less air than their body actually needs.
B. get into a pattern of uncontrolled rapid and shallow breathing.
C. increase the level of carbon dioxide in the blood.
D. decrease the level of carbon dioxide in the blood.

Question 14

Which of the following is a biological intervention for treatment of a specific phobia?

A. exercise
B. psychoeducation
C. systematic desensitisation
D. any evidence-based treatment

Question 15

'Sharib' has a specific phobia of escalators and refuses to use one to travel to the basement of a department store. This overt reaction is an example of

A. avoidance behaviour.
B. a stress response.
C. safety behaviour.
D. catastrophic thinking.

SECTION B

Answer **all** questions in the spaces provided. Write using blue or black pen.

Question 1 (1 mark)

A list of feared objects or situations, ranked from least to most anxiety-producing, is used as part of a treatment intervention for specific phobias that is called _____

Question 2 (1 mark)

Most people experience anxiety at some stage in their lives. When might someone be considered to have an anxiety disorder?

Question 3 (3 marks)

Differentiate between stress, anxiety and phobia.

Question 4 (2 marks)

Explain why the stress response may be considered non-adaptive when initiated by a phobic stimulus.

Question 5 (1 mark)

What is a goal of psychoeducation in the treatment of a specific phobia?

Question 6 (3 marks)

Explain the role of catastrophic thinking in the development and perpetuation of a specific phobia.

Question 7 (4 marks)

What are two potential benefits of each of the following interventions in the treatment of a specific phobia?

breathing retraining 2 marks

exercise 2 marks

Question 8 (2 marks)

Give two reasons to explain why evidence-based interventions are preferred in the treatment of a specific phobia.

Question 9 (2 marks)

Explain why people with a specific phobia are advised to challenge their unrealistic or anxious thoughts.

Question 10 (2 marks)

Explain why families and supporters of people with a specific phobia are advised to not encourage avoidance behaviour.

Question 11 (4 marks)

Explain how classical and operant conditioning may contribute to the development and perpetuation of a specific phobia, with reference to an example demonstrating the influence of each learning process.

Question 12 (8 marks)

(a) What is GABA (gamma-amino butyric acid)? 1 mark

(b) What is GABA dysfunction? 1 mark

(c) Explain how GABA dysfunction may contribute to the development and perpetuation of a specific phobia. 3 marks

(d) How do benzodiazepines alleviate fear or anxiety symptoms? 2 marks

(e) Why do mental health professionals tend to prefer that benzodiazepines are not used in isolation of psychotherapy? 1 mark

Question 13 (7 marks)

An experiment was conducted at a large university to test the effectiveness of systematic desensitisation for treating specific phobia.

Twenty participants were selected from volunteer Psychology students enrolled at the university where the researchers worked. Selection was based on questionnaires and interviews which determined whether they had a snake phobia. Only those assessed to have a severe snake phobia were included.

The participants were randomly allocated to one of two conditions. The experimental group participants received systematic desensitisation during ten 45-minute sessions in which they learned a breathing relaxation technique and gradually worked through their hierarchy of fears. The control group participants did not receive any therapy.

At the end of the program, all participants were assessed one at a time using a Snake Avoidance Test during which observations were made of their behaviour when faced with a live snake, and by getting them to rate their level of fear in the presence of the snake.

The results showed that 9 of the 10 experimental group were able to touch or hold the snake, whereas only 1 control group participant was able to do so. Self-ratings of fear by the experimental group were also significantly lower.

(a) Identify the sampling procedure 1 mark

(b) Identify the experimental research design. 1 mark

(c) Identify the operationalised independent and dependent variables. 2 marks

(d) Write a research hypothesis that would be supported by the results. 1 mark

(e) Give two reasons that may explain why the results of this experiment do not necessarily mean that systematic desensitisation is in itself an effective treatment of specific phobia. 2 marks

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The answers to the Section A multiple-choice questions are in the answer section at the end of this book and in eBookPLUS. The answers to the Section B questions are in eBookPLUS.

14 MAINTENANCE OF MENTAL HEALTH

KEY KNOWLEDGE

- resilience as a positive adaptation to adversity including the relative influence of protective factors with reference to: adequate diet and sleep (biological); cognitive behavioural strategies (psychological); support from family, friends and community (social)
- models of behaviour change with reference to the transtheoretical model including the stages of pre-contemplation, contemplation, preparation, action and maintenance/relapse.

Source: ©VCAA, VCE Psychology Study Design (June 2017 update), p. 30.

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Mental health involves our state of mind and our ability to cope with the everyday situations we find ourselves in. When we are mentally healthy, we think, feel and behave in ways that enable us to cope with change and the challenges arising in the course of everyday life. We are also more likely to enjoy our relationships with others, benefit from opportunities and contribute productively to society. When we have a mental health disorder, this process is often a lot more difficult (ReachOut, 2018).

Many factors contribute to the maintenance of mental health. In this chapter we examine a range of factors using the biopsychosocial model. These include:

- biological factors involving adequate diet and sleep
- psychological factors involving cognitive behavioural strategies
- social factors involving support from family, friends and the community.

Sometimes behaviour change is required to maintain or improve mental health; for example, by abandoning problematic behaviour (e.g. substance use) and/or adopting health-promoting behaviours (e.g. exercise). We examine how the change process may occur using the transtheoretical model of behaviour change. We start by revisiting resilience, focusing on how it contributes to protection and maintenance of good mental health.

RESILIENCE

Not everyone copes effectively with stressors and other challenges that arise in everyday life. For example, some people ruminate and stay focused on negative emotions without doing anything to improve their situation, whereas others may rely on alcohol, drugs or another substance as a means of avoiding or alleviating adversity. These are examples of maladaptive ways of coping that are not associated with good mental health, especially when they become habitual. Nor do they demonstrate resilience, which is considered to be a positive way of maintaining mental health by adapting to adversity.

Resilience refers to the ability to successfully cope with adversity, and to 'bounce back' and restore positive functioning. It is considered a protective factor that is a strength or asset for 'good' mental health as it helps safeguard against the effects of risk factors for 'bad' mental health and minimises their impact. Resilience is sometimes described as being like the elasticity of a rubber ball — a property that enables it to resume its original shape and function without any significant damage after being bent, stretched or put under pressure.

Many mental health professionals believe resilience to be an attribute that is *essential* to good mental health. Additionally, research studies have found that resilience enables people of all ages to endure and recover fully, despite suffering significant traumatic conditions of extreme deprivation, serious threat and major stress. This includes children in situations involving natural disasters, war or terrorism (Masten & Narayan, 2012).

Resilience is not merely coping or adaptive behaviour. Some psychologists have distinguished resilience from these and other concepts such as 'mental toughness' or 'invulnerability' with reference to three key qualities:

- the ability to achieve positive results in adverse situations
- the ability to function competently in situations of acute or chronic stress
- the ability to recover from trauma (Shastri, 2013).

Psychologists have studied resilience in adolescents and adults under stress and have identified a number of characteristics that enable someone to 'bounce back' and get back on track when faced with adversity. People with a high level of resilience tend to have attributes such as:

- *high self-esteem* — a positive view of their overall self-worth; they regard themselves highly and value themselves
- *high self-efficacy* — a strong belief in their abilities to accomplish a specific task and succeed
- a *positive outlook* in bad times as well as good, e.g. approaching stressors with a sense of optimism, opportunity and hope; having a sense of purpose or meaning in life
- *flexibility*, e.g. adapting more easily to adversity, using a range of effective strategies for coping with difficult situations and disruptions in their lives
- *good emotional control and regulation*, e.g. the capacity to manage strong feelings and impulses
- *good interpersonal relationships and social support systems* e.g. having a sense of belonging; knowing other people they can talk to or to get help from in difficult times; having caring and supportive relationships within and outside the family; feeling part of the community
- the *ability to interpret stressors* in appropriate ways
- the *ability to make realistic plans and take steps to carry them out*
- *skills in communication and problem solving*

(APA, 2018b; beyondblue, 2016c; Mind Matters, 2018a).

As described in Chapter 11, resilience is not considered an ability that people either have or do not have, despite the fact that people may be referred to as 'resilient' or 'not resilient'. Nor is resilience an innate or fixed, unchangeable ability. It involves behaviours, thoughts and actions that can be learned and developed in most people. For example, Box 14.1 opposite describes various ways of building resilience.

Figure 14.1 Resilience is considered a protective factor for 'good' mental health as it helps safeguard against the effects of risk factors for 'bad' mental health.

BOX 14.1 Ten ways to build resilience

- *Make connections.* Good relationships with close family members, friends or others are important. Accepting help and support from those who care about you and will listen to you strengthens resilience. Some people find that being active in community groups, faith-based organisations, or other local groups provides social support and can help with reclaiming hope. Assisting others in their time of need also can benefit the helper.
- *Avoid seeing crises as insurmountable problems.* You can't change the fact that highly stressful events happen, but you can change how you interpret and respond to these events. Try looking beyond the present to how future circumstances may be a little better. Note any subtle ways in which you might already feel somewhat better as you deal with difficult situations.
- *Accept that change is a part of living.* Certain goals may no longer be attainable as a result of adverse situations. Accepting circumstances that cannot be changed can help you focus on circumstances that you can alter.
- *Move toward your goals.* Develop some realistic goals. Do something regularly — even if it seems like a small accomplishment — that enables you to move toward your goals. Instead of focusing on tasks that seem unachievable, ask yourself, 'What's one thing I know I can accomplish today that helps me move in the direction I want to go?'
- *Take decisive actions.* Act on adverse situations as much as you can. Take decisive actions, rather than detaching completely from problems and stresses and wishing they would just go away.
- *Look for opportunities for self-discovery.* People often learn something about themselves and may find that they have grown in some respect as a result of their struggle with loss. Many people who have experienced tragedies and hardship have reported better relationships, greater sense of strength even while feeling vulnerable, increased sense of self-worth, a more developed spirituality and heightened appreciation for life.
- *Nurture a positive view of yourself.* Developing confidence in your ability to solve problems and trusting your instincts helps build resilience.
- *Keep things in perspective.* Even when facing very painful events, try to consider the stressful situation in a broader context and keep a long-term perspective. Avoid blowing the event out of proportion.
- *Maintain a hopeful outlook.* An optimistic outlook enables you to expect that good things will happen in your life. Try visualising what you want, rather than worrying about what you fear.
- *Take care of yourself.* Pay attention to your own needs and feelings. Engage in activities that you enjoy and find relaxing. Exercise regularly. Taking care of yourself helps to keep your mind and body primed to deal with situations that require resilience.
- *Additional ways of strengthening resilience may be helpful.* For example, some people write about their deepest thoughts and feelings related to trauma or other stressful events in their life. Meditation and spiritual practices help some people build connections and restore hope.

The key is to identify ways that are likely to work well for you as part of your own personal strategy for fostering resilience.

Source: American Psychological Association (2018b). *The road to resilience* [Psychology Help Center]. Retrieved from http://www.apa.org/helpcenter/road-resilience.aspx

eBook*plus*

Weblink
TED^{x} talk on resilience and mental health 14m 4s

eGuide*plus*

Weblink
APA — More about building resilience

BOX 14.2 Research on resilience in adolescence

Australian psychologists Sue Howard and Bruce Johnson (2000) conducted research to investigate resilient behaviour in adolescents.

Howard and Johnson described resilience as a changeable quantity that is not innate but instead profoundly influenced by external factors. They proposed that resilience is influenced by:

- *personal factors*, such as coping strategies and beliefs
- *family factors*, such as exposure to people who provide emotional and material support and who model social problem solving
- *school factors* that help adolescents develop a sense of purpose and autonomy and promote connectedness, as well as teach valuable life skills
- *community factors* that provide social, sporting and cultural activities and promote feelings of belonging and connectedness.

From a group of students identified as being 'at risk', 71 interviews were conducted with 38 students who had displayed 'resilient' behaviour and 33 who had displayed 'non-resilient' behaviour. Patterns and trends were identified.

According to Howard and Johnson, 'resilient' and 'non-resilient' students talked in markedly different ways about their lives. For example, their results showed that:

- 'resilient' students talked about accomplishments and personal achievements, skills and competencies of which they were proud, whereas 'non-resilient' students rarely did
- 'resilient' students expressed a sense of belonging and connectedness to individuals, groups and institutions, whereas 'non-resilient' students talked less and/or less confidently about these things
- 'resilient' students demonstrated a sense of autonomy and personal agency when they talked about their lives, whereas 'non-resilient' students were more inclined to indicate a sense of powerlessness and fatalism
- 'resilient' students had definite plans and positive views about their futures, whereas 'non-resilient' students had limited and less enthusiastic visions of the future and what it held in store for them.

Figure 14.2 Resilience is not an innate, unchangeable characteristic and is profoundly influenced by external factors.

LEARNING ACTIVITY 14.1

Review questions

1. Define resilience.

2. With reference to a specific life stressor, explain how resilience:
   (a) influences mental health
   (b) is influenced by mental health.

3. Why is resilience considered a 'positive' means of maintaining mental health? Explain with reference to an example of a 'negative' means of maintaining mental health.

4. (a) Construct a continuum of resilience and show where each of the following individuals would be likely to be plotted.
   (i) a person who 'is resilient'
   (ii) a person who is 'not resilient'
   (iii) a mentally healthy person
   (iv) a person with a mental health problem
   (v) a person with a mental disorder
   (b) What difficulties did you have in plotting each individual?

5. Consider the personal characteristics commonly associated with a high level of resilience.
   (a) List them in the order which you believe is most important for resilience.
   (b) Comment on whether a person can have a high level of resilience without any of the three characteristics at the bottom of your list.
   (c) What does your answer to (b) suggest about the nature of resilience?

6. Read the research in Box 14.2 above and comment on similarities and differences between the research findings and the personal characteristics reviewed for question 5.

LEARNING ACTIVITY 14.2

Reflection

Do you believe resilience is innate, learned or a combination of both? Explain your belief.

BIOLOGICAL PROTECTIVE FACTORS

There are many biological interventions that can be used to help maintain or improve mental health, or protect against mental ill health. These include medications and relaxation techniques such as breathing retraining, exercise, meditation and yoga. What we eat and how well we sleep can also affect our mental wellbeing.

In this section, we examine the potential benefits of having an adequate diet and adequate sleep. Both are considered protective factors against mental ill health and are achievable without support from a professional.

Adequate diet

Most people know that eating well is vital to good physical health and contributes to an overall healthier lifestyle. An adequate diet is important to proper body functioning. It not only reduces the risk of physical health problems such as cardiovascular disease and diabetes, but it can also help with sleep, energy levels, mood and mental health. We tend to generally feel better and have an overall sense of wellbeing when we eat well (Jacka, et al., 2017).

We are eating well when we have an adequate diet. Having an *adequate diet* means eating a good amount of a variety of different foods that maintains good health and makes us feel well as a result. It is not about the way we look or how much we weigh. Nor is it about counting calories or having tiny portion sizes (ReachOut, 2018a).

There are some relatively simple guidelines for maintaining an adequate diet. One important guideline is that an adequate diet needs to be 'balanced'. This basically means a diet with minimal amounts of the bad things (e.g. junk food and lots of sugars) and more of the good things (e.g. vegetables, fruit, grains and plenty of water). Adopting this guideline helps ensure we have enough of all the vitamins and minerals that help our body and brain function well. Generally, no food is off limits — it's just a question of how often we eat certain foods and how much of them we eat. Eating when hungry and stopping when full is also useful.

According to various mental health service providers such as beyondblue, ReachOut and headspace, a number of specific nutritional strategies can also help maintain mental health. These include:

- *Eat a variety of foods:* Each food contains its own unique vitamins and minerals. Therefore, in order for our body to have a balance of all the nutrients it needs, it's important to eat lots of different foods. The *Australian Guide to Healthy Eating* recognises five main food groups, which are all equally as important when it comes to getting the nutrients we need. As shown in Figure 14.3 on the next page, these are (1) vegetables and legumes/beans, (2) fruit, (3) milk, yoghurt and cheese, (4) lean meats (meats without a lot of fat), poultry, fish, eggs, tofu, nuts and seeds, and (5) grain (cereal) foods.
- *Drink lots of water:* The adult human body is up to 60% water, so water is a very important part of an adequate diet. It is recommended that we have around eight glasses of water every day, but the most important thing is to drink as much as we feel we need. Sometimes we will need more, such as when we exercise.

