CAMBRIDGE

VCE UNITS
3&4

Cambridge Senior Science

Psychology

Kate **Gallagher**
Natasha **Eshuis**
Andrew **Keating**
Alisha **Muller**
Suresh **Sundram**
Natalie **Zuccon**

INTERACTIVE TEXTBOOK INCLUDED

CAMBRIDGE
UNIVERSITY PRESS

VCE UNITS
3&4

Cambridge Senior Science

Psychology

Kate Gallagher
Natasha Eshuis
Andrew Keating
Alisha Muller
Suresh Sundram
Natalie Zuccon

ISBN 978-1-009-25416-8

CAMBRIDGE
UNIVERSITY PRESS

Shaftesbury Road, Cambridge CB2 8EA, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi – 110025, India

103 Penang Road, #05-06/07, Visioncrest Commercial, Singapore 238467

Cambridge University Press is part of Cambridge University Press & Assessment, a department of the the University of Cambridge.

We share the University's mission to contribute to society through the pursuit of education, learning and research at the highest international levels of excellence.

www.cambridge.org

First published 2022

20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

Cover designed by Loupe Studio
Text designed by Shaun Jury
Typeset by QBS Learning
Printed in China by C&C Offset Printing Co. Ltd.

A catalogue record for this book is available from the National Library of Australia at www.nla.gov.au

ISBN 978-1-009-25416–8 Paperback

Additional resources for this publication at www.cambridge.edu.au/GO

Please be aware that this publication may contain images of Aboriginal and Torres Strait Islander people who are now deceased. Several variations of Aboriginal and Torres Strait Islander terms and spellings may also appear; no disrespect is intended. Please note that the terms 'Indigenous Australians' and 'Aboriginal and Torres Strait Islander peoples' may be used interchangeably in this publication.

Cambridge University Press & Assessment acknowledges the Australian Aboriginal and Torres Strait Islander peoples of this nation. We acknowledge the traditional custodians of the lands on which our company is located and where we conduct our business. We pay our respects to ancestors and Elders, past and present. Cambridge University Press & Assessment is committed to honouring Australian Aboriginal and Torres Strait Islander peoples' unique cultural and spiritual relationships to the land, waters and seas and their rich contribution to society.

About the authors

Kate Gallagher is the lead author of the VCE Psychology team. She has taught VCE Psychology for many years across all three sectors in Victoria, as well as A level Psychology in England. Kate has also been involved in leading VCAA Psychology, as a previous Study Design review panellist, examination specification/sample paper writer and examination assessor. In addition, she has shared her passion for VCE Psychology with teacher candidates as a tutor in the Psychology learning area, at the University of Melbourne Graduate School of Education.

Natasha Eshuis has held Head of Psychology and lead Mathematics roles during her 12-year teaching career across government and independent schools. She has also worked as a therapist for children on the autism spectrum and as a VCAA examiner for Psychology. She has authored and published various VCE Psychology resources. Natasha has experience leading trauma-informed education, positive psychology education and STEM-focused programs. Natasha is an enthusiastic teacher who is passionate about lifelong learning.

Andrew Keating is a co-founder and director of Psyched, the VCE Psychology Teachers' Network. He has held Head of Curriculum and VCE Coordinator positions throughout his career, and is also a published textbook author for VCE Health and Human Development. Andrew has been a VCAA Assistant Chief Assessor and worked on VCAA Study Design Review Panels.

Alisha Muller has been a VCE Psychology teacher for the last 12 years. She has been a VCAA assessor, a presenter for Carter Down Education Services and has written content for other educational publications.

Professor Suresh Sundram is Chair and Head of Department of Psychiatry, School of Clinical Sciences, Monash University, and Director of Research, Mental Health Program, Monash Health. He is a research psychiatrist and neuroscientist and leads the Translational Molecular Psychiatry program at Monash University, focusing on understanding the causes of and developing new treatments for the major mental disorders. He has served as an advisor to the United Nations and numerous national governments on asylum seeker and refugee mental health and has worked with the VCAA on curriculum development in Psychology.

Natalie Zuccon has been a Years 7–12 Science and Maths teacher since 2011, specialising in VCE Psychology. Over the years, she has developed her expertise through VCAA assessing, VCAA Study Design reviews, and resource writing. Most of all, she enjoys sharing her love and enthusiasm for Psychology with her students.

Contents

ISBN 978-1-009-25416-8 Gallagher et al

Answers are available in the Interactive Textbook and the teacher resources.

ISBN 978-1-009-25416-8 Gallagher et al

Overview: How to use this resource

The Cambridge Education Australia and New Zealand website has more information and demos for this title.

This overview guides you through all the components of the **print and PDF textbooks**, the **Interactive Textbook (ITB)**, and the teacher resources in the **Online Teaching Suite (OTS)**. Users of the award-winning *Cambridge Science 7–10 for the Victorian Curriculum* will recognise some similarities with this senior science resource, including the hosting of the digital material on the Edjin platform, which was developed from *Cambridge HOTmaths* and is already being used successfully by thousands of teachers and students across Victoria.

Print book features

Learning objectives

In the Curriculum table at the start of each chapter, the Study Design dot points are translated into Learning objectives, describing what students should be able to do by the end of the chapter:

(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, and operant conditioning as a three-phase process (antecedent, behaviour and consequence)		(before, during and after conditioning) using key terminology (neutral stimulus, unconditioned stimulus, unconditioned response, conditioned stimulus and conditioned response)
	5A.3	Apply my understanding of the three-phase process (before, during and after conditioning) and use key terminology to identify the neutral stimulus, unconditioned stimulus, unconditioned response, conditioned stimulus and conditioned response in real-life examples of classical conditioning

Black text indicates the portion of the dot point covered by the section shown in the second column

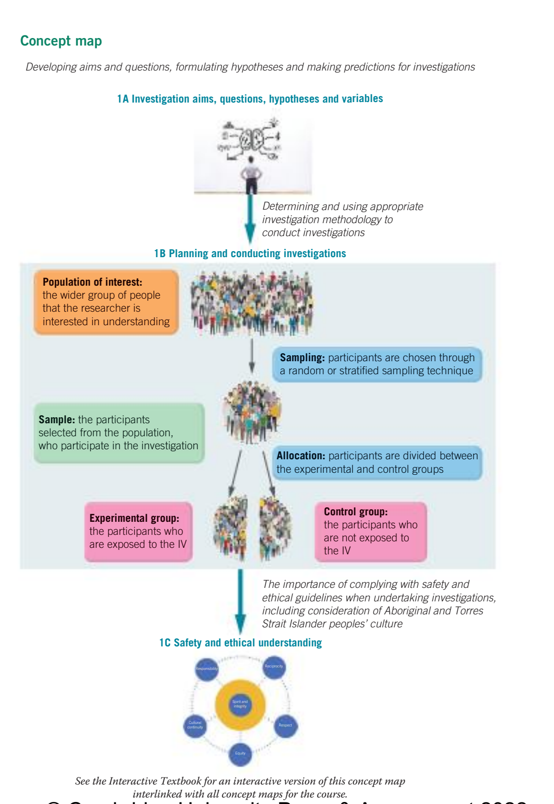
White text indicates the portion of the dot point covered by other sections

Learning objectives are turned into Success Criteria (achievement standards) at the end of the chapter and are assessed in the Chapter review and tracked in the Checklists

Relevant Study Design dot points are repeated at the start of each section in the chapter, and an overall curriculum grid is provided in the teacher resources.

Concept maps

Concept maps display each chapter's structure with annotations emphasising interconnectedness, providing a great memory aid. The versions in the ITB are hyperlinked and offer an alternative way of navigating through the course. An overall concept map of Units 3&4 is also provided after this overview.



Links

The interconnectedness of topics in Psychology is demonstrated through links between sections, displayed in the margins. In the ITB, these are hyperlinks that provide an alternative way of navigating through the course.

Fight or flight responses

In fight or flight responses, you experience similar physiological responses, such as increased heart rate, sweaty palms and dilated pupils as a part of an acute stress response. This is because the fight or flight response is activated by the sympathetic subdivision of the autonomic nervous system. As was discussed in Chapter 3, the autonomic nervous system works unconsciously, without our awareness, to regulate our arousal and internal bodily functions. In the case of a fight or flight response, our arousal is increased because a

LINK 3A THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS

Chapter sections

Chapters are divided into numbered sections each with a consistent set of features.

Study Design coverage for section

Glossary terms in the section

5B

Operant conditioning

Study Design:
Behaviourist approaches to learning, as illustrated by 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

Glossary:
Antecedent
Behaviour
Consequence
Negative punishment
Negative reinforcement
Operant conditioning

Engage

At the start of each section, these boxes provide points of interest for the topic emphasising its place in Psychology. This material, though not assessable, can be used as examples of applications.

ENGAGE

Using faecal transplants to treat mental illness

Our nervous system and gut are connected in a complex way that researchers are still trying to fully understand. As a result, many people who struggle for years with mental health issues are willing to try experimental treatments such as a transplant of faeces from a healthy person into their own gut.

Kerwin, a 45-year-old industrial engineer who lives in Peru, tried many medications for his depression and anxiety, with little success. As a result, he sank into a deep

Explain

This icon marks the start of essential content that is assessed.

Glossary

Scientific terms are highlighted in the text, definitions are given in the margin of the print and PDF textbooks, or on mouseover in the ITB, and the terms are listed at the start of each chapter and section.

EXPLAIN

Stressors and the stress response

Stressor
any event that causes stress or is perceived as a threat and a challenge to our ability to cope

We experience many events that can be stressful. These range from minor irritating events, such as being stuck in a traffic jam or having a lot of homework, through to challenging, life-changing events such as a significant injury or losing your home in a bushfire. Stressful events can also be positive, such as being offered entry into two equally exciting university courses. Any event that causes stress is referred to as a **stressor**.

Glossary definitions

Terms in the glossary

Check-in questions

Each section in the chapter has one or more sets of check-in questions, for formative assessment. Full answers are provided in the digital resources.