  Soft drinks contain a lot of sugar and few nutrients, as do a lot of the fruit juices. Alcoholic drinks also have very little of nutritional value, so it's best to limit intake. Coffee and energy drinks (which are made with caffeine and loads of sugar) can increase alertness and provide 'pep up', but this tends to pass quickly and can leave us feeling tired or sleepy as the effect wears off.
- *Don't skip breakfast and try to eat regularly throughout the day*. Breakfast is important in re-fuelling the body with nutrients after sleep and energising the body for daily activities. Eating regularly helps maintain blood sugar and energy levels.
- *Don't rely on vitamin/mineral supplements*. Real foods are the best source of vitamins and minerals, especially fresh or natural foods. While supplements are no substitute for a healthy diet, there may be occasions when they are helpful. For example, if under-eating and/or eating poor quality foods for prolonged periods, a multivitamin/mineral supplement can help meet nutritional needs until able to resume better eating patterns.
- *Avoid heavily processed foods with surplus salt, sugar or fat*. A processed food is any food that has been altered in some way during preparation. Food processing can be as basic as freezing, canning, baking and drying.

  Not all processed foods are unhealthy but some may contain high levels of salt, sugar and fat to make their flavour more appealing, to extend their shelf life, or in some cases to contribute to the food's structure, such as salt in bread or sugar in cakes. Other examples of common processed foods include breakfast cereals, cheese, tinned vegetables, savoury snacks such as crisps, sausage rolls, pies and pasties, meat products such as bacon, sausage, ham and salami, and 'convenience foods' such as microwave meals.

  Eating processed foods can result in eating more than the recommended amounts of sugar, salt and fat as we may not be aware of how much has been added to the food. These foods can also be higher in calories due to the high amounts of added sugar or fat in them.

  Not all processed food is a bad choice. Some foods need processing to make them safe, such as milk, which needs to be pasteurised to remove harmful bacteria. Other foods need processing to make them suitable for use, such as pressing seeds to make oil (NHS Choices, 2018).
- *Don't rely on drugs and alcohol*. Drinking alcohol, smoking cigarettes and taking other drugs for recreational purposes or to cope with a mental health problem or disorder all have nutritional consequences. Regular use of these substances can deplete the body of certain nutrients and disrupt regular eating patterns, worsening mood fluctuations and challenging a person's ability to establish healthy

eating habits. Tobacco smoking, for example, can suppress appetite and therefore lead to a person not eating enough. Thiamine and other vitamin deficiencies are common in heavy drinkers and these deficits can cause low mood, irritability and/or aggressive behaviour. Cannabis can stimulate appetite and in some cases lead to over-eating; however, taking amphetamines can lead to going days without eating.

Figure 14.3 The five main food groups according to the *Australian Guide to Healthy Eating*. Legumes/beans are included twice because they are a source of protein as well as being vegetables.

Source: National Health and Medical Research Council (2017). *Australian Guide to Healthy Eating*. Retrieved from https://www.eatforhealth.gov.au/guidelines/australian-guide-healthy-eating

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Weblinks
- More information on the five food groups
- Australian Guide to Healthy Eating

LEARNING ACTIVITY 14.3

Reflection

Comment on the accuracy of the adage that 'you are what you eat' and its relevance to mental health.

Adequate sleep

Sleep is an essential, naturally occurring, involuntary process, without which we cannot function at our best. We cannot avoid the need for sleep. Eventually our body shuts down and we sleep whether we want to or not. We have all experienced the effects of going without sleep for varying periods of time so we know it is important for maintaining good mental health as well as physical health. It is as vital to our functioning as eating, drinking and breathing.

The way we think, feel and behave while awake depends in part on what happens while we sleep. During sleep, we undergo a number of important maintenance processes that help us to function and be productive during waking time. According to restoration theory, our body undergoes repair and replenishes resources depleted during the major waking period. Additionally, sleep triggers the release of hormones that affect growth and other functions. Sleep may also give our brain some 'down time' to process information and to form or consolidate new pathways to help us remember what we learnt when awake and ensure the relevant knowledge and skills are available when needed.

We all need to make sure we get the right amount of sleep, and enough good quality sleep. There is no set amount of sleep time that is appropriate for everyone. The amount of sleep time people need is a highly individual matter and varies in relation to age, lifestyle, sleep habits and many other factors. Good quality sleep tends to be the result of spending enough uninterrupted time in both NREM and REM sleep, including enough deep sleep which helps us feel refreshed. It also depends on whether we are sleeping at a time when our body is prepared and ready to sleep.

Generally, an adequate amount of total sleep time is about 10 hours per night for school age children, about 9 hours for teenagers and about 8 hours for adults. Elderly people tend to need less sleep (see Table 14.1 on the next page). However, some people in these lifespan stages can cope very well with much less sleep and some need much more every night. In particular, there are some people who are genuine short sleepers (sleep less than 5.5 hours per 24 hour period) or long sleepers (more than 9.5 hours). Overall, adequate sleep tends to be more about waking up feeling rested, refreshed and ready for the day and feeling positive about ourselves and our abilities, rather than getting a certain number of hours (Bruck, 2006; SHF, 2016b).

Inadequate or poor sleep can adversely affect mental health by impairing affective, behavioural and cognitive functioning. You are familiar with many of these impairments, especially sleepiness and fatigue. For example, a sleepy and fatigued person tends to be irritable, have difficulty controlling their emotions (often resulting in amplified emotional responses), have a lower level of alertness, difficulty maintaining concentration, be slower to react and make more mistakes. They also tend to have lapses in memory, think less clearly, make poor judgments and be more accident prone when compared with people who are not sleepy and fatigued. These types of side-effects of inadequate sleep can affect our overall sense of wellbeing. Additionally, when moody or over-reacting emotionally, we can have problems getting along with others and may not be particularly pleasant company. Sometimes we can even have problems simply making conversation. Consequently, inadequate sleep can also affect our relationships with others and thereby further compromise our mental health.

There is considerable research evidence that indicates a strong link between sleep and mental health. In particular, many people who experience mental health problems also experience sleep problems. As described in Chapter 12, poor sleep quantity or quality over a sustained period is considered a risk factor for the development or perpetuation of a range of mental disorders, including mood, anxiety, addictive, personality and psychotic disorders.

In the same way that a healthy diet can help improve our mental health, so can sleep. There is no doubt that adequate sleep can help us think, feel and do better as well as enhance our enjoyment of life in general. This may require some time and effort, but it's worth it. For many people, it may simply be a case of making small attitude or lifestyle adjustments (i.e. improving sleep hygiene). For those with insomnia or another sleep disorder it may be necessary to seek professional support.

There is no universal answer to the question of what constitutes 'adequate sleep'. What is important is that people should find out how much good quality sleep they need and develop good sleep hygiene to ensure that they achieve this on a regular basis (Mental Health Foundation (UK), 2011).

Figure 14.4 Adequate sleep — the right amount of sleep, and enough good quality sleep — is vital for mental health.

TABLE 14.1 Recommended sleep according to age

Age	Recommended	May be appropriate	Not recommended
Newborns (0–3 months)	14–17 hours	11–13 hours 18–19 hours	Less than 11 hours More than 19 hours
Infants (4–11 months)	12–15 hours	10–11 hours 16–18 hours	Less than 10 hours More than 18 hours
Toddlers (1–2 years)	11–14 hours	9–10 hours 15–16 hours	Less than 9 hours More than 16 hours
Preschoolers (3–5 years)	10–13 hours	8–9 hours 14 hours	Less than 8 hours More than 14 hours
School-aged children (6–13 years)	9–11 hours	7–8 hours 12 hours	Less than 7 hours More than 12 hours
Teenagers (14–17 years)	8–10 hours	7 hours 11 hours	Less than 7 hours More than 11 hours
Young adults (18–25 years)	7–9 hours	6 hours 10–11 hours	Less than 6 hours More than 11 hours
Adults (26–64 years)	7–9 hours	6 hours 10 hours	Less than 6 hours More than 10 hours
Older adults (≥ 65 years)	7–8 hours	5–6 hours 9 hours	Less than 5 hours More than 9 hours

Note: The above sleep duration recommendations are based on a report of an expert panel convened by the US based National Sleep Foundation and published in 2015 in their journal *Sleep Health*.

Source: Sleep Health Foundation (2016). *How much sleep do you really need?* [Fact sheets]. Retrieved from https://www.sleephealthfoundation.org.au/public-information/fact-sheets-a-z/how-much-sleep-do-you-really-need.html

LEARNING ACTIVITY 14.4

Reflection

Comment on whether the consequences of inadequate sleep tend to be underestimated by many people or not taken as seriously as they should be.

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National Sleep Foundation (America) Sleep IQ quiz

PSYCHOLOGICAL PROTECTIVE FACTORS

People who are mentally healthy usually think logically and clearly and tend to have a positive view of themselves and life in general. Their generally positive attitude helps them be productive, realise their abilities, cope effectively with the challenges and stressors of everyday life, and to fully enjoy and appreciate other people, day-to-day life and their environment in general. Establishing positive thinking patterns (rather than negative) and having the ability to question erroneous, dysfunctional or unrealistic thoughts and expectations is an important means of protecting and maintaining mental health. One of the ways in which this can be achieved is to use cognitive behavioural strategies.

Cognitive behavioural strategies

Cognitive behavioural strategies are techniques drawn from cognitive behavioural therapy (CBT) to identify, assess and correct faulty patterns of thinking or problem behaviours that may be affecting mental health and wellbeing. For example, a technique such as *cognitive restructuring* aims at replacing erroneous or dysfunctional thoughts with more helpful cognitions. In turn, this can help reduce problem thoughts, as well as ways of feeling and/or behaving that are influenced by those thoughts. Similarly, a *behavioural technique* may be used to protect, maintain or improve mental health through behaviour change. For example, this could involve skills training that targets a specific area of functioning, such as breathing or relaxation training to help with stress management, learning anger management skills to help control emotional reactivity, social skills training to improve ways of interacting with others or training that focuses on improving parenting skills (APS, 2010). Box 14.4 on page 681 includes an example of a behavioural technique involving activity scheduling.

Dysfunctional thoughts, often referred to as *cognitive distortions* by CBT practitioners, can be habitual ways of thinking that adversely impact on mental health. For example, if you get an assignment back that contains a number of criticisms and is accompanied by a low mark despite your having made a big effort, you may think,

'I am so dumb, I am hopeless. I will never be able to do well in this subject'. This, in turn, may lead to a mentally unhealthy feeling of helplessness or worthlessness in that subject and may result in you not trying to do well in the future. According to the principles of CBT, you can change the way you feel and behave by thinking about a situation in a more positive and optimistic way. For example, if you were to get low marks for an assignment for which you made a big effort, instead of thinking, 'I am so dumb, I am hopeless, I will never do well in this subject' change your thinking to, 'This was a difficult task, I know I can do better next time. Just because I haven't done well on one assignment doesn't mean I have failed this subject or that I can't do well in the future.' Examples of other cognitive distortions, called 'thinking errors', are outlined in Box 14.3 on the next page.

Some cognitive behavioural strategies can be used without the need for specialist intervention. For example, journals or diaries with 'daily thought records' can be kept to identify and correct problematic ways of thinking. A typical thought record would include notes such as the situation where the negative thought occurred, details of the negative thinking (including any initial 'automatic thoughts), and emotions and behaviours that may have occurred with the thoughts. These records can then be analysed using various cognitive strategies. For example, beyondblue (2016c) outlines the following five strategies that can be used to identify and challenge negative, irrational and unhelpful thoughts.

Strategy 1: Consider the evidence
If you find yourself thinking negatively about an event or situation, ask yourself, 'What evidence do I have that this is actually true or going to happen?' Chances are, you probably don't have any evidence and you're worrying without good reason.

Strategy 2: Is there an alternative explanation?
If you have it in your head that an event happened because of something you did or didn't do, ask yourself: is there an alternative to that explanation?

Strategy 3: What would you say to a friend who is thinking like that?
It is the easiest thing in the world to call yourself unpleasant names when you make a mistake. But, as you will appreciate, unhelpful and negative self-talk can be very harmful and discouraging. So, if you find yourself in a situation where you are tempted to call yourself dumb, stupid, an idiot or refer to yourself in some other unpleasant way, act like your own best friend, and say something helpful like, 'Chill out. It was a mistake, you didn't do it on purpose.'

Strategy 4: What is the likelihood?
Again, it is easy to imagine the worst when something important to you happens or remains unresolved. In these situations where your imagination is tempted to run wild with negative possibilities, ask yourself, 'What is the likelihood?' When you think rationally and objectively, you can reduce your stress and help yourself feel a bit better.

Strategy 5: Is there a more helpful way to think about this?
This is about looking at an event (even one with a less than ideal outcome) and working out if there is a way to think about it that isn't just going to make you feel miserable. For example, suppose you discover that you have no money left in your bank account and became really stressed because you thought you had enough to do something special with a friend. Will that make the money problem disappear? No. Mistakes and disappointments arising from mistakes are inevitable in life — they are a part of how we learn. And a big part of learning is looking at everything that happens, good and bad, in helpful ways. If you think in a more constructive or helpful way in this situation, then you might realise the need to create and stick to a budget in the future. This helps ensure the you don't make the same mistake again. Knowing this can actually make you feel a lot better (beyondblue, 2016d).