Check-in questions – Set 1

1 Describe the difference between a sample and a population.
2 What is the most important requirement when using a random sampling technique?
3 How is a sample chosen by the stratified sampling technique?

Skills

Skills boxes in every section provide advice and guidance on how to answer and prepare for questions, especially in examinations. The ITB has video versions of these which provide extra comments and an alternative medium of delivery. In the VCE Psychology textbooks there are also Key Science Skills boxes, shown on p.ix.

1B–1 SKILLS

Identifying populations and samples

When asked to identify the population from a research scenario, think about who the researcher is interested in applying the results to. Often the population can be found in the aim of a study. The population is rarely 'all people in the world'.

A description of the population would typically not include the number of people, just the broad characteristics that make them similar. When describing the sample, specific details such as the number of participants, where they were selected from, and any other common characteristics should be included, such as age or sex.

Charts, diagrams and tables

Detailed charts integrating text and diagrams, and illustrated tables, feature throughout the print books. In the ITB, most of these are available as animated slide-show presentations for students to use, with copies for teachers to display on data projector or whiteboard.

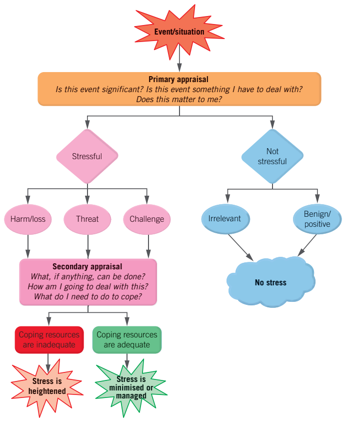


Figure 4D–2 The two forms of appraisal that occur within the transactional model of stress and coping: primary and secondary

However, several criticisms have also been made of the model. These mostly centre on the individual and subjective nature of stress as a psychological process. Given that a person's perception of a 'stressful experience' can vary significantly, it can make it difficult to design experiments or stress management interventions that would apply to larger groups or populations. Similarly to Selye's GAS model, it also does not account for any external factors that may influence a person's stress response, such as race, socio-economic status or education.

Table 7D–2 *(Continued)*

Stage of life span and age	Total recommended hours of sleep and typical proportion of REM and NREM	Explanations for sleep patterns
Adolescent 14–17 years	8–10 hours REM 20% NREM 80%	Adolescents experience a delay in the circadian rhythm because of a hormonally determined shift in melatonin release to 1–2 hours later than other age groups. This can cause a preference for a later bedtime, resulting in fewer hours of sleep than needed because of early waking for school. In this age group, increasing school-related requirements, increasing independence and easy access to constant entertainment and social networks also contribute to delayed bedtime. LINK 8B CIRCADIAN RHYTHM SLEEP DISORDERS
Young adult 18–25 years	7–9 hours REM 20% NREM 80%	Sleep patterns in young adults can alter because of psychosocial factors such as tertiary study, work requirements, social schedules and increased independence. A circadian phase advance begins towards the end of this stage, resulting in a preference for earlier sleep time. Melatonin concentrations also begin to decline after puberty. LINK 7C INTERNAL BIOLOGICAL MECHANISMS THAT REGULATE SLEEP–WAKE PATTERNS
Adult 26–64 years	7–9 hours REM 20% NREM 80%	Adult sleep patterns can alter as a result of lifestyle changes such as caring for infants and children, changing work and social requirements, development of health problems and changing family dynamics like balancing work with parenthood. Later in this stage, N3 sleep begins to decline and is replaced by N2 sleep. Melatonin concentrations continue to decline over adulthood.
Older adult ≥65 years	7–8 hours REM 18–20% NREM 80–82%	Sleep patterns in older adults can alter because of lifestyle changes such as retirement, increased health issues including sleep disorders, physical inactivity, decreased social interactions, increased medication use, change of living arrangements and bereavement. A circadian phase advance occurs, and less sleep may be achieved if a person resists the body's preference for an earlier bedtime and earlier awakening. Amount of N3 sleep continues to decline and may not occur at all, replaced with N2 sleep. During older adulthood there is an increase in sleep latency (the time taken to fall asleep) and multiple awakenings occur. Melatonin concentrations continue to decline. The shorter total sleep in this stage may be due to the impaired ability to obtain sleep, rather than a reduced need for sleep.

Section questions

Summative assessment is provided at the end of each section, again with full answers provided in the digital resources.

Section 4A questions

1 Explain how a stressor and stress are related.

2 A student is nervous about presenting at the next school assembly and speaking in front of their peers. Using examples, explain why the stress response to this event would be a psychobiological one.

Chapter reviews

Summaries: Students are encouraged to make their own set of summary notes, to help them assimilate the material. Model summaries are provided in the teacher resources, to be given to those who need help. Creating summaries can also be turned into an assessment task, with the models serving as the answer.

Checklists and **Success criteria:** The learning objectives from the front of the chapter are listed again in the form of success criteria linked to the **multiple-choice** and **short-answer questions** that follow. The checklists are printable from the ITB, and students can tick off their achievement manually. If they do the questions in the ITB, they are ticked automatically when the multiple-choice questions are marked and the short-answer questions are self-assessed as correct.