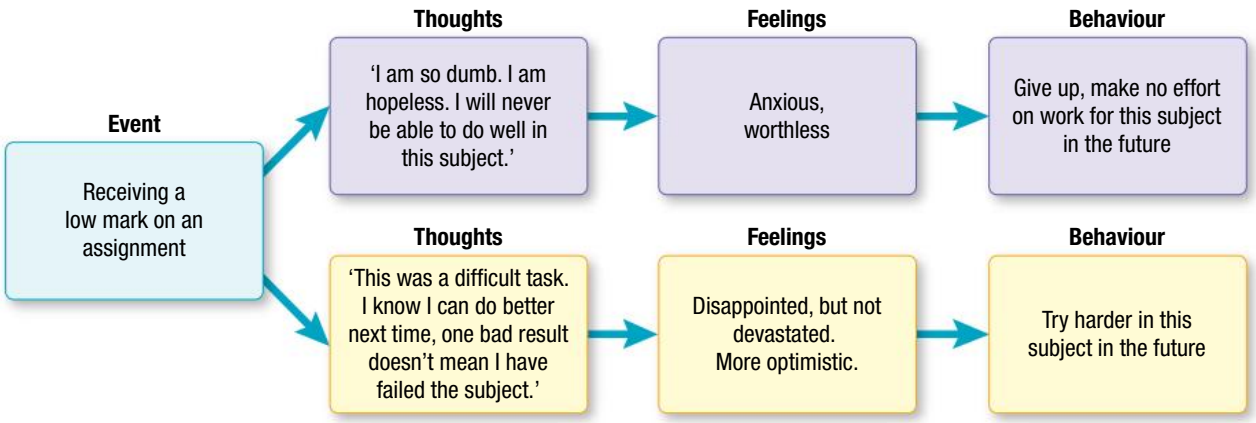
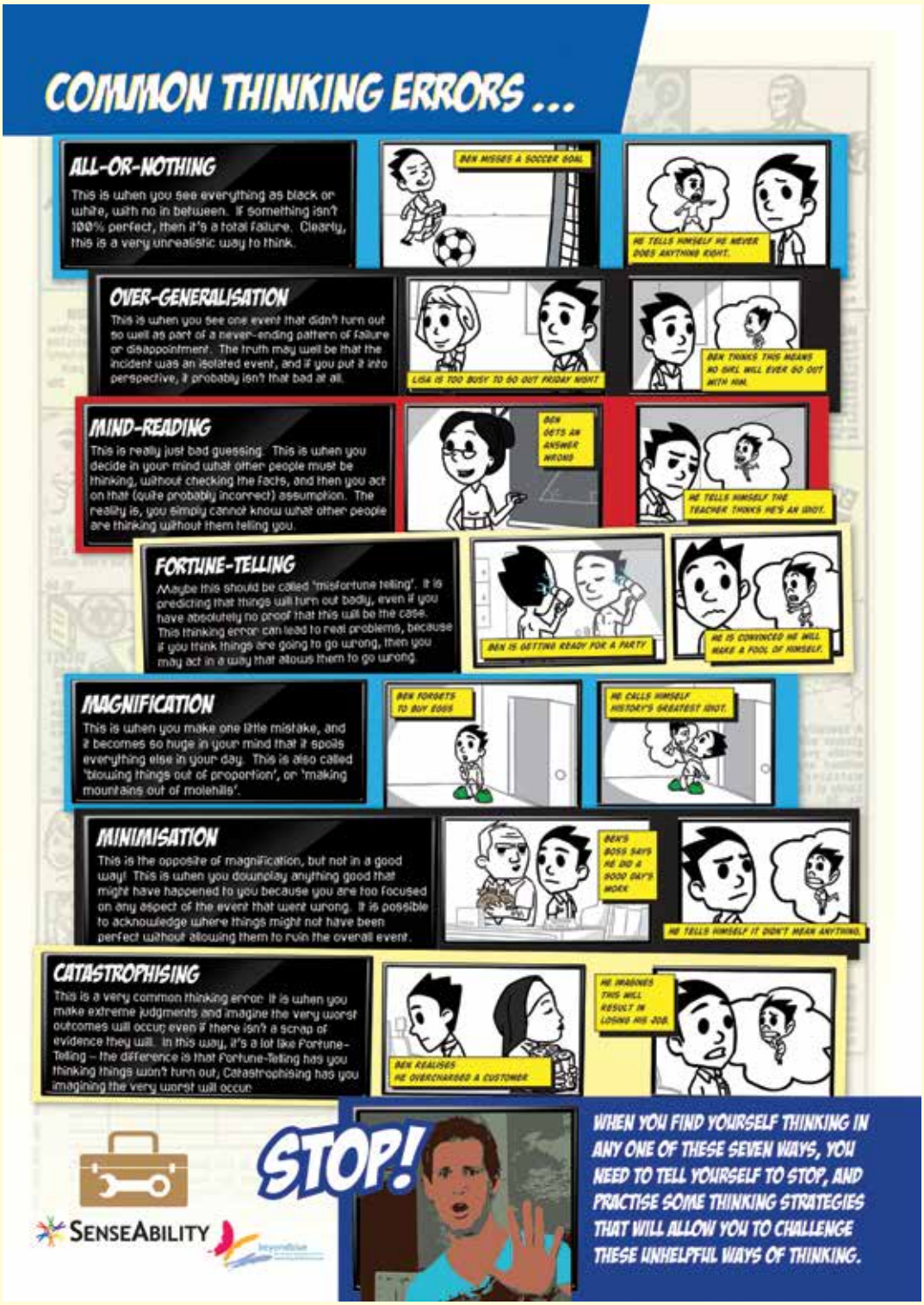


Figure 14.5 Using CBT, negative thoughts that underlie dysfunctional feelings and behaviour can be changed.

BOX 14.3



beyondblue (2016). *Common thinking errors*. [Healthy places > Secondary schools and tertiary > SenseAbility> Download SenseAbility]. Retrieved from https://www.beyondblue.org.au/docs/default-source/senseability/common-thinking-errors.pdf?sfvrsn=2

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beyondblue video on common thinking errors 5m 12s

BOX 14.4 Activity scheduling

Activity scheduling is sometimes used by CBT professionals as a treatment intervention for people with depression. Generally, this behavioural technique is designed to maximise engagement in mood-elevating activities. These can be as simple as going for a walk or calling a friend.

Steps involved in implementing an activity schedule typically include the following.

1. *Monitor current activities*: the person lists all activities they engage in during the day on an hourly basis. They then rate each hour's activity on two dimensions: pleasure (level of satisfaction experienced) and mastery (level of accomplishment). Each dimension is rated on a 10-point scale, with 0 equivalent to 'no pleasure' and 'no mastery' and 10 equivalent to 'maximum pleasure' and 'complete mastery'. Monitoring activities in this way typically reveals that someone with depression is engaging in very few rewarding activities. Often they spend hours in activities with a low level of satisfaction and accomplishment, such as watching television or sitting around ruminating by mulling over negative thoughts.
2. *Develop a list of rewarding activities*: the next step is to list potentially rewarding activities with which the person may engage. A goal is to include activities the person currently enjoys, activities the person has enjoyed in the past prior to their depressive disorder and activities the person has thought about trying but never has.
3. *Plan rewarding activities*: the person is asked to schedule some activities from the rewarding activity list so that they can be undertaken. As part of this process, the person may be asked to predict in advance how much enjoyment and mastery they think they will experience from the activity, again using a 10-point scale.
4. *Complete planned activities*: the person engages in the planned activities according to the schedule, rates each activity for mastery and pleasure and records these ratings.
5. *Evaluate the schedule*: after engaging in pleasurable activities for a week or so, the schedule is evaluated through discussion with the professional to find out whether it is having its intended effect of lifting the person's mood. This could, for example, require the person to obtain a 'mood rating' for each day they followed their plan and a 'mood rating' for each day they did not. If the schedule is not having any impact on the person's mood, it is possible that they have chosen activities that are too hard, that require too much planning or that they don't really enjoy.

Time	Thursday	Friday	Saturday	Sunday
9–10 am	*School*	*School*	*Play tennis*	*Go for jog*
10–11	*School*	*School*	*Play tennis*	*Clean up room and do washing, social media*
11–12	*School*	*School*	*Catch up and lunch with friends*	*Homework*
12–1 pm	*Lunch*	*Lunch*	*Lunch with friends*	*Lunch with mum*
1–2	*School*	*School*	*Casual job*	*Homework*
2–3	*School*	*School*	*Casual job*	*Homework*
3–4	*School*	*School*	*Casual job*	*Homework*
4–5	*Visit grandparents*	*Read school novel*	*Casual job*	*Social media*
5–6	*Social media*	*Read school novel*	*Do chores at home, social media*	*Help brother make dinner*
6–7	*Eat with family and clean up*	*Eat with family and clean up*	*Eat dinner at friend's house*	*Catch up with cousins*
7–8	*Homework*	*Watch TV, social media*	*Go to movie*	*Catch up with cousins*
8–10	*Homework, social media, sleep*	*Watch TV, social media, sleep*	*Go to movie, social media, sleep*	*Organise the week, read school novel, social media, sleep*

SOCIAL PROTECTIVE FACTORS

The growing prominence of the biopsychosocial model has placed increased emphasis on the importance of social factors that can affect our mental health, particularly the amount and type of support received from family, friends and community.

Support from family, friends and community

Being connected with other people and the community in general is an important part of protecting and maintaining mental health. As well as the social needs that are fulfilled through our interactions with others, connectedness helps ensure access to social support.

Social support generally refers to the assistance, care or empathy provided by people to each other. The people who provide social support can vary and include anyone with whom we may have a relatively stable or ongoing relationship, although this does not necessarily mean a close interpersonal relationship or an intimate relationship. For example, people who may provide social support can include family members, friends and people in the local and wider community, such as peers at school, teachers we trust, work colleagues, members of a church or self-help group to which we may belong, professionals (e.g. family doctor, a counsellor or psychologist) and even people with whom we may connect in the 'virtual community' through telephone help lines or online support groups and chat rooms.

When affected by a mental health problem, people often don't feel like mixing with others. There is a tendency to avoid seeing friends and family as usual. Some people may even avoid going to school and skip other commitments within their community such as a casual job or sports training. Interacting with others can just seem too overwhelming and difficult. It can often be more comfortable and feel easier to be alone. However, research findings indicate that isolating oneself from others instead of seeking some form of social support when experiencing a mental health problem is not usually helpful. For example, it can make the person feel worse and delay access to receiving treatment that can be helpful (SANE, 2018c).

One Australian study involving more than 2500 Year 8 students aged 13–14 years old from 26 Victorian secondary schools found that those who reported poor 'social connectedness', defined as having no one to talk to, no one to trust, no one to depend on, and no one who knows them well, were between two and three times more likely to experience depressive symptoms compared with those students who reported the availability of more confiding relationships (Glover, et al., 1998). More recent studies with samples of varying ages, socioeconomic and cultural backgrounds have also obtained results indicating that social support is a significant contributor to good mental health (Leach, 2015; Sohlman, 2004). It also seems that young people tend to be more likely to seek or recommend help for a friend, than to seek help themselves (ReachOut, 2018).

According to SANE Australia (2018c), when someone is affected by mental health problems, other people can often be the best medicine. Making the effort to see or stay in touch with other people is likely to result in feeling better, and, in some cases, can be a critical, even life-saving means of support. This includes efforts that may involve contacting or seeing others only for short periods or in ways in which the individual feels comfortable; for example, catching up on the phone, posting a comment on Facebook or going to a movie with a friend or family member. Similarly, it can make a difference to go out into the community where it may be possible to have a chat with someone at the local shopping strip or mall. People seem to be inherently predisposed to be social, and really do feel better and more connected after even a brief encounter.

Figure 14.6 Support from others is considered vital to maintaining mental health.

Figure 14.7 The 'virtual community' may also be a source of social support.

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ReachOut forum

BOX 14.5 Forms of social support

American psychologists Jerry Suls and Kenneth Wallston (2003) have proposed that social support tends to have four main forms: appraisal support, tangible assistance, informational support and emotional support.

Appraisal support is help from another person that improves someone's understanding of their mental health problem and the resources and coping strategies that may be needed to deal with it. For example, through appraisal support from a family member, friend or an online forum discussion, a person facing a stressful event can determine how threatening the stressor actually is and can reduce uncertainty associated with the nature of the stressor and its potential impact.

Having someone else to talk to may alleviate the impact of a mental health problem by providing a solution to the problem, by reducing the perceived importance of the problem, or by providing a distraction from the problem. In addition, the perception that others can and will provide assistance may help redefine the 'harm' potential of a situation and bolster a person's perceived ability to cope with imposed demands, thereby preventing a problem or situation from being appraised as unmanageable or highly stressful (Cohen & Pressman, 2004; Kawachi & Berkman, 2001; Maulik, Eaton & Bradshaw, 2010).

Tangible assistance involves the provision of material support, such as services, financial assistance or goods, that may help offset the effects of a mental health problem. Delivering sandwiches or a casserole to someone who has lost their job or is struggling to cope with the death of a loved one is an example of this type of support. Access to tangible assistance means that the person will not have to perform certain routine chores at a time when their energy and enthusiasm for such tasks may be low. It can also indirectly provide psychological support by helping break down feelings of isolation (e.g. 'I am in this alone') and reinforcing feelings of connectedness with family, friends and community.

Other people, including community groups and agencies, can also provide *informational support* about how to cope with a mental health problem, symptoms or contributory factors. For example, a person experiencing stress because of difficulties managing their workload may get information from co-workers about strategies that could be effective, such as going to the HR department for advice or how to best approach their team leader or supervisor for training or job restructure. Similarly, online support groups and forums can provide a non-threatening, anonymous space to access or exchange information and tips on mental health issues of concern.

Family, friends and the community can also provide *emotional support*; for example, through expressions of empathy and by reassurance that a person is cared for, valued and will be helped in any way required. The warmth and nurturing provided by other people can enable a person with a mental health problem to be more confident about coping and outcomes, based on the realisation that they have access to social support when needed. Consequently, social support also decreases one's feelings of loneliness and isolation, which in turn helps maintain an individual's mental health (Hall-Lande, et al., 2007).

Social mums beat the blues

New mums are at lower risk of postnatal depression if they stay connected with their important social networks.

That's the central finding from a study by Magen Seymour-Smith of The University of Queensland School of Psychology.

'The period after a woman gives birth is a time of significant identity change', Ms Seymour-Smith said.

'We studied 1084 Australian women who gave birth over a 10-year period and surveyed them at two points in time.'

'The first survey was completed in the year before they had a baby and the second between one and 12 months after childbirth.'

'Analysis revealed that mothers with high levels of social support before birth were protected against mental health decline — but only if they kept a similar amount of support afterwards.'

Mothers who lost some of their previously high social support network had a higher risk of mental health decline.

'Becoming a mother for the first time can be an exciting and wonderful time', Ms Seymour-Smith said.

'However, for some women the arrival of the "bundle of joy" is an overwhelming life transition that leaves them feeling afraid, anxious and alone.'

'Why do some women embrace parenthood and seemingly thrive in their new roles, but others develop severe mental illness during this time of life transition?'

'This is the focus of our current research.'

Postnatal depression is estimated to affect 10–20 per cent of first-time mothers.

Symptoms can include severely depressed mood, anxiety, fatigue, compulsive thoughts, loss of control, feelings of inadequacy, irrational fears and an inability to cope.

Source: The University of Queensland news, (September 2015). Retrieved from https://www.uq.edu.au/news/article/2015/09/social-mums-beat-blues

LEARNING ACTIVITY 14.5

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Word copy of table

Summarising protective factors for mental health

Complete the following table to summarise the influence of biopsychosocial protective factors for mental health.

Protective factor	What is it?	How it may influence mental health	Examples
Biological – adequate diet – adequate sleep			
Psychological • Cognitive behavioural strategies – cognitive strategy – behaviour strategy			
Social • Support from family, friends and community			

LEARNING ACTIVITY 14.6

Media analysis/response

Read the article 'Social mums beat the blues' above and answer the following questions.

1. What is the article about?
2. Suggest a hypothesis for the research that would be supported by the results obtained.
3. Identify the sample and population used in the research.
4. Identify the research and data collection methods.
5. What do the results suggest about social support as a protective factor for mental health? Explain your answer.
6. Identify a potential extraneous or confounding variable that could have affected the results of this particular study and suggest a way of controlling its influence.
7. Comment on whether maintaining social support after the birth of a child could reduce stigma that might inhibit access to treatment for postnatal depression.
8. Comment on the usefulness of the article in increasing community awareness of social support as a protective factor.

TRANSTHEORETICAL MODEL OF BEHAVIOUR CHANGE

It should not be surprising that many people frequently engage in behaviours that are not associated with good mental or physical health. For example, they may maintain a poor diet with way too much junk food, have sleep habits that result in inadequate sleep quantity and quality, smoke cigarettes, misuse or abuse alcohol on a regular basis, or spend so much time playing video games that it is detrimental to their relationships with family, friends and community engagement.

It is also common for people to want to change their behaviour at some point in time, especially when they consider a behaviour to be unhealthy or problematical in some way. For example, they may decide to modify, limit or abandon a problem behaviour altogether.

Changing health-related problem behaviour tended to be viewed in psychology as a single, 'one-off' *event* rather than a *process* that takes time. This view assumed that the determinants of an individual's behaviour were static and did not change over time. For example, some people may smoke cigarettes for many years without taking the threats associated with their smoking very seriously as long as they do not have any symptoms. However, once symptoms such as coughing and shortness of breath are regularly experienced, they may seek to change their behaviour. They may, for example, decide to exercise more to compensate for their respiratory problems, to cut back on the amount of their smoking, or to quit altogether. Consequently, alternative 'stage-based' models emerged to allow for the fact that people can be in different stages of readiness for change at different times in their lives and that their readiness for change may change drastically over time. One of the best known stage-based models is the transtheoretical model.

The **transtheoretical model of behaviour change** is a stage-based model that describes and explains how people intentionally change their problem behaviour to achieve a health-related goal. Also called the *stages of change model*, it describes health-related behaviour change as a complex process that takes place gradually over time through a sequence of stages that have to be passed successfully. The model explains the process of change in the context of substance use and dependence. However, the model may be applied to understanding how people change physical health related behaviours, such as smoking, diet, exercise and sun exposure, or, mental health related behaviours such as alcohol and drug abuse, stress and distress.