Chapter 1 review

Summary

Create your own set of summary notes for this chapter on paper or in a digital document. A model summary is provided in the Teacher Resources, which can be used to compare with yours.

Checklist

In the Interactive Textbook, the success criteria are linked from the review questions and will be automatically ticked when answers are correct. Alternatively, print or photocopy this page and tick the boxes when you have answered the corresponding questions correctly.

Success criteria – I am now able to:		Linked questions
1A.1	Identify and research aims and questions for investigation	1☐
1A.2	Construct aims and questions for investigation	10a☐

Multiple-choice questions

The following information relates to Questions 1 and 2.

Elizabeth Loftus is a researcher who conducted many studies on how eyewitness testimonies can be influenced by leading questions – questions that influence a person to give a desired answer. Leading questions can propose incorrect information that is then incorporated into the original memory.

1 Which of the following is a possible research question or aims for one of Loftus's studies?

A Leading questions will lead to inaccurate eyewitness testimonies.

B Can eyewitness testimonies be influenced by leading questions?

C To investigate whether eyewitness testimonies can be influenced by leading questions.

Short-answer questions

10 Akeno works in an after-school care centre and is trying to get the children to wash their hands properly to help prevent the spread of illness. He has heard that it is recommended that people spend 20 seconds to wash their hands thoroughly enough to remove germs. Akeno decides to trial getting the children to sing the song 'Twinkle Twinkle Little Star' while washing their hands, to ensure they are washing for long enough to be effective. When each student in the centre arrives at the sink to wash their hands, Akeno flips a coin. If he flips 'Heads', he asks the child to sing the song while washing. If he flips 'Tails', he does not tell them to sing a song. Akeno times how long each child spends washing their hands over the afternoon.

a Write an aim for this study. (1 mark)

b One child does not know all the words to 'Twinkle Twinkle Little Star' and only sings half the song while washing their hands. Identify this type of variable and explain its effect.

Unit revision exercises

Each Unit has a revision exercise in the print book, with both multiple-choice and short-answer questions.

ISBN 978-1-009-25416-8 Gallagher et al

Special content

- The Study Design's requirement to cover Aboriginal and Torres Strait Islander peoples' knowledge, cultures and history is provided by topics within chapter sections as well as in the digital resources. See the overview on page xi.

Figure 9A–10 A model of social and emotional wellbeing for Aboriginal and Torres Strait Islander peoples. *Source: National Strategic Framework for Aboriginal and Torres Strait Islander Peoples' Mental Health and Social and Emotional Wellbeing 2017–2023* © Commonwealth of Australia 2017.

- **Key Science Skills** are given prominence in this resource through two chapters on science skills, and the integration of questions and activities in all chapters applying science skills. In addition the digital resources include guidance on logbooks and investigations in Psychology.

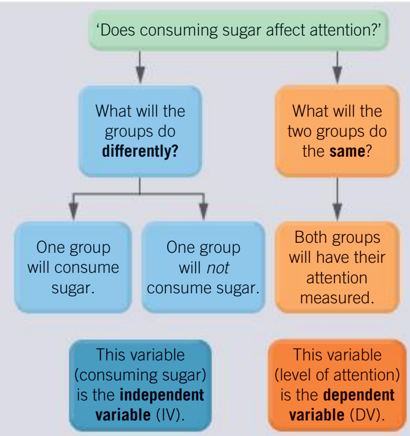


Figure 1A–5 You can identify the variables by thinking about what the groups of participants will do the same and what they will do differently.

Key Science Skills

- Identify, research and construct aims and questions for investigation
- Identify independent, dependent and controlled variables in controlled experiments
- Formulate hypotheses to focus investigations
- Predict possible outcomes of investigations
- Design and conduct investigations; select and use methods appropriate to the investigation, including consideration of sampling technique (random and stratified) and size, equipment and procedures, taking into account potential sources of error and uncertainty; determine the type and amount of qualitative and/or quantitative data to be generated or collated

7D KEY SCIENCE SKILLS

Analysing data qualitatively
Data collected from an investigation needs to be analysed in terms of its quality before any decisions can be made based on the data and the investigation concluded. Data can be analysed for accuracy, precision, repeatability, reproducibility, true value, validity, errors, certainty, outliers and contradictory or incomplete data.

LINK

- Activities are included throughout, with supporting documents in the digital resources where required.

ACTIVITY 4E–1 EXERCISE AND ME

For many reasons, exercise is an effective coping strategy. Exercising releases built-up tension and increases the flow of endorphins or 'feel-good' hormones in the body. Think back over the past week and make a note of each time you exercised. Then go to the Australian Department of Health webpage 'Physical activity and exercise guidelines for all Australians' at the following link: http://cambridge.edu.au/redirect/9727.