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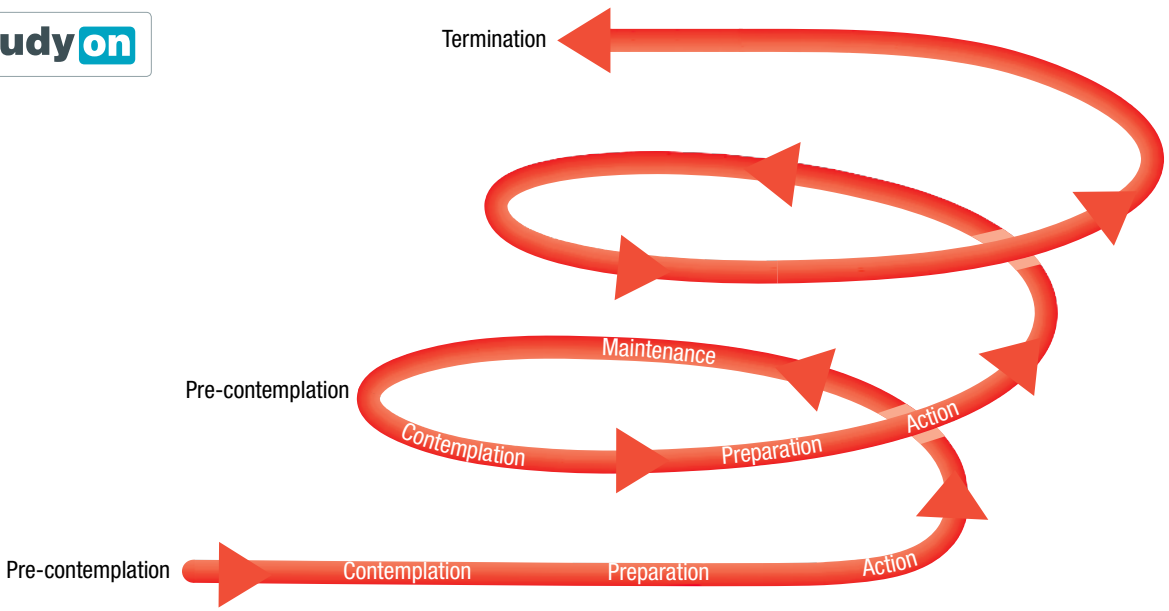

Figure 14.8 Transtheoretical model of behaviour change. This is represented as a spiral process, involving progression through a series of five stages until the process is complete (i.e. termination). Each loop of the spiral consists of the stages pre-contemplation, contemplation, preparation, action and maintenance. A loop is used because the behavioural change is not necessarily linear whereby this is only forward progression from one stage to another in a sequence. Most people experience setbacks ('slip-ups') and may therefore recycle through a stage or return to a previous stage from a later one.

Source: Based on Prochaska, J, O., DiClemente, C. C., & Norcross, J. C. (1992). In search of how people change: Applications to addictive behaviors. *American Psychologist, 47*(9), 1102–1114.

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Weblinks
Animations on transtheoretical model

There are five 'stages of change' in the transtheoretical model. These are phases that people go through gradually at their own pace as they attempt to change their behaviour, but not necessarily in a linear order where one stage is reached after another in a straightforward way.

As shown in Figure 14.8 on the previous page, people may move from one stage to another in a spiral fashion. This can include movement to a new stage as well as movement back to a previous stage, until they have finally completed the process of behaviour change. The model therefore allows for setbacks (or 'slip-ups') during the change process. For example, it is likely that the person who decides to severely cut back their video gaming time to allow for better sleep hygiene will experience several obstacles or difficulties as they attempt behaviour change.

The transtheoretical model was originally devised by American psychologists James Prochaska and Carlo DiClemente (1982, 1983) on the basis of research with people who were trying to quit smoking. They compared the experiences of self-changers who were trying to quit smoking on their own with those smokers using professional treatments. The participants were found to be using different processes at different times of their challenges with smoking. This led Prochaska and DiClemente to identify and describe the five 'change' stages of their model. They called their model 'transtheoretical' because it draws on a range of different theories of psychotherapy and behaviour change, rather than a single theory (Prochaska, 1979).

In conducting their research on which their model is based, Prochaska and DiClemente also found that individuals were more likely and able to quit smoking on their own if they were 'ready' to do so. Their model therefore recognises that different individuals are in different stages of 'readiness' for behaviour change. This includes people who are ready for or want to make an immediate or permanent change.

The transtheoretical model has been revised or adapted since it was first proposed in the early 1980s, but the basic principles and stages have generally remained intact. *Self-efficacy* is considered an important influence in the transition from one stage to another; for example, an individual's confidence in their ability to change across situations that may tempt them to revert to problem behaviour and to ultimately achieve their target behaviour (Prochaska, DiClemente & Norcross, 1992).

The five stages of the transtheoretical model are called pre-contemplation, contemplation, preparation, action and maintenance.

Figure 14.9 James Prochaska and Carlo DiClemente devised the transtheoretical model.

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Weblink
Prochaska comments on behaviour change 1m 45s

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Weblink
Video interview with DiClemente about the transtheoretical model 28m 40s

Pre-contemplation stage

People in this stage are not ready to change and have no intention of taking any action to change or abandon a problem behaviour in the foreseeable future, more specifically, a timeframe defined or operationalised as 'within the next six months'. They also tend to defend their problem behaviour.

Generally, there is no intention to change because they do not view their behaviour as a significant problem, so there is a lack of motivation for change. This is reflected in comments such as 'As far as I'm concerned, I don't have any problems that need changing' and 'I guess I have faults, but there's nothing that I really need to change'. In addition, the positives or benefits of the problem behaviour tend to outweigh any costs or adverse consequences so they are happy to maintain their behaviour and not make any change.

However, people in this stage tend to underestimate the benefits of change and overestimate the costs of change to justify their inaction. Some cigarette smokers, for example, may believe that because they exercise regularly, they will not suffer the negative health effects of smoking and that if they stop smoking, they will gain weight and therefore suffer the much worse health consequence of obesity. They may also believe that although other people have suffered negative outcomes from the behaviour, they have some unique personal invulnerability. For example, someone may defend their cigarette smoking by claiming they are genetically immune from damage because their grandparents smoked and lived to a very old age, or someone who regularly

drink-drives may claim that they actually drive better when drunk (Sanderson, 2013).

When someone tries to talk to a person in the pre-contemplation stage about their problem behaviour, the person tends to 'tune out' or change the subject. Basically, they are not open to change and therefore feedback or advice from others.

Individuals in this stage may also lack confidence in their ability to successfully abandon problem behaviour or to engage in and maintain new behaviour. For example, they may lack the confidence and therefore the motivation to change their behaviour as a result of past failed attempts to do so, or change may have been achieved but it couldn't be sustained.

For an individual to move out of the pre-contemplation stage, they tend to need to experience a negative emotion or mood state in relation to their problem behaviour and its consequences. In addition, they must be prepared to acknowledge that their behaviour is problematical and feel some motivation to change (Prochaska, Norcross & DiClemente, 2013; Prochaska & Prochaska, 2011; Velicer, et al., 2000).

Figure 14.10 During the pre-contemplation stage, the individual has no intention of changing their behaviour within the foreseeable future (operationalised as 'within the next six months').

Contemplation stage

When people reach this stage they think about the possibility of changing their behaviour. For example, a cigarette smoker may have heard about the possible serious consequences of prolonged smoking and may wonder whether to quit. However, they tend to feel ambivalent, or have 'mixed feelings', about taking the next step. On the one hand their problem behaviour has its positives. On the other hand, they are starting to recognise some adverse consequences of the behaviour as well as their personal vulnerability to those consequences.

Although people in this stage may begin to consider making a change (e.g. 'I may start to think about how to quit smoking') they do not actually initiate any behaviour change. Instead, they think about changing, weigh up the 'pros' and 'cons', realise that making a change would probably be a very good idea and seriously consider taking action to change their behaviour at some time 'within the next six months'.

People in this stage may also start seeking information on the negative effects of their behaviour as well as strategies for changing their behaviour. This is reflected in comments such as, 'I have a problem and I really think I should work on it' or 'I've been thinking that I might want to change something about myself'. However, weighing up the pros and cons in their cost–benefit analysis of making the change can cause them to remain in this stage for a long time without actually making any adjustments to their behaviour.

Figure 14.11 Individuals in the contemplation stage weigh up the pros and cons of changing their problem behaviour. This 'decisional balance' measure of potential gains and losses will influence the intention to change 'within the next 6 months'.

Preparation stage

The preparation stage generally involves mental 'preparation' for the desired behaviour change by formulating intentions and an action plan for change. For example, a cigarette smoker may formulate the intention to quit smoking during their next vacation and may plan to use nicotine gum as a substitute, and avoid coffee and alcohol which they associate with their smoking.

People in this stage have made a commitment to change their behaviour and intend to take action to ultimately abandon or change the problem behaviour 'within the next 30 days'. They see the cons of behaviour change as continuing to outweigh the pros but they are less ambivalent about taking the next step. This is reflected in comments such as, 'I've got to do something about this. This is serious. Something has to change.'

The stage may also involve preparation for change with behavioural activity involving small steps towards the desired behaviour change. For example, the cigarette smoker may decrease the number of cigarettes they smoke each day, or delay the time they have their first cigarette each day in preparing to quit entirely.

Although individuals in this stage are often highly motivated to change, they may vary in how confident they are in achieving success. Many tend to believe that change is necessary and that the time for change is imminent. Equally, some people in this stage decide not to do anything about their behaviour. Individuals are more likely to move to the next stage when they have a plan of action that they believe will work and if they feel confident that they can follow through with their plan (Prochaska, Norcross & DiClemente, 2013; Prochaska & Prochaska, 2011).

Figure 14.12 Individuals in the preparation stage are ready to change their health-related problem behaviour and may take some small steps to do so. For example, a cigarette smoker preparing to give up may delay the time when they usually have their first cigarette each day.

Action stage

This stage is characterised by overt attempts to change or abandon the problem behaviour. It is apparent when the person is actually engaging in behaviour change or has adopted a new behaviour. This is reflected in comments such as, 'I have quit smoking' or 'Anyone can talk about changing. I am actually doing something about it.'

Action requires considerable commitment of time and/or energy. Some people persevere more than others and may try several different techniques to achieve and maintain their desired change.

Because behavioural change in the action stage is visible, it is now public and can therefore be externally recognised by others. When people have also made a public commitment to change by telling others about their intention, they often receive a lot of support from their family and friends, which has a reinforcing effect.

Despite the apparent commitment, ambivalence is still possible in this stage which can make the person vulnerable to setbacks, including relapse. Many people who change their behaviour decide for a number of reasons to resume their abandoned behaviour or return to old patterns of behaviour. **Relapse** is said to occur when there is a full-blown return to the original problem behaviour. Relapse is common in the action and maintenance stages. It is different from a lapse. A *lapse* is a slip up with a quick return to action (or maintenance).

Some psychologists describe relapse as a sixth stage because it is quite common. However, relapse involves resuming the old behaviours. So, a person will have to engage in new health-related behaviour, which means they are in the action or maintenance, before they can actually relapse into old behaviours. Although relapse is undesirable as it can be a trigger for giving up in the quest for change, it can be important for learning and helping the person to become stronger in their resolve to change (Australian Government, Department of Health [DOH], 2004).

Progression to the fifth maintenance stage is most likely to occur when an individual has a high level of evidence of performance improvement, has a positive affective state, and receives positive social and performance feedback from others (Prochaska & Prochaska, 2011; Prochaska, Norcross & DiClemente, 2013).

Figure 14.13 The action stage is characterised by explicit attempts to change or abandon the problem behaviour. It is apparent when the person is actually engaging in behaviour change or has adopted a new behaviour; for example, actually attending a gym for regular exercise rather than joining and not acting on the membership.

Maintenance stage

The maintenance stage is reached when people have successfully sustained the changed behaviour over a relatively long period of time *without relapse*, typically for 'six months or more'.

The focus in this stage is on preventing relapse. People tend to receive less social support during this stage because they have already engaged in action, but support can still play a significant role in maintaining the new behaviour.

Sometimes there may be temptations to return to old behaviour patterns, but these can usually be avoided. Many people learn to anticipate and handle temptations and are able to employ new ways of coping. It is possible to have one or more temporary lapses, but this does not necessarily result in a failure to maintain behaviour change. For some problem behaviours, such as those involving addictions, maintenance may last a lifetime.

Some descriptions of the transtheoretical model refer to 'termination' or 'lasting exit' to identify permanent behaviour change. For example, *termination* is said to be reached when it is believed that the problem behaviour will never return, and the individual has complete confidence to maintain the new behaviour without fear of relapse. Termination has also been described as a sixth stage of the model (Prochaska & Velicer, 1997).

TABLE 14.2 Summary of the transtheoretical model

Stage of change	Readiness for change	Timing of change	Typical comments
Pre-contemplation	Not ready for change	Has no intention to take action within the next 6 months	'I have no intention to quit smoking.' 'I have no intention to start exercise.'
Contemplation	Getting ready for change (e.g. considering pros and cons for change)	Intends to take action within the next 6 months	'I may start to think about how to quit smoking.' 'I may start to think about doing some exercise.'
Preparation	Ready for change	Intends to take action within the next 30 days and has taken some behavioural steps in this direction.	'I will stop smoking within the next month.' 'I will become more regularly active within the next month.'
Action	Making the change	Has changed overt behaviour for less than 6 months	'I have stopped smoking.' 'I exercise regularly.'
Maintenance	Maintaining the change	Has changed overt behaviour for more than 6 months.	'I will continue to not smoke.' 'I will continue to exercise regularly.'

Strengths and limitations of the transtheoretical model

The transtheoretical model has been influential in psychology and helped popularise the stage-based approach to describing health-related behaviour change. It is generally considered to be relevant to behaviour change involving improvement or abandonment of either relatively simple behaviours (e.g. nail biting) or some of the more complex behaviours (e.g. addiction).

A strength of the model is that it is useful in understanding behaviour change that is either self-initiated or recommended by a professional as part of an intervention program. Additionally, the model emphasises that behaviour change is a *process* that may occur gradually over time. Many of the previous 'traditional' models and theories viewed health-related behaviour change as a single *event* rather than a process. This often involved only one possible outcome: total cessation or abstinence. Consequently, other possible, beneficial outcomes are overlooked. For example, many traditional models do not take account of the small steps towards cessation of a problem behaviour that a person might make, such as reducing the number of cigarettes smoked in a week, the achievement that those smaller steps might represent and how the reinforcing nature of these achievements can promote or maintain behaviour change (DOH, 2004).

Another strength of the transtheoretical model is that it takes account of individual differences. It recognises that different people are in different stages or states of readiness to make changes to their behaviour. This includes the fact that some people are not ready for or want to make an immediate or permanent behaviour change. By identifying a person's position in the change process, a professional can more appropriately match the intervention to the person's stage of readiness for change. For example, if a cigarette smoker had never even thought about giving up smoking (pre-contemplation), there is little value in trying to develop an action plan for smoking cessation with them. Instead, it could be more appropriate to educate them about the dangers of smoking and encouraging them to think about quitting (contemplation).

Another strength of the model is that it allows for minor and significant setbacks from which an individual may recover and re-engage with their change attempt. This is considered to be particularly important when considering addictive and other problematic behaviours for which relapse tends to be more common. For example, when individuals who experience relapse are aware that this significant setback is considered to be a part of the ongoing change process, they are often less inclined to feel as though they have 'failed' and to therefore persist with their behaviour change attempt (Ayers & de Visser, 2011; Nigg, et al., 2011).

It is also significant that the model was developed in the context of empirical research and has been tested through further research. Although the initial research on the transtheoretical model focussed on predicting cigarette smoking *cessation*, studies have found that it can also predict *adoption* of a variety of health-related behaviours, including fruit and vegetable consumption, exercise, sunscreen use and screening for cancer (Sanderson, 2013).

Figure 14.14 The transtheoretical model is useful for understanding health-related behaviour change but is not without limitations.

Some psychologists, however, argue that there has not been enough research on variables that influence stage transitions, which limits the usefulness of the model for treatment interventions. For example, to make it a reliable tool for interventions to induce behaviour change and match these interventions to the respective stage, more information and specifications are needed regarding the variables that determine the transitions between each of the different stages (Jonas & Lebherz, 2008). In addition, there is research evidence that the cognitive processes leading some people to stop certain behaviours (e.g. smoking) may be different from those involved in leading them to start certain behaviours (e.g. exercise) and that the model does not adequately allow for this important difference (Sanderson, 2013).

Other psychologists have pointed to the lack of research to justify the relevance or validity of time frames specified in the model for different stages. For example, time specifications such as 'Has no intention to take action within the next six months' for the pre-contemplation stage and 'Intends to take action within the next six months' for the contemplation stage seem to be arbitrary. Evidence on long-term adherance to behaviour change attributable to the model is also considered to be limited (Adams & White, 2005; Kraft, Sutton & Reynolds, 1999).

Some researchers have also questioned whether the stages are in fact distinct categories, whether they are in the correct order and whether there are other stages that have been overlooked. Others have suggested that the role of the individual's decision making in the change process may be overstated and that the role of social and cultural influences may be understated. Finally, the model has also been criticised on the grounds that it may not be applicable to more complex behaviours, such as changing parenting styles across a range of areas important in child upbringing. Similarly, the benefits of the model for improving exercise may be overstated as exercise behaviour may be considered a complex of different behaviours, not a single behaviour such as cigarette smoking (Adams & White, 2005; Heather & Honekopp, 2014; Sanderson, 2013).

LEARNING ACTIVITY 14.7

Review questions

1. What is the transtheoretical model?

2. Name the five stages of change in the model and write a brief description of each stage.

3. (a) Individuals in the pre-contemplation stage have no intention of changing a problem behaviour in the next _____ month(s).
(b) Individuals in the contemplation stage are seriously considering changing a problem behaviour sometime within the next _____ month(s).
(c) Individuals in the preparation stage are intending to take action to change a problem behaviour in or within the next_____ month(s).
(d) Individuals are said to be in the maintenance stage when they have successfully attained and maintained behaviour change for at least _____ month(s).

4. Identify the stage most likely associated with each of the following statements.
(a) 'I won't change this behaviour.'
(b) 'I am changing this behaviour.'
(c) 'I might change this behaviour.'
(d) 'I have changed this behaviour.'
(e) 'I will change this behaviour.'

5. Refer to the 'typical comments' in Table 14.2 on page 689. For each stage, write a 'typical comment' for another example of a problem behaviour to be modified (rather than a behaviour to be abandoned).

6. (a) Distinguish between a lapse and relapse during behaviour change.
(b) What is potential cost and gain of relapse?

7. Which stage of readiness for change seems to fit each of the following individuals?
(a) S.L. is an unemployed 19-year-old male who is currently participating in a court-initiated drug usage intervention program. He has a history of multiple drug use that includes cannabis, 'speed', cocaine and 'ice'. His drug use led to criminal activity to maintain his habit. He continues to drink heavily a couple of times a week and also takes 'benzos' he can buy 'in the street' as he reports this helps him get to sleep. A recent urine test was positive for cannabis, benzodiazepines and amphetamines. He is now concerned that he will be jailed and is desperate to stay on the court program and out of trouble.
(b) O.T. is a 17-year-old female who has been smoking cannabis regularly for about 18 months and has decided to seek support to stop. She reports having cut back her smoking 'a few times' in the past year, including 'once for nearly a month' during which there was no cannabis use. However, her early cannabis use pattern is now apparent.
(c) A.F. is a 15-year-old boy who smokes tobacco and cannabis. He is not 'hooked' on cannabis use and reports that he can 'take it or leave it'. However, he enjoys smoking as often as he can afford to. He also likes to get together with friends at 'a mate's house' where they also drink alcohol to 'get smashed' whenever 'we can get our hands on it'.

8. Identify a positive mental or physical health-related behaviour change you could make to improve your wellbeing. State this as a clear, achievable goal. Prepare an outline of a behaviour change program for goal attainment using the transtheoretical model.

9. Describe two strengths and two limitations of the transtheoretical model.

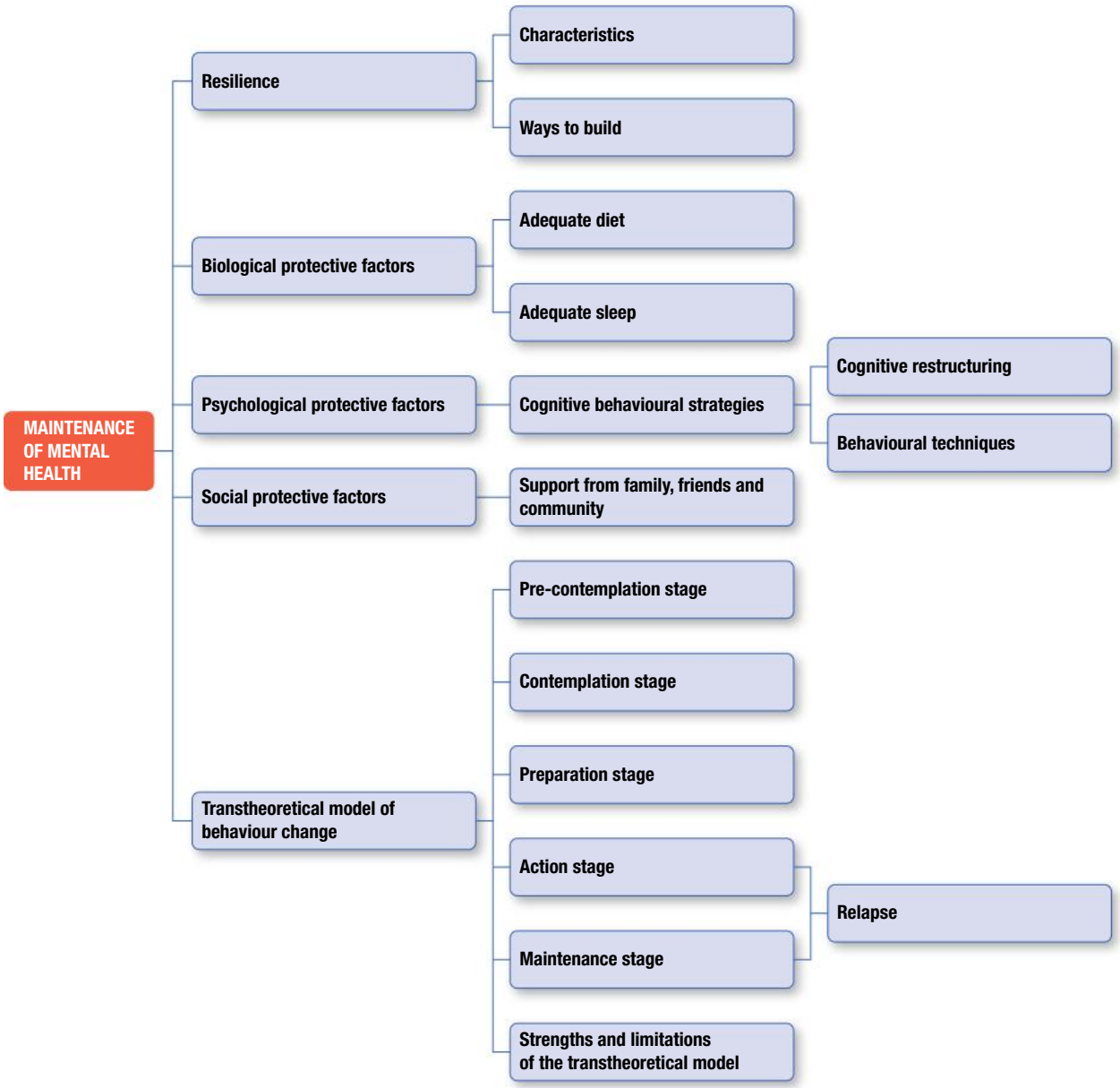
LEARNING ACTIVITY 14.8

Media analysis/response

Consider the cartoon at right in relation to the transtheoretical model.

(a) In which stage of readiness for change is the man?
(b) Explain your answer for (a) above.
(c) Suggest two comments the man might make following transition to the next stage.

CHAPTER SUMMARY



KEY TERMS

action stage p. 688
adequate diet p. 675
adequate sleep p. 677
biological protective factor p. 675
cognitive behavioural strategy p. 678
contemplation stage p. 687
lapse p. 688
maintenance stage p. 689
pre-contemplation stage p. 686
preparation stage p. 688
psychological protective factor p. 678
relapse p. 688
resilience p. 672
self-efficacy p. 686
social protective factor p. 682
social support p. 682
transtheoretical model of behaviour change p. 685

LEARNING CHECKLIST

Complete the self-assessment checklist below, using ticks and crosses to indicate your understanding of this chapter's key knowledge (a) before and (b) after you attempt the chapter test. Use the 'Comments' column to add notes about your understanding.

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Word copy of checklist

Key knowledge I need to know about maintenance of mental health	Self-assessment of key knowledge I understand *before* chapter test	Self-assessment of key knowledge I need to do more work on *after* chapter test	Comments
Resilience			
Characteristics			
Ways to build			
Biological protective factors			
Adequate diet			
Adequate sleep			
Psychological protective factors			
Cognitive behavioural strategies			
cognitive restructuring			
behavioural techniques (e.g. activity scheduling)			
Social protective factors			
Support from family, friends and community			
Transtheoretical model of behaviour change			
Pre-contemplation stage			
Contemplation stage			
Preparation stage			
Action stage			
Maintenance stage			
Relapse			
Strengths and limitations of the model			

studyon

Unit 4 > Area of study 2 > Topic 4

Concept screens and practice questions

CHAPTER 14 TEST

SECTION A — Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Question 1

Martha is a 43-year-old female who does not think she needs to exercise, even though her doctor has informed her that her bone mineral density is low. In which stage of the transtheoretical model is Martha most likely to be?

A. maintenance
B. action
C. preparation
D. pre-contemplation

Question 2

Which of the following is a psychological protective factor for mental health?

A. challenging self-critical thoughts
B. community engagement
C. accessing an online forum to share a problem
D. participation in a self-help group to solve a problem

Question 3

Which of the following involves a positive means of coping with adversity?

A. stress
B. resilience
C. pre-contemplation
D. eating food for comfort

Question 4

Pasquale is described by his teachers, friends and family as resilient. Which of the following attributes is Pasquale like to have?

A. good self-esteem
B. poor self-efficacy
C. catastrophic thinking
D. emotional reactivity

Question 5

Which of the following is a biological protective factor for mental health?

A. poor diet
B. genetic vulnerability
C. good sleep hygiene
D. stress response

Question 6

If Howard is in the preparation stage of the transtheoretical model, then he

A. is seriously thinking about starting an exercise program within the next six months.
B. is still considering the pros and cons of starting an exercise program.
C. has bought an exercise bike and intends to begin regular exercise within the next month.
D. has been exercising regularly for more than one month but less than six months.

Question 7

Mental health professionals who use cognitive behavioural therapy assume that our thoughts

A. play a critical role in influencing our feelings and behaviour.
B. play a critical role in influencing our feelings but not our behaviour.
C. play a critical role in influencing our behaviour but not our feelings.
D. do not influence our feelings or behaviour.

Question 8

'Kabe' has been using the drug 'ice' for over two years. He does so on a daily basis and also uses cannabis or minor tranquilisers if he can't get any ice. Kabe has been caught shoplifting several times and also steals property from unlocked vacant cars. He believes he is a 'much better person' when 'on ice' and therefore has no desire to stop using.

In which stage of the transtheoretical model is Kabe most likely to be?

A. maintenance
B. action
C. preparation
D. pre-contemplation

Question 9

About how many hours of sleep is generally an adequate amount for teenagers?

A. 11
B. 9
C. 8
D. 7

Question 10

Which of the following dietary guidelines is the most likely to contribute to good mental health?

A. take care with portion size in each meal
B. maintain a rough idea of the calorie count for each meal
C. eat a good amount of a variety of different foods
D. eat as much as you want of whatever you want as often as you want as long as the food is not unhealthy

SECTION B

Answer **all** questions in the spaces provided. Write using black or blue pen.

Question 1 (3 marks)

(a) Define the meaning of resilience. 1 mark

(b) Explain why resilience is commonly described as essential for good mental health. 2 marks

Question 2 (2 marks)

(a) Give an example of a cognitive behavioural strategy that may contribute to mental health. 1 mark

(b) Explain how this strategy would help maintain mental health. 1 mark

Question 3 (3 marks)

(a) Explain the meaning of adequate sleep. 1 mark

(b) Describe two benefits of adequate sleep to mental health. 2 marks

Question 4 (3 marks)

Jimmy has an extremely stressful job as prison guard at a maximum security prison. In fact, he thinks he is on the edge of being 'burnt out'. Jimmy works shift work and because he has to travel a long distance to and from the prison, he often eats 'on the run'.

Describe one biological, one psychological and one social strategy Jimmy could use to reduce his stress levels and maintain his mental health.

Question 5 (7 marks)

(a) List all five stages of the transtheoretical model in the correct order, ensuring you number each stage. 1 mark

(b) Read the following statements made by different individuals about sleep hygiene. Identify the transtheoretical model stage of change in which each individual is most likely to be. 4 marks

Statements	Stage of change
I have just started keeping regular times for going to bed and getting up.	
I have been keeping regular times for going to bed and getting up for over six months now.	
I have weighed up the pros and cons and decided it is probably a good idea to avoid going to bed on a full or empty stomach.	
Sometime within the next month I will stop checking social media before I go to sleep.	

(c) Give an advantage and a limitation of the transtheoretical model in relation to sleep hygiene behaviour change. 2 marks

Question 6 (12 marks)

A researcher conducted an experiment to test whether a diet with an adequate amount of omega-3 fatty acid will prevent the development of psychosis.

The experiment involved a randomised, double-blind placebo trial with 81 participants aged 13 to 25 years of age who were experiencing various psychotic symptoms, but did not have a diagnosable psychotic disorder.

Participants were randomly allocated to either the experimental group or control group for a period of 12 weeks. Participants in the experimental group took capsules containing 1.2g of omega-3, whereas participants in the control group took a placebo.

At the end of the 12-week period, participants in the experimental group were found to have a significantly reduced number of psychotic symptoms compared with participants in the control (placebo) group.

The researcher concluded that omega-3 dietary intake may offer a safe and effective prevention strategy in young people who are at a high risk of developing a psychotic disorder.

(a) The experiment is described as being a 'randomised, double-blind, placebo trial'. Explain what this means with reference to each term. 3 marks

(b) Write a research hypothesis that would be supported by the results obtained. 2 marks

(c) Identify the operationalised independent and dependent variables. 2 marks

IV: _____

DV: _____

(d) What conclusion was drawn by the researcher? 1 mark

_____

_____

_____

(e) Identify two potential extraneous or confounding variables that may be relevant to this particular experiment. 2 marks

_____

_____

_____

_____

_____

(f) What are two ethical issues of relevance to the use of a placebo treatment in this particular experiment? 2 marks

_____

_____

_____

_____

_____

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The answers to the Section A multiple-choice questions are in the answer section at the end of this book and in eBookPLUS.
The answers to the Section B questions are in eBookPLUS.