ISBN 978-1-009-25416-8 Gallagher et al

Interactive Textbook features

The digital version of the textbook is hosted on the Edjin platform, offering easy navigation, excellent on-screen display and multimedia assets, as well as auto-marking of multiple-choice questions, and workspaces for other questions with self-assessment and confidence rating tools. The different kinds of digital assets are listed below:

- Printable **Worksheets** with extra questions and activities (and content in some cases) are provided for most chapters, marked by an icon in the margin, as shown on the right.
- **Videos** are provided for all chapters, and are of two kinds: **concept videos** demonstrate or illustrate important theory, while **skills and example videos** work through the textbook's skills and example boxes, providing extra explanation and guidance. Some videos are provided in the print pages as QR codes for immediate access and review.
- **Animated slide-show presentations** (in PowerPoint Show format) are provided of many charts, diagrams and tables, as marked by an icon in the margin as shown at right, enabling them to be explored interactively.
- **Answers** (suggested responses) to questions are provided as printable documents in the teacher resources and, if enabled by the teacher, below the question workspaces for short-answer questions in the ITB.

WORKSHEET 1B–1
COMPARING INVESTIGATION METHODOLOGIES

VIDEO 4E–1
COPING WITH STRESS

Online Teaching Suite features (teacher resources)

The OTS provides Edjin's learning management system, which allows teachers to set tasks, track progress and scores, prepare reports on individuals and the class, and give students feedback. The assets include:

- **Curriculum Grid** and **teaching programs**
- Editable and printable **Chapter tests** with answers
- **Checklists** with linkage to the success criteria for the chapter question sets and tests
- A **question bank** and test generator, with answers
- **Practice exams** and **assessment tasks**, with answers
- Editable versions of **Worksheets** in the Interactive Textbook, and answers to them
- Editable versions of the PowerPoint files in the Interactive Textbook
- Downloadable, editable and printable **practical activities**
- Editable and printable chapter **summaries** (model answers for the chapter summary activity)
- **Teacher notes** on selected content with additional theory explanation and suggestions for further activities and resources
- **Curated links** to internet resources such as videos and interactives.

Exam generator

The Online Teaching Suite includes a comprehensive bank of exam style and actual VCAA exam questions to create custom trial exams to target topics that students are having difficulty with. Features include:

- Filtering by question-type, topic and degree of difficulty
- Answers provided to teachers
- VCAA marking scheme
- Multiple-choice questions that will be auto-marked if completed online
- Tests that can be downloaded and used in class or for revision.

ISBN 978-1-009-25416-8 Gallagher et al

Overview: Aboriginal and Torres Strait Islander knowledge, cultures and history

The VCE Psychology Study Design includes aspects of Aboriginal and Torres Strait Islander knowledge, cultures and history. This overview is a guide to where they are covered in this resource.

Aboriginal and Torres Strait Islander peoples' world views are highly integrated: each aspect of culture, history and society connects with all other aspects. Each community has their own personalised system of thinking, doing and knowing based on sharing culture and adapting to the environment around them.

In order to gain an understanding of any system, Indigenous or not, time and effort is needed to appreciate it. That time is limited in this course; and it is wrong to try and generalise the Indigenous culture of Australia, or even of Victoria. Instead, the coverage in the resource should be taken as a collection of examples, and students should read up on or engage with their local Indigenous community to understand their cultural aspects.

This textbook includes Aboriginal and Torres Strait Islander knowledge, cultures and history in these sections:

- 5D Aboriginal and Torres Strait Islander ways of knowing
- 6D Mnemonic devices to increase encoding, storage and retrieval
- 9D Cultural determinants of mental wellbeing

In addition, for students, the Interactive Textbook includes an introductory guide prepared by First Nations consultants advising on approaches to studying Aboriginal and Torres Strait Islander knowledge, cultures and history, with links to further reading.

For teachers, the teacher resources include a guide to approaches to teaching Aboriginal and Torres Strait Islander knowledge, cultures and history in the VCE Psychology course, with links to internet resources.

Guide to terms used in this resource

Language is very important in discussing Indigenous issues, especially given the past history of deliberately offensive usage in Australia, where language was used to oppress and control.

Indigenous
First Australians and First Peoples of any country

Respectful usage requires a capital I.

First Australians, First Nations or First Peoples
Indigenous people of Australia

These terms have become more common in recent years, with 'Indigenous' as the adjective.

Aboriginal
an Aboriginal person is someone who is of Aboriginal descent, identifies as being Aboriginal and is accepted as such by the Aboriginal community with which they originally identified