MULTIPLE CHOICE ANSWERS

Chapter 1

1 A	**2** D	**3** B	**4** D	**5** D
6 B	**7** A	**8** D	**9** D	**10** C
11 C	**12** B	**13** B	**14** C	**15** A
16 C	**17** A	**18** B	**19** A	**20** D
21 B	**22** C	**23** D	**24** B	**25** D

Chapter 2

1 D	**2** B	**3** C	**4** C	**5** D
6 A	**7** D	**8** B	**9** C	**10** C
11 A	**12** A	**13** B	**14** D	**15** A
16 A	**17** D	**18** C	**19** A	**20** B
21 B	**22** D	**23** A	**24** D	**25** B

Chapter 3

1 B	**2** B	**3** A	**4** D	**5** D
6 C	**7** A	**8** A	**9** D	**10** A
11 D	**12** C	**13** A	**14** D	**15** B
16 C	**17** C	**18** B	**19** C	**20** A
21 D	**22** B	**23** D	**24** A	**25** C

Chapter 4

1 A	**2** D	**3** A	**4** D	**5** A
6 B	**7** D	**8** C	**9** B	**10** A

Chapter 5

1 C	**2** A	**3** C	**4** C	**5** B
6 D	**7** D	**8** C	**9** B	**10** D
11 A	**12** B	**13** B	**14** A	**15** C
16 A	**17** D	**18** A	**19** B	**20** D

Chapter 6

1 B	**2** D	**3** B	**4** C	**5** C
6 D	**7** A	**8** B	**9** D	**10** C
11 C	**12** A	**13** A	**14** B	**15** A

Chapter 7

1 A	**2** B	**3** B	**4** D	**5** C
6 B	**7** D	**8** D	**9** B	**10** B
11 B	**12** A	**13** A	**14** B	**15** C
16 C	**17** D	**18** A	**19** A	**20** B

Chapter 8

1 C	**2** C	**3** B	**4** B	**5** A
6 B	**7** C	**8** D	**9** C	**10** A

Chapter 9

1 B	**2** D	**3** C	**4** D	**5** A
6 B	**7** B	**8** A	**9** D	**10** A
11 C	**12** D	**13** B	**14** C	**15** B
16 A	**17** C	**18** D	**19** C	**20** A

Chapter 10

1 A	**2** D	**3** C	**4** B	**5** A
6 B	**7** B	**8** C	**9** A	**10** D

Chapter 11

1 D	**2** A	**3** D	**4** A	**5** B
6 B	**7** D	**8** C	**9** D	**10** C

Chapter 12

1 A	**2** D	**3** B	**4** C	**5** B
6 D	**7** C	**8** B	**9** D	**10** A
11 B	**12** D			

Chapter 13

1 D	**2** A	**3** D	**4** B	**5** B
6 A	**7** A	**8** C	**9** C	**10** B
11 C	**12** C	**13** D	**14** A	**15** A

Chapter 14

1 D	**2** A	**3** B	**4** A	**5** C
6 C	**7** A	**8** D	**9** B	**10** C

GLOSSARY

4P factor model describes four influences on mental health and occurrence or re-occurrence of a mental disorder: *predisposing risk factors*, *precipitating risk factors*, *perpetuating risk factors*, *protective factors*

acculturative stress the stress people experience in trying to adapt to a new culture when living in it for a considerable period of time

action stage in the transtheoretical model of behaviour change, characterised by overt attempts to change or abandon problem behaviour

additive model in relation to cumulative risk and mental disorder, proposes that as the number of risk factors increases, there is also a corresponding increase in the likelihood of developing a mental disorder

adrenaline a hormone that is secreted during stress; may also enhance memory consolidation of emotionally arousing experiences

advanced sleep phase disorder a circadian rhythm phase disorder causing sleepiness, sleep onset and awakening much earlier than desired; see also *circadian rhythm phase disorder*; compare with *delayed sleep phase disorder*

afferent information sensory information coming into the central nervous system; compare with *efferent information*

agonist drug action that stimulates neurotransmitter activity; compare with antagonist

alarm reaction stage the first stage of the General Adaptation Syndrome in which the body goes into a temporary state of shock, then rebounds (counter shock), following initial exposure to a stressor

alpha brain wave pattern associated with relaxed, calm, internally focussed, wakeful state, with eyes closed

altered state of consciousness (ASC) a condition of awareness that is distinctly different from normal waking consciousness in terms of level of awareness and experience

Alzheimer's disease a type of dementia characterised by gradual widespread degeneration of brain neurons, progressively causing memory decline, deterioration of cognitive and social skills, and personality changes

amnesia loss of memory that is inconsistent with ordinary forgetting; see also *anterograde amnesia*

amygdala structure located deep within the brain; involved in emotional reactions (particularly fear and aggression) and formation of a wide variety of emotional memories

antagonist drug action that inhibits neurotransmitter activity; compare with agonist

antecedent a stimulus that precedes a specific behaviour and signals the probable consequence for the behaviour

anterograde amnesia loss of memory only for information or events occurring after the trauma that caused the amnesia

anxiety a state of arousal involving unpleasant feelings of apprehension or uneasiness that something is wrong or something bad is about to happen

approach coping strategy an effort to cope with stress by confronting the causal stressor and dealing directly with it and its effects; compare with *avoidant coping strategy*

arousal threshold in relation to sleep, the level of sleep from which a sleeping person can be awakened

Atkinson–Shiffrin multi-store model of memory represents memory as consisting of three separate stores called sensory memory, short-term memory and long-term memory

attachment in relation to human development, the emotional bond which forms between an infant and another person, usually their main caregiver

attention generally refers to a concentration of mental activity that involves focusing on specific stimuli while ignoring and therefore excluding other stimuli; in *observational learning*, the first step in the process and involves closely watching a model's behaviour and its consequences

automatic process information processing that involves little conscious awareness and mental effort and minimal attention and does not interfere with performance of other tasks; compare with *controlled process*

autonomic nervous system a self-regulating subdivision of the peripheral nervous system that connects the central nervous system to the body's internal organs and glands, providing feedback to the brain about their activities

avoidance behaviour actions that help avert any contact, exposure or engagement with a feared object or situation

avoidant coping strategy an effort to cope with stress by evading the causal stressor and indirectly dealing with the stressor and its effects; compare with *approach coping strategy*

axon a single, tubelike, extension that transmits neural information to other neurons or cells

axon collateral small branch at the end of an *axon terminal* where a *terminal button* that stores and secretes neurotransmitter is located

axon terminal structure at the end of an axon collateral with a terminal button at the tip where neurotransmitter is stored and secreted

behaviour any action a person (or animal) uses to adjust the environment; may be *overt* (directly observable) or *covert* (hidden from view); compare with *mental process*

behavioural model emphasises the role of learning processes in describing and explaining behaviour

beneficence in relation to research ethics, the potential benefits of the research to participants or the wider community

benzodiazepine a drug that works on the central nervous system, acting selectively on GABA (*gammaamino butyric acid*) receptors in the brain to increase GABA's inhibitory effects and make post-synaptic neurons resistant to excitation; may be used in the treatment of phobic anxiety; commonly referred to as a sedative, tranquiliser or depressant

beta brain wave pattern associated with alertness and intensive mental activity during normal waking consciousness, including use of stimulant drugs

biased sample a research sample that does not adequately represent key characteristics of the population from which it was drawn

biological clock an internal mechanism or neural system that maintains and controls one or more biological rhythms; see also *suprachiasmatic nucleus*

biological rhythm a naturally occurring pattern of cyclic changes in a bodily function or state that repeats itself over time; see also *circadian rhythm* and *ultradian rhythm*

biopsychosocial model a way of describing and explaining how biological, psychological and social factors combine and interact to influence an individual's behaviour and mental processes; sometimes called *biopsychosocial approach* or *theory*

blood alcohol concentration measure of alcohol in the body expressed as grams of alcohol/100 mL of blood

bradykinesia slowness of voluntary movement, particularly when initiating and executing movement and in performing repetitive movement; a key symptom of Parkinson's disease

brain trauma an umbrella term for a brain injury acquired after birth and impairs the normal functioning of the brain, either temporarily or permanently

breathing retraining in relation to specific phobia, an anxiety management technique that involves teaching correct breathing habits; also called breathing training

bright light therapy a technique for treating circadian rhythm phase disorders that uses timed exposure of the eyes to light with the aim of shifting an individual's sleep-wake cycle to a desired, more appropriate or conventional schedule

carry-over effect a type of order effort involving influence of task when experience on performance in a task that follows it; see also *order effect*

case study an intensive, in-depth investigation of some behaviour or event of interest in an individual, group, organisation or situation

catastrophe an event that causes widespread damage or suffering

catastrophic thinking cognitive bias involving negative thinking in which an object or situation is perceived as being far more threatening, dangerous or insufferable than it really is and will result in the worst possible outcome

central nervous system the brain and spinal cord

cerebellum cauliflower shaped structure at the base of the brain; coordinates timing and fluency of movements; involved in formation of long-term motor skill memories; stores implicit memories of simple conditioned reflexes

cerebral cortex thin, outer layer of the brain; involved in complex mental abilities, sensory processing, voluntary movements and numerous other functions that distinguish us as humans

circadian rhythm a biological rhythm involving changes in bodily functions or activities that occur as part of a cycle with a duration of about 24 hours; compare with *ultradian rhythm*

circadian rhythm phase disorder a sleep disorder involving sleep disruption that is primarily due to a mismatch between an individual's sleep-wake pattern and the pattern that is desired or required; see also *advanced sleep phase disorder* and *delayed sleep phase disorder*

circadian theory of sleep a theory on the purpose and function of sleep proposing that sleep evolved to enhance survival by protecting an organism through making it inactive during the part of the day when it is most risky or dangerous to move about; also called *evolutionary theory*

classical conditioning a type of learning that occurs through repeated association of two (or more) different stimuli

classically conditioned memory implicit memory of a conditioned response to a conditioned stimulus acquired through classical conditioning

cognitive behavioural strategy in relation to psychotherapy, a technique drawn from cognitive behavioural therapy to identify, assess and correct faulty patterns of thinking or problem behaviours that may be affecting mental health and wellbeing

cognitive behavioural therapy (CBT) a type of psychotherapy based on the assumption that the way people feel and behave is largely a product of the way they think; aims to identify, assess and correct faulty patterns of thinking or problem behaviours that may be affecting mental health and wellbeing

cognitive bias in relation to specific phobia, a tendency to think in a way that involves errors of judgment and faulty decision-making

cognitive model in relation to specific phobia, an approach to understanding that emphasises how the individual processes information about a phobic stimulus and related events

cohort effect participant thoughts, feelings and/or behaviour that may be attributable to age-specific life experiences or population-wide exposure to one or more events at a specific point in time

conclusion a decision about what the results obtained from a research study mean

conditioned emotional response an emotional reaction in response to a specific stimulus acquired through classical conditioning

conditioned response (CR) in classical conditioning, the learned or acquired response to the conditioned stimulus

conditioned stimulus (CS) in classical conditioning, the stimulus that is neutral at the start of the conditioning process and does not normally produce the unconditioned response but eventually becomes associated with the unconditioned stimulus and elicits a conditioned response

conditioning a learning process through which stimuli and responses become associated with one another

confounding variable a variable other than the independent variable that has had an unwanted effect on the dependent variable making it impossible to determine which of the variables produced the predicted change in the dependent variable; see also *extraneous variable*

consciousness awareness of objects and events in the external world, and of our sensations, mental experiences and own existence at any given moment

conscious response a reaction to a sensory stimulus that involves awareness; usually voluntary, goal-directed and we have some degree of control over it; compare with *unconscious response*

consequence in operant conditioning, the environmental event that occurs immediately after the relevant behaviour and determines whether or not that behaviour will occur

consolidation the biological process of making a newly formed long-term memory stable and enduring after learning

contemplation stage in the transtheoretical model of behaviour change, when a person thinks about changing their problem behaviour

context dependent cue a prompt for memory retrieval based on environmental factors in the specific situation in which the required memory was originally formed; compare with *state dependent cue*

context-specific effectiveness in relation to coping with stress, when there is a match or 'good fit' between the coping strategy that is used and the stressful situation

continuum a representation of something that varies or changes over time without clear dividing points, such as consciousness and mental health; usually in the form of a scale

continuum of awareness in relation to consciousness, a scale with total awareness and complete lack of awareness at the two extremities, and other states of awareness in between

control condition 1 in an experiment, the standard against which the experimental condition can be compared; involves the control group who are not exposed to the independent variable

control group the group in an experiment who is not exposed to the independent variable; the group undergoes the control condition and results are used for comparison with the experimental group

controlled process information processing that involves conscious, alert awareness and mental effort in which the individual actively focuses their attention on achieving a particular goal; compare with *automatic process*

control process in the Atkinson-Shiffrin multi-store model, an activity that is consciously performed to assist the memory process, such as attention and maintenance rehearsal; compare with *structural feature*

convenience sampling sample selection procedure involving choice of participants who are readily or most easily available; also called *opportunity sampling* and *accidental sampling*

coping in relation to stress management, attempting to manage the demands of a stressor in some effective way

coping flexibility the ability to effectively modify or adjust one's coping strategies according to the demands of the stressful situation

coping strategy a specific method used to manage or reduce the stress produced by a stressor; see also *approach coping strategy* and *avoidance coping strategy*

cortisol a hormone secreted from the adrenal cortex in response to a stressor; energises the body for fight–flight reactions but also has an anti-inflammatory effect and can be an immune system suppressant

counterbalancing systematically changing the order of treatments or tasks for participants in a 'balanced' way to 'counter' the unwanted effects on performance of any one order

counter shock in the General Adaptation Syndrome, rebound from the temporary state of shock following exposure to a stressor during the initial alarm reaction stage

cross-sectional study research method involving selection and comparison of groups of participants on one or more variables of interest at a single point in time

cued recall reproducing information from memory by using a prompt to assist retrieval

cumulative risk the aggregate risk to mental health from the combined effects of exposure to multiple biological, psychological and/or social factors

daily pressure a type of stressor involving a little problem of everyday living that is an irritant; also called *hassle*

data information collected through research; see also *primary data, secondary data, quantitative data* and *qualitative data*

deep sleep period of sleep characterised by slower frequency delta brain waves that are predominant during NREM stages 3 and 4; also called *slow wave sleep*

delayed sleep phase disorder a circadian rhythm phase disorder causing sleepiness, sleep onset and awakening much later than desired; see also *circadian rhythm phase disorder*; compare with *advanced sleep phase disorder*

delta brain wave pattern associated with the deepest stage of sleep and unconsciousness

dendrite thin extension of a neuron that detects and receives information from other neurons and transmits it to the soma

dendritic spine a tiny, knob-like growth on a dendrite that provides a site with receptors where the neuron can receive neurotransmitter from a neighbouring neuron

dependent variable the variable in an experiment the researcher chooses to measure in order to assess the effect(s) of the independent variable(s)

depressant a drug that decreases activity in the central nervous system and the rest of the body; compare with *stimulant*

descriptive statistics used for analysing, organising, summarising and presenting results; compare with *inferential statistics*

disorganised attachment a type of emotional bond between an infant and caregiver characterised by inconsistent or odd and contradictory behaviours by the infant in the presence of the caregiver

distress in relation to stress, a negative psychological response to a stressor; compare with *eustress*

divided attention the ability to distribute attention and undertake two or more activities simultaneously; compare with *selective attention*

dopamine a neurotransmitter in the brain that plays a role in coordinating movement, learning and behaviours that are rewarding; a reduced level in the *substantia nigra* contributes to Parkinson's disease motor symptoms

double blind procedure helps ensure neither the participants nor the researcher interacting with them knows which participants are in an experimental or control group (or condition); compare with *single blind procedure*

drug any substance that can change a person's physical and/or mental functioning; see also *depressant* and *stimulant*

dyssomnia a type of sleep disorder involving difficulty initiating, maintaining and/or timing sleep; see also *sleep-onset insomnia*; compare with *parasomnia*

echoic memory auditory sensory memory for incoming auditory information that stores sounds in their original sensory form for about 3 or 4 seconds

ecological validity the extent to which research findings are able to be generalised to everyday common real-life behaviours and natural settings; see also *external validity*

efferent information motor information leaving the central nervous system; compare with *afferent information*

elaborative rehearsal the process of linking new information in a meaningful way with information already stored in memory or with other new information to aid its storage and future retrieval from long-term memory; compare with *maintenance rehearsal*

electroencephalograph (EEG) a device that detects, amplifies and records general patterns of electrical activity of the brain

electromyograph (EMG) a device that detects, amplifies and records the electrical activity of muscles

electro-oculargraph (EOG) a device that measures eye movements or eye positions by detecting, amplifying and recording electrical activity in eye muscles that control eye movements

emotional wellbeing generally refers to how well we feel about our ability to control our emotions and express them appropriately and comfortably

encoding in relation to memory, conversion of information into a usable form so that it can be neurologically represented and stored in memory

entrainment process of adjusting or resetting a biological rhythm to align with external cues or an environmental cycle

epinephrine see *adrenaline*

episodic memory the long-term explicit memory of personally experienced events

ethics standards that guide individuals to identify good, desirable or acceptable behaviour

ethics committee a group established to assess research proposals for approval purposes, and then monitor the research for adherence to ethical standards

eustress in relation to stress, a positive psychological response to a stressor; compare with *distress*

evidence-based intervention a treatment that has been found to be effective on the basis of valid and reliable research studies

evolutionary theory of sleep a theory on the purpose and function of sleep proposing that sleep evolved to enhance survival by protecting an organism through making it inactive during the part of the day when it is most risky or dangerous to move about; also called *circadian theory*

excitatory effect when a neurotransmitter stimulates or activates a postsynaptic neuron to perform its functions; compare with *inhibitory effect*

exercise physical activity that is usually planned and performed to improve or maintain one's physical condition, and which may also be useful for stress management or as a relaxation technique

exhaustion stage the third stage of the General Adaptation Syndrome when the body can no longer sustain resistance and the effects of a stressor can no longer be dealt with, resulting in the organism becoming weak and more vulnerable to physical and mental disorders

experiment a research method in which a researcher tests whether one variable(s) influences or causes a change to another variable(s) under strictly controlled conditions

experimental condition a condition in an experiment in which participants are exposed to the independent variable to determine whether it influences or causes a predicted response as compared with that of the control condition; involves the experimental group; the term is sometimes used to mean any or all groups or conditions in an experiment, including the control group (or conditions)

experimental group the group in an experiment who is exposed to the independent variable

experimenter effect an unwanted influence on research participant performance and therefore the results produced by a person carrying out the research

experimenter expectancy a type of experimenter effect that occurs when the experimenter provides cues about the response that participants should make; also called *expectancy effect*

explicit memory memory that occurs when information can be consciously or intentionally retrieved and stated; see also *episodic memory* and *semantic memory*; compare with *implicit memory*

external factor an influence that originates outside a person

external validity the extent to which the results obtained for a study can be generalised to the population from which the sample was drawn or to other people in other settings over time; see also ecological validity

extinction in relation to conditioning, the gradual decrease in the strength or rate of a response; in classical conditioning, extinction occurs over time when the unconditioned stimulus is not presented; in operant conditioning, extinction occurs over time when reinforcement ceases

extraneous variable any variable other than the independent variable that can cause a change in the independent variable and therefore affect the validity of the results in an unwanted way; see also *confounding variable*

eye-witness testimony any firsthand account given by an individual of an event they have seen

fear hierarchy a list of feared objects or situations, ranked from least to most anxiety-producing

fight–flight–freeze response an involuntary, physical response to a sudden and immediate threat (or stressor) in readiness for fight (confront), flight (escape) or freeze (be still and silent)

forgetting the inability to access or recover information previously stored in memory

free recall reproducing information from memory in any order, without the assistance of any cue

functioning generally refers to how well an individual independently performs or operates in their environment

gamma-amino butyric acid (GABA) the primary inhibitory neurotransmitter in the central nervous system, making postsynaptic neurons less likely to fire

gamma-amino butyric acid (GABA) dysfunction failure to produce, release or receive the correct amount of GABA needed to regulate neuronal transmission in the brain

General Adaptation Syndrome (GAS) a three-stage physiological response to stress involving alarm reaction (shock/countershock), resistance and exhaustion

generalisation a decision about how widely the findings of a research study can be applied, particularly to other members of the population from which the sample was drawn

genetic vulnerability in relation to mental health or disorder, a biological risk factor for developing a specific mental disorder due to one or more factors associated with genetic inheritance

glutamate the primary excitatory neurotransmitter throughout the brain and enhances information transmission by making postsynaptic neurons more likely to fire; plays crucial roles in the growth and strengthening of synaptic connections during learning and memory formation

Hebb's rule an explanation of changes to synaptic connections between neurons during learning; often summarised as 'neuron's that fire together, wire together'; also see *synaptic plasticity*

hippocampus structure located deep within the brain; involved in formation of long-term explicit memories (including spatial memories) and their transfer to the cortex for storage

hypnogram a 'sleep graph'

hypothalamus brain structure that links the nervous system to the endocrine system; regulates the body's internal environment and influences a range of behaviours

iconic memory visual sensory memory for incoming visual information that stores visual images in their original sensory form for about a third of a second

implicit memory memory that does not require conscious or intentional retrieval; see also *procedural memory* and *classically conditioned memory*; compare with *explicit memory*

independent groups an experimental research design for which each participant is randomly allocated to one of two (or more) entirely separate groups (conditions); also called *between participants*

independent variable variable that is manipulated in order to test its effects on the dependent variable

individual participant differences in relation to an experiment, the unique combination of personal characteristics, abilities and backgrounds each participant brings to the research

induced state in relation to states of consciousness, a state that is intentionally achieved by the use of some kind of aid, such as through meditation, hypnosis or substance use; compare with *naturally occurring state*

inferential statistics used for interpreting and giving meaning to results; compare with *descriptive statistics*

informed consent when participant consent for research involvement is voluntary and based on sufficient information and adequate understanding of both the proposed research and the consequences of participation in it

inhibitory effect when a neurotransmitter blocks or prevents a postsynaptic neuron from firing and therefore performing its functions; compare with *excitatory effect*

insomnia a sleep disorder that typically involves persistent difficulty initiating or maintaining sleep

integrity see *research integrity*

internal factor an influence on behaviour or a mental process that originates inside or within a person

internal validity the extent to which the results obtained for a study are actually due to the variable(s) that was tested or measured and not some other factor

interneuron carries messages between sensory and motor neurons within the central nervous system

interview when a researcher asks questions to obtain self-report data; may be structured, unstructured or semi-structured

jet lag a sleep disorder due to a disturbance to the circadian sleep–wake cycle caused by rapid travel across multiple time zones; shifting to a new time zone in this way results in a mismatch of the circadian biological clock and the external environment; also called *time zone change syndrome*

justice in relation to research ethics, the use of fair procedures and ensuring fair distribution of the costs and benefits of the research

lapse in the transtheoretical model of behaviour change, when there is a slipup with a quick return to the action or maintenance stage; compare with *relapse*

leading question a question that has content or is phrased in such a way as to suggest what answer is desired or to lead to the desired answer

learning a relatively permanent change in behaviour due to experience

life event in relation to stress, a type of stressor in everyday life involving change that forces an individual to adapt to new circumstances

lock-and-key process in relation to chemical neurotransmission, neurotransmitter with a distinctive shape (a 'key') released from a presynaptic neuron must precisely match the shape of the receptor site (a 'lock') on the postsynaptic neuron in order to bind or attach to its receptors and take effect

long-term depression the long-lasting decrease in the strength of synaptic connections and transmission through lack of stimulation of pre- and postsynaptic neurons or prolonged low level stimulation; compare with *long-term potentiation*

long-term memory a memory store that holds a potentially unlimited amount of information for a very long time, possibly permanently; see also *explicit memory* and *implicit memory*

long-term potentiation the long-lasting strengthening of synaptic connections through activity at the synapse, resulting in enhanced or more effective synaptic transmission; compare with *long-term depression*

maintenance rehearsal repetition of information over and over again so that it can be kept in short-term (or working) memory; compare with *elaborative rehearsal*

maintenance stage in the transtheoretical model of behaviour change, when a person has successfully sustained the changed behaviour over a relatively long period of time without relapse

major stressor a type of stressor involving an event that is extraordinarily stressful or disturbing for almost everyone who experiences it

matched participants an experimental research design for which each participant in one condition 'matches' a participant in the other condition(s) on one or more participant variables of relevance; also called *matched groups*

mean the arithmetical average of all the individual scores in a set of scores

measure of central tendency score that indicates the central value of a set of scores

measure of variation a score that indicates how widely scores are distributed or spread around the central point; see also *standard deviation*

melatonin a hormone secreted by the pineal gland in relation to the amount of light that is detected; influences alertness and drowsiness and timing of the sleep–wake cycle; a higher melatonin level is associated with greater drowsiness and vice versa

memory processing, storage and retrieval of information acquired through learning; often described as neurological representation of learning; also see *Atkinson–Shiffrin multi-store model of memory*

memory bias a type of cognitive bias involving distorting influences of present knowledge, beliefs and feelings on the recollection of previous experiences

mental disorder a mental health state that involves a combination of thoughts, feelings and/or behaviours which are usually associated with significant personal distress and impair ability to function effectively in everyday life; commonly used in relation to a clinically diagnosable mental health state with own set of symptoms; also called *mental illness*

mental health a state of wellbeing in which an individual realises his or her own abilities, can cope with the normal stresses of life, can work productively and is able to make a contribution to his or her community (WHO definition)

mental health continuum see *continuum*

mental health problem a mental health concern that interferes with functioning but is usually less severe and of a shorter duration than a *mental disorder*

mentally healthy being in a generally positive state of mental wellbeing, having the ability to cope with and manage life's challenges, working productively, striving to fulfil one's goals and potential, and having a sense of connection to others and the community in general

mental process generally refers to a person's thoughts, feelings and other mental activities that cannot be directly observed; compare with *behaviour*

merit see *research merit*

microsleep a very short period of involuntary sleep that occurs while a person appears to be awake

model a general explanation of a set of observations or findings about behaviour and/or mental processes which seem to be related; also called *theory*. In *observational learning*, who or what is being observed.

modelling see *observational learning*

motor neuron carries messages from the central nervous system to cells in skeletal muscles, organs and glands to stimulate activity

myelin white, fatty substance forming the myelin sheath that surrounds and insulates a neuron's axon

naturalistic observation when the researcher views and records behaviour of interest in the natural, 'real life' environment where it would ordinarily occur

naturally occurring state in relation to states of consciousness, a state that occurs naturally in the course of our everyday activities without the need for any aid; compare with *induced state*

negative punishment the removal or loss of a desirable stimulus thereby weakening or decreasing the likelihood of a response occurring again; see also *response cost*

negative reinforcement the removal of an unpleasant stimulus, thereby strengthening or making a response more likely to occur again

negative reinforcer any unpleasant or aversive stimulus that, when removed or avoided, strengthens or increases the frequency or likelihood of a specific response occurring

neural pathway interconnected neurons that form a communication network within the brain and between the brain and other parts of the nervous system and body; also called a *tract*

neural plasticity the ability of the brain's neural structure or function to be changed by experience

neurodegenerative disease a disorder characterised by a progressive decline in the structure, activity and function of brain tissue

neurohormone a chemical messenger manufactured by a neuron that is released from its axon terminals into the bloodstream (via capillaries) and carried to target neurons or cells; compare with *neurotransmitter*

neuron individual nerve cell that receives, processes and/or transmits information to other cells

neurotransmitter a chemical substance manufactured by a neuron that carries a message to other neurons or cells in muscles, organs or other tissue; compare with *neurohormone*

neutral stimulus in classical conditioning, any object or event that does not normally produce a predictable response; becomes a conditioned stimulus through repeated association with unconditioned stimulus (UCS)

non-standardised research procedures (including instructions) that are not the same for all participants (except for exposure to the independent variable by participants in the experimental group)

normal waking consciousness state of consciousness associated with being awake and aware of objects and events in the external world, and of one's sensations, mental experiences and own existence

NREM sleep non-rapid eye movement sleep conventionally subdivided into four stages involving increasingly deeper sleep and constituting about 75–80% of a typical night's sleep; compare with *REM sleep*

objective not involving personal opinion or interpretation; compare with *subjective*

observational learning when someone uses observation of a model's actions and the consequences of those actions to guide their future actions; involves a sequence of processes called attention, retention, reproduction, motivation and reinforcement; also called *modelling*

observational study collection of data by carefully watching and recording behaviour as it occurs

operant any response (or set of responses) that acts ('operates') on the environment to produce some kind of consequence

operant conditioning a type of learning for which the consequences of a behaviour (e.g reward or punishment) determine the likelihood that it will be performed again in the future; see also *three-phase model of operant conditioning*

operationalising defining independent or dependent variables in terms of the procedures or actions used to measure them

order effect when a participant's response relevant to the dependent variable is influenced by the specific order in which an experimental task, treatment or condition is presented rather than the independent variable; see also *practice effect* and *carry-over effect*

parasomnia a type of sleep disorder characterised by the occurrence of inappropriate physiological and/or psychological activity during sleep or sleep-to-wake transitions; see also *sleep walking*; compare with *dyssomnia*

parasympathetic nervous system a sub-division of the autonomic nervous system that helps to maintain the internal body environment in a steady, balanced state of normal functioning; calms or restores the body to the normal state of functioning after an extreme emotion subsides or an emergency or threat has passed; compare with *sympathetic nervous system*

Parkinson's disease a chronic and degenerative neurological condition that affects both motor and non-motor functions; believed to primarily result from the degeneration and loss of dopamine-producing neurons in the *substantia nigra*

partial sleep deprivation having less sleep (either quantity or quality) than what is normally required

percentage a descriptive statistic that expresses a number as a proportion of 100

perceptual disengagement in relation to sleep, the observation that a sleeper has no awareness of sensory stimuli in their external environment of which they are usually conscious in the waking state

peripheral nervous system entire network of nerves located outside the central nervous system; carries information to and from the central nervous system (via its somatic and autonomic sub-divisions)

perpetuating risk factor in the *4P Factor model*, any characteristic or event that maintains or prolongs occurrence of a specific mental disorder and inhibits recovery

phobia excessive, persistent and unreasonable fear of an object or situation

placebo in research, an inactive substance or fake treatment that is like the independent variable treatment but which has no known effect

placebo effect when there is a change in a participant's behaviour or responses due to their belief that they are receiving some kind of experimental treatment and they respond in accordance with that belief, rather than to the effect of the independent variable

placebo treatment a fake treatment in a research study ('clinical trial') to determine the effectiveness of a new or improved medication or other treatment

poor response to medication having little to no reduction in the number or severity of symptoms despite taking medication as prescribed

population the entire group of research interest from which a sample is drawn

positive punishment presentation of an unpleasant stimulus that weakens a response or decreases the likelihood the response occurring again

positive reinforcement presentation of a positive reinforcer following a desired response, thereby strengthening a response or making it more likely to occur again by providing a pleasant or satisfying consequence

positive reinforcer a stimulus that strengthens or increases the frequency or likelihood of a desired response by providing a satisfying consequence

postsynaptic neuron the neuron which receives neurotransmitter is secreted from a presynaptic neuron during neurotransmission

practice effect a type of order effect involving influence on performance (the dependent variable) that arises from repeating and/or prior experience doing a task; see also *order effect*

precipitating risk factor in the *4P Factor model*, any characteristic or event that increases susceptibility to and contributes to the occurrence of a specific mental disorder

pre-contemplation stage in the transtheoretical model of behaviour change, when a person is not ready to change and has no intention of taking action to change or abandon a problem behaviour in the foreseeable future

predisposing risk factor in the *4P Factor model*, any characteristic or event that increases susceptibility to a specific mental disorder

preparation stage in the transtheoretical model of behaviour change, when a person prepares for the desired behaviour change by formulating intentions and an action plan for change

presynaptic neuron the neuron from which neurotransmitter is secreted and sent to a postsynaptic neuron during neurotransmission

primacy effect the serial position effect of superior recall for items at the beginning of a list

primary appraisal in the transactional model of stress and coping, an evaluation of the significance of a potential stressor and whether anything is at stake in the encounter, resulting in a decision that it is either irrelevant, benign–positive or stressful