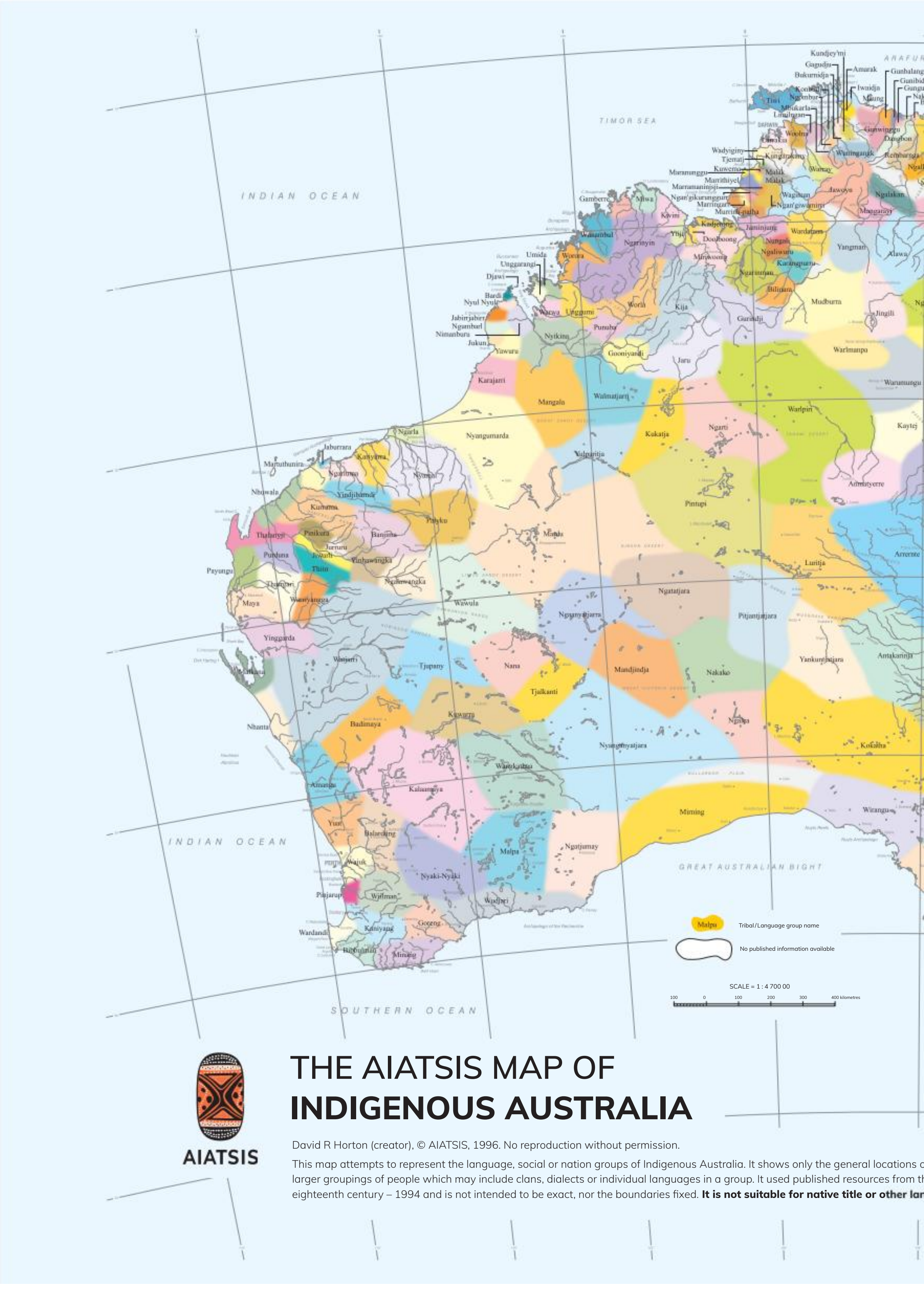
One of the reasons that 'First Nations' and allied forms have become more common is that the term 'Aboriginal' was sometimes used disrespectfully, and still is in some circles.

Aboriginal and Torres Strait Islander peoples
the Australian Indigenous population includes Aboriginal People, Torres Strait Islander People, and people who have both Aboriginal and Torres Strait Islander heritage. The term 'Aboriginal and Torres Strait Islander' encompasses all three

While this is still used in official circles and is in the name or title of many organisations and documents, it is tending to be replaced by 'First Australians' and similar terms, especially in everyday use. This is partly because the abbreviation 'ATSI' is considered disrespectful by Indigenous people, who regard it as lazy not to use a full title. The abbreviation should not be used to refer to people.