primary data information collected directed by the researcher (or through others) for their own purpose; compare with *secondary data*

procedural memory the long-term implicit memory of motor skills and actions that have been learned previously

protective factor in the *4P Factor model*, any characteristic or event that prevents the occurrence or re-occurrence of a mental disorder

psychoeducation the process of increasing an individual's knowledge and understanding of a mental disorder and its treatment

psychological construct a concept that is 'constructed' to describe specific 'psychological' activity, or a pattern of activity, that is believed to occur or exist but cannot be directly observed

punishment the delivery of an unpleasant consequence following a response, or the removal of a pleasant consequence following a response in order to weaken a response or decrease the likelihood of the response occurring again; see also *positive punishment* and *negative punishment*

qualitative data data (information) involving the 'qualities' or characteristics of a participant's experience of what is being studied

quantitative data numerical information on the 'quantity' or amount of what is being studied

questionnaire data collection tool with a written set of questions designed to collect self-report data

random allocation procedure used to place participants in experimental and control groups (or conditions) so that they are as likely to be in one group as the other; ensures uniform distribution of participant characteristics; also called *random assignment*

random sampling sample selection procedure that ensures every member of the population of research interest has a genuinely equal chance of being selected as a participant and thereby helps achieve a *representative sample* (and avoid a *biased sample)*

rating scale data collection tool with fixed-response questions or statements for which participants rank each item by selecting from a number of choices

reasoning goal-directed thinking in which inferences are made or conclusions are drawn from known or assumed facts or pieces of information

recall reproducing information stored in memory; see also *cued recall*, *free recall* and *serial recall*

recency effect the serial position effect of superior recall for items at the end of a list

recognition in relation to memory retrieval, identifying the original, learnt information

reconstruction in relation to memory, combining stored information with other available information to form what is believed to be a more coherent, complete or accurate memory; also called *reconstructive memory*

reflex an unconscious, automatic, involuntary reaction to a stimulus that occurs in the same way each time

rehearsal in relation to memory, the process of consciously manipulating information to keep it in short-term memory, to transfer it to long-term memory or to aid storage and retrieval; see also *elaborative rehearsal* and *maintenance rehearsal*

reinforcement when a stimulus strengthens or increases the frequency or likelihood of a response that it follows; may also refer to the process of administering the stimulus (i.e. the reinforcer) and therefore be used interchangeably with reinforcer; see also *positive reinforcement* and *negative reinforcement*

reinforcer any stimulus that strengthens or increases the frequency or likelihood of a response that it follows; see also *positive reinforcer* and *negative reinforcer*

relapse in the transtheoretical model of behaviour change, occurs when there is a full-blown return to the original problem behaviour; compare with *lapse*

relearning learning information again that has been previously learned and therefore stored in long-term memory; also called *savings*

reliability the extent to which the results obtained from a research study are consistent, dependable and stable; may also be used in relation to a measure used in research

REM rebound following a period of lost REM sleep, spending more time than usual in REM sleep when next asleep

REM sleep rapid-eye movement sleep during which the eyeballs rapidly move beneath closed eyelids; constitutes about 20–25% of a typical night's sleep and is the period in which most dreaming occurs; compare with *NREM sleep*

repeatability in relation to replication of research, the closeness of agreement between independent results obtained with the same method on identical test material, under the same conditions (VCAA definition); compare with *reproducibility*

repeated measures an experimental research design for which each participant is in both the experimental and control groups (and therefore all conditions); also called *within participants*

replication generally refers to the reproducibility and repeatability of a research investigation and its results

representative sample a sample that closely matches the population from which it is drawn in every important participant variable

reproducibility in relation to replication of research, the closeness of agreement between independent results obtained with the same method on identical test material but under different conditions (VCAA definition); compare with *repeatability*

reproduction in observational learning, imitation of behaviour that has been attended to and retained in memory

research hypothesis a testable prediction of the relationship between two or more variables under investigation in a research study

research integrity in relation to research ethics, research committed to honest and proper conduct

research merit in relation to research ethics, research that is worthwhile and conducted appropriately to achieve the aims

resilience the ability to successfully cope with adversity, and to 'bounce back' and restore positive functioning

resistance stage the second stage of the General Adaptation Syndrome, when the body's resistance to the particular stressor develops and rises above its normal levels in order to cope with and adapt to the stressor

respect for human beings in relation to research ethics, when the researcher recognises and takes account of the rights, beliefs, perceptions and cultural backgrounds of all participants

response a reaction by an organism to a stimulus

response cost in relation to negative punishment, when any stimulus valued by an organism is removed, whether or not it causes a response; weakens or decreases the likelihood of a response occurring again

restoration theory of sleep a theory on the purpose and function of sleep proposing that sleep provides 'time out' to help us recover from depleting activities during waking time that use up the body's physical and mental resources

retention in observational learning, the second step in the process involving memory storage of observed behaviour so the behaviour may be reproduced when needed

retrieval in relation to memory, recovery of stored information and bringing it into conscious awareness for use

retrieval cue any stimulus that assists the process of locating and recovering information stored in memory

retrieval method any means used to retrieve information from memory; see also *recall, recognition* and *relearning*

reversibility in relation to sleep, the observation that a sleeper can always be awoken with a strong enough stimulus and therefore 'reverse back' to the waking state quite quickly

risk factor in the *4P Factor model*, increases the likelihood that a mental disorder will develop, or increase in severity or duration when it occurs, or will hinder recovery; compare with *protective factor*

rumination repeatedly thinking about or dwelling on undesirable thoughts and feelings, such as problems or bad moods, without acting to change them

sample a group of research participants selected from a larger group (population) of research interest

sampling process of selecting participants from a population of research interest; see also *convenience sampling, stratified sampling and random sampling*

secondary appraisal in the transactional model of stress and coping, an evaluation of our ability to overcome the situation in which we find ourselves, including coping options and resources that may be available for dealing with the event

secondary data information collected by someone other than the original user who did so for their own purpose; compare with *primary data*

selective attention choosing and attending to a specific stimulus to the exclusion of others; compare with *divided attention*

self-efficacy an individual's belief in their capacity to execute behaviours necessary to succeed in a specific situation or accomplish a specific task

self-fulfilling prophecy when an experimenter obtains results they expect to obtain due to an experimenter expectancy effect

self-report a participant's written or spoken responses to questions, statements or instructions presented by the researcher

self-stigma the stigmatising views that people hold about themselves, such as acceptance and self-application of negative attitudes and beliefs held by others; compare with *social stigma*

semantic memory the long-term explicit memory of facts and knowledge about the world

sensory memory the entry point of memory in which incoming sensori stimuli are retained in their original sensory form for a very brief time; see also *echoic memory* and *iconic memory*

sensory neuron receives and carries sensory information from both the external and internal environments and transmits to the central nervous system

serial position effect a research finding that free recall is better for items at the end and beginning of a list than for items in the middle of the list; see also *primary effect* and *recency effect*

serial recall reproducing information from memory in the order in which it was learned

shock in the General Adaptation Syndrome, the temporary state immediately following exposure to a stressor during the initial alarm reaction stage

short-acting in relation to a drug, remains in the bloodstream and is cleared from the body in a relatively short period of time

short-term memory a memory system with limited storage capacity in which information is stored for a relatively short time, unless renewed in some way; also functions as 'working memory'

single blind procedure helps ensure participants are not aware of the condition of the experiment to which they have been allocated and therefore the experimental treatment (independent variable); compare with *double blind procedure*

sleep a reversible behavioural state of perceptual disengagement from and unresponsiveness to the environment

sleep debt accumulated daily sleep loss that is owed and needs to be made up

sleep deprivation a state caused by inadequate quantity or quality of sleep, either voluntarily or involuntarily

sleep diary a self-report record of an individual's sleep and waking time activities

sleep disorder any sleep disturbance that regularly disrupts sleep, causing distress or impairment in important areas of everyday life during normal waking hours; see also *dyssomnia* and *parasomnia*

sleep disturbance any sleep-related problem that disrupts an individual's normal sleep–wake cycle, including problems with sleep onset, waking from sleep and abnormal behaviour occurring during sleep

sleep hygiene education a providing information about practices that tend to improve and maintain good sleep and full daytime alertness

sleep inertia a sleep-to-wake transition effect characterised by grogginess, low alertness and disorientation that can interfere with behavioural and cognitive functioning

sleep latency the length of time it takes to transition from being awake to being asleep

sleep-onset insomnia a sleep disorder involving persistent difficulty falling asleep at the usual sleep time; see also *dyssomnia*

sleep onset the transition period from being awake to being asleep

sleep paralysis the temporary inability to move and speak during sleep onset or when waking up

sleep–wake cycle shift a change in the timing of the major sleep episode, either through forward or backward movement

sleep walking getting up from bed and walking about or performing other behaviours while asleep; also called *somnambulism*; see also *parasomnia*

slow wave sleep period of sleep characterised by slower frequency delta brain waves that are predominant during NREM stages 3 and 4; also called *deep sleep*

social learning theory emphasises learning as a cognitive process and the importance of the social context in which learning occurs, recognising that learning can occur through observation; see also observational learning

social stigma in relation to mental disorder, the negative attitudes, beliefs and behaviour in the community that motivate people to exclude, reject, avoid, fear and discriminate against people with a mental disorder; compare with *self-stigma*

social support the assistance, care or empathy provided by people to each other

social wellbeing state of wellbeing primarily based on how satisfied we feel about our relationships and interactions with others

somatic nervous system a sub-division of the peripheral nervous system that carries sensory information to the central nervous system and motor information from it

specific phobia an anxiety disorder characterised by marked anxiety or fear about a specific object or situation, often leading to to avoidance behaviour; see also *phobia*

speed and accuracy response or reaction time to a stimulus and the number of correct responses and incorrect responses (errors) made by the individual

spinal cord a long, thin bundle of nerve tissue that extends from the base of the brain to the lower back, connecting the brain and rest of the body via the peripheral nervous system; initiates simple reflex responses independently of the brain; see also *spinal reflex*

spinal reflex an unconscious, involuntary and automatically occurring response to certain stimuli, initiated within the spinal cord and without any involvement of the brain; also called *reflex arc*

spontaneous recovery the reappearance of a conditioned response following a rest period and after its apparent extinction

standard deviation statistic that summarises how far scores within a set of scores spread out from the mean for those scores

standardised instruction in research, when directions and explanations given to all participants in each group (or condition) are identical in terms of what they state and how they are given

standardised procedure in research, when a technique for observing and measuring responses is the same for all participants, except for variations associated with exposure to the independent variable

state dependent cue a prompt for memory retrieval based on an individual's internal physiological and/or psychological state at the time the required memory was formed; compare with *context dependent cue*

state of consciousness level of awareness of objects and events in the external world, and of our sensations, mental experiences and own existence at any given moment; varies along a continuum; see also *altered state of consciousness* and *normal waking consciousness*

stigma a sign of shame, disgrace or disapproval typically associated with a particular characteristic or attribute that sets a person apart, such as a mental disorder; see also *self-stigma* and *social stigma*

stimulant a drug that increases activity in the central nervous system and the rest of the body; compare with *depressant*

stimulus any object or event that elicits (produces) a response from an organism

stimulus control therapy a behavioural therapy for people with insomnia that aims to strengthen the bed and bedroom as cues for sleep, to weaken them as cues for behaviours that are incompatible with sleep, and to establish a regular sleep–wake schedule that is consistent with the circadian sleep–wake cycle

stimulus discrimination the ability to distinguish between two (or more) different stimuli, even if the stimuli are similar

stimulus generalisation the tendency for similar stimuli to produce the same, but not necessarily identical, response

storage capacity in relation to memory, the amount of information that can be retained at any given moment

storage duration in relation to memory, the length of time that information can be retained

storage in relation to memory, retention of encoded information over time

stratified sampling a sampling procedure which involves dividing the population to be sampled into different subgroups, then selecting a separate sample from each subgroup in the same proportions as they occur in the population of interest

stress a state of physiological and psychological arousal produced by internal or external stressors that are perceived by the individual as challenging or exceeding their ability or resources to cope; may be acute, episodic acute or chronic

stressor a stimulus that causes or produces stress and challenges our ability to cope

structural feature in the Atkinson–Shiffrin multi-store model, a permanent, built-in fixed feature of memory that does not vary from one situation to the other; compare with *control process*

subjective involving personal opinion or interpretation; compare with *objective*

substantia nigra structure located within the basal ganglia in the midbrain and containing dopamine-producing neurons

suprachiasmatic nucleus (SCN) an area of the brain's hypothalamus that regulates the timing and activity of the sleep–wake cycle (and other biological rhythms); see also *biological clock*

sympathetic nervous system a subdivision of the autonomic nervous system; activates internal muscles, organs and glands to prepare for vigorous activity or to deal with a stressor, fear stimulus, threat or emergency; compare with *parasympathetic nervous system*

synapse the site of communication between adjacent neurons

synaptic gap the tiny space between the axon terminal of a presynaptic neuron and the dendrite of a postsynaptic neuron; also called *synaptic cleft*

synaptic plasticity the ability of a synapse to change over time through use or disuse; also see *Hebb's rule*

systematic desensitisation a behaviour therapy for treatment of specific phobia that aims to replace an anxiety response with relaxation when an individual encounters a fear-inducing, phobic stimulus

terminal button structure at an axon terminal that stores and secretes neurotransmitter; also called *synaptic knob* or *synaptic button*

theory a general explanation of a set of observations about behaviour and/or mental processes which seem to be related; also called *model*

theta brain wave pattern associated with drowsiness, falling asleep, awakening from sleep, creative activities, excitement and when in a deep meditative state in which there is no awareness of external stimuli

three-phase model of operant conditioning explains operant conditioning as having three parts that occur in a specific sequence: (1) presence of an *antecedent* stimulus that occurs before the behaviour; (2) the *behaviour* that occurs due to the antecedent and (3) the *consequence* to the behaviour

threshold model in relation to cumulative risk and mental disorder, proposes that the risk of developing a mental disorder is far more likely after a certain number of concurrent risk factors and that the risk is in excess of the total of their separate effects

total sleep deprivation not having any sleep at all over a short-term or long-term period

Transactional Model of Stress and Coping proposes that stress involves an encounter between an individual and their environment, and that a stress response depends upon both the appraisal of the stressor and the ability to cope with it

transtheoretical model of behaviour change a stagebased model that describes and explains how people intentionally change their problem behaviour to achieve a health-related goal

ultradian rhythm changes in bodily functions or activities that occur as part of a cycle shorter than 24 hours; compare with *circadian rhythm*

unconditioned response in classical conditioning, the response that occurs automatically when the unconditioned stimulus is presented

unconditioned stimulus in classical conditioning, any stimulus that consistently produces a particular naturally occurring, automatic response (i.e. an unconditioned response)

unconscious response a reaction to a sensory stimulus that does not involve awareness; involuntary, unintentional, automatic and we cannot ordinarily control its occurrence; compare with *conscious response*

unresponsive in relation to sleep, the observation that there is a lack of response by the sleeper to environmental stimuli

validity the extent to which a research study and its procedures accurately measure what it claims to have measured; see also *internal validity* and *external validity*

variability how widely scores within a set of scores are distributed or spread around a central point such as a mean score; see also *standard deviation*

variable something in which individuals, animals or objects differ among themselves, can change in amount or kind, and is measurable

vicarious conditioning in observational learning, when an individual observes a model displaying behaviour that is either reinforced or punished and later behaves in the same way, in a modified way, or refrains from doing so as a result of the observation

vicarious punishment in observational learning, when an individual observes a model displaying behaviour that is punished, which has the effect of reducing the likelihood of the observer performing that behaviour in a modified or identical way

vicarious reinforcement in observational learning, when an individual observes a model displaying behaviour that is reinforced, which has the effect of increasing the likelihood of the observer performing that behaviour in a modified or identical way

wellbeing our sense of 'wellness' or how well we feel about ourselves and our lives; see also *social wellbeing* and *emotional wellbeing*

zeitgeiber an environmental time cue

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