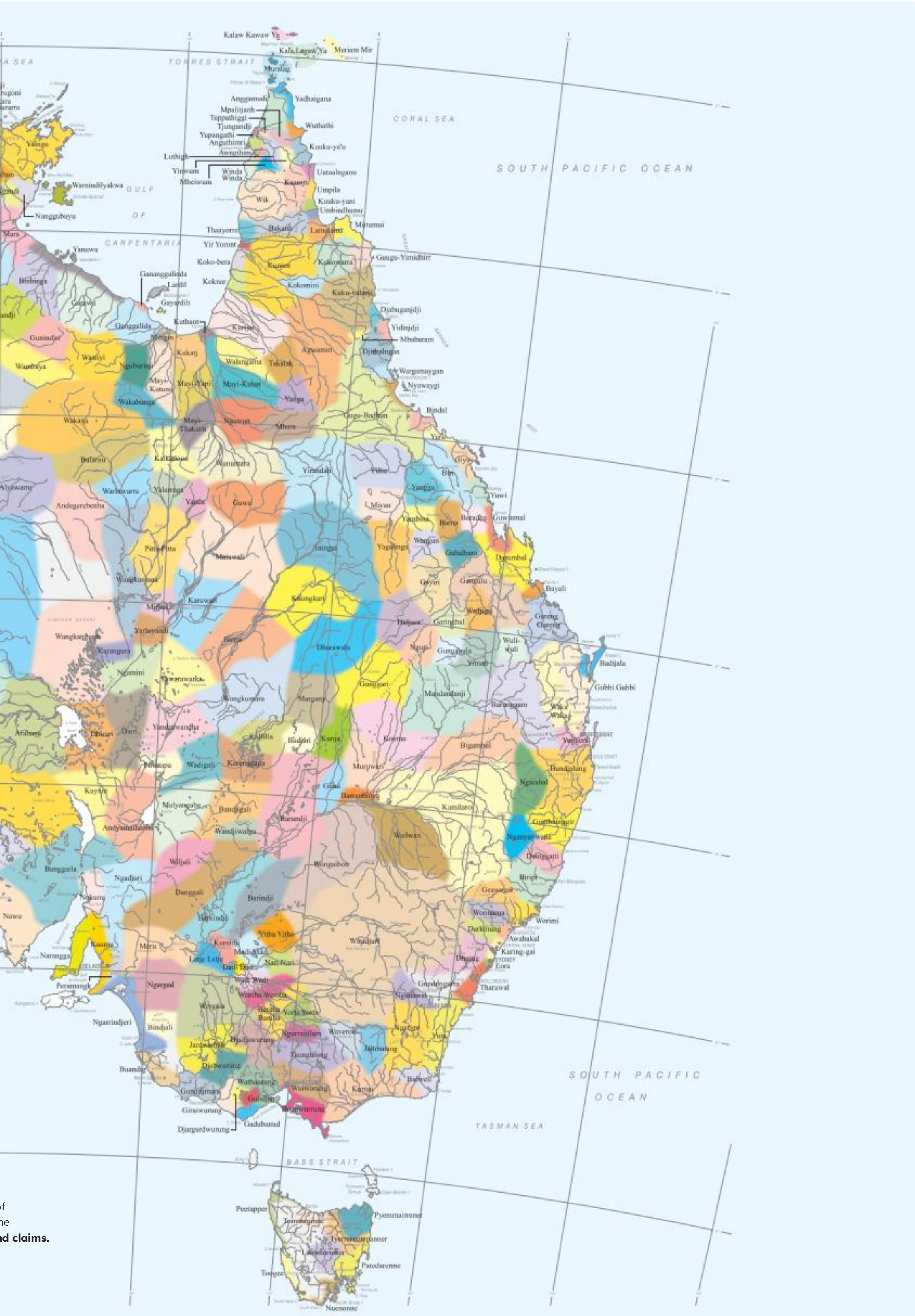
Cambridge University Press & Assessment acknowledges the Australian Aboriginal and Torres Strait Islander peoples of this nation. We acknowledge the traditional custodians of the lands on which our company is located and where we conduct our business. We pay our respects to ancestors and Elders, past and present.

Map of Indigenous peoples of Australia



AIATSIS Map of Indigenous Australia, showing the general locations of larger language, social or nation groups. To zoom in on detail especially in Victoria, access the map in the Interactive Textbook.

ISBN 978-1-009-25416-8 Gallagher et al



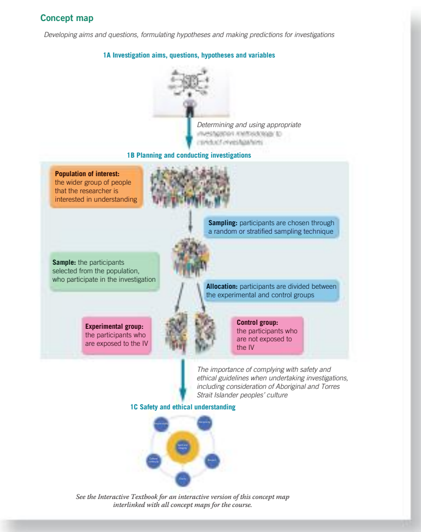
This map attempts to represent the language, social or nation groups of Aboriginal Australia. It shows only the general locations of larger groupings of people which may include clans, dialects or individual languages in a group. It used published resources from the eighteenth century-1994 and is not intended to be exact, nor the boundaries fixed. It is not suitable for native title or other land claims. David R Horton (creator), © AIATSIS, 1996. No reproduction without permission. To purchase a print version visit: https://shop.aiatsis.gov.au/

ISBN 978-1-009-25416-8

Concept maps for Units 3&4

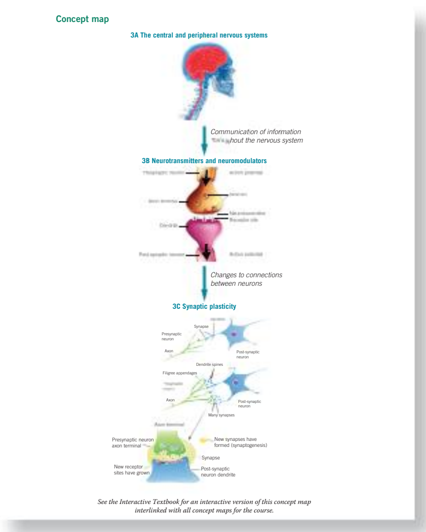
These pages display the concept maps for Chapters 1–10. Access the digital versions in the ITB to click on hyperlinks to explore the interconnections of the topics.

Chapter 1 Scientific investigation, planning, ethics and safety

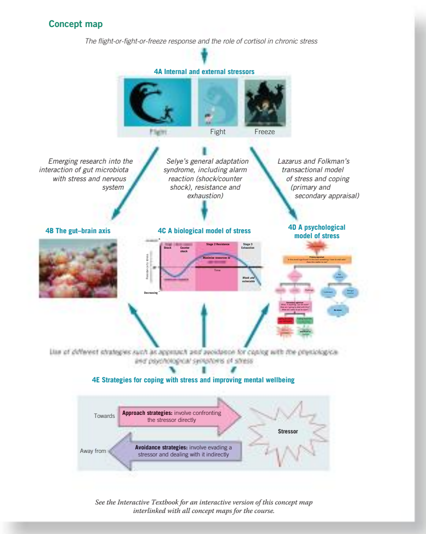


Chapter 2 Recording and analysing data, drawing and communicating conclusions

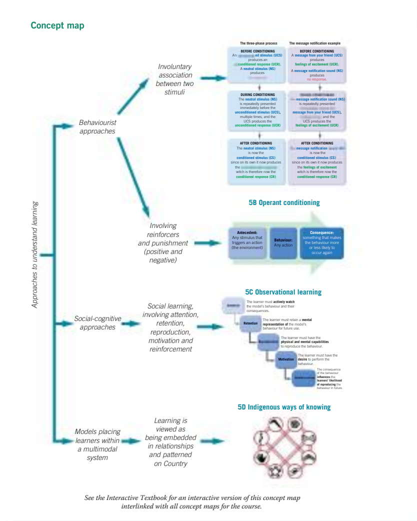
Chapter 3 Nervous system functioning



Chapter 4 Stress as an example of a psychobiological process

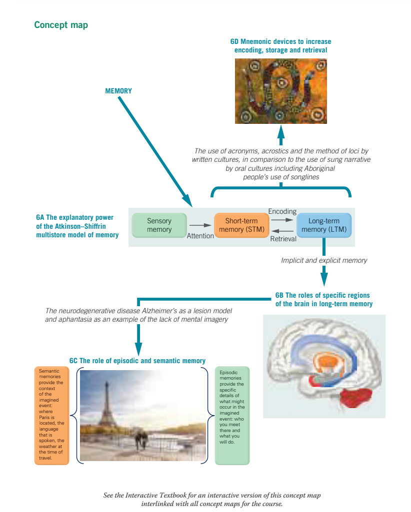


Chapter 5 Approaches to understand Learning

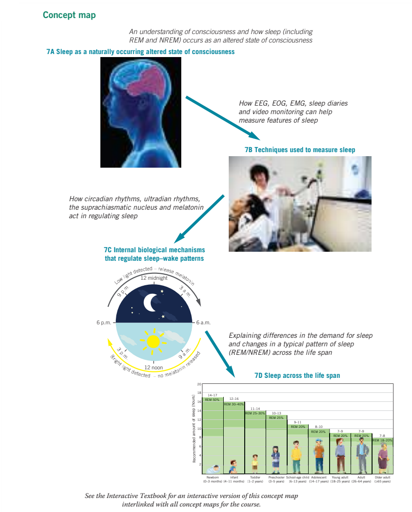


ISBN 978-1-009-25416-8 Gallagher et al

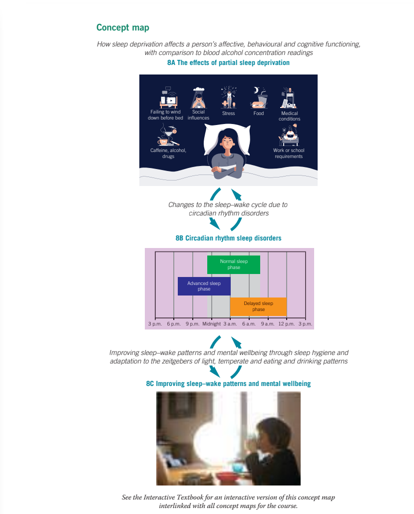
Chapter 6 The psychobiological process of memory



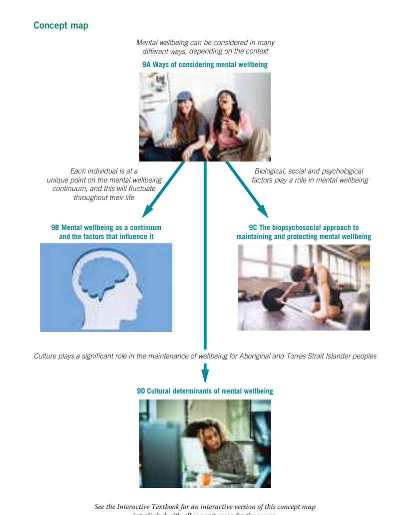
Chapter 7 The demand for sleep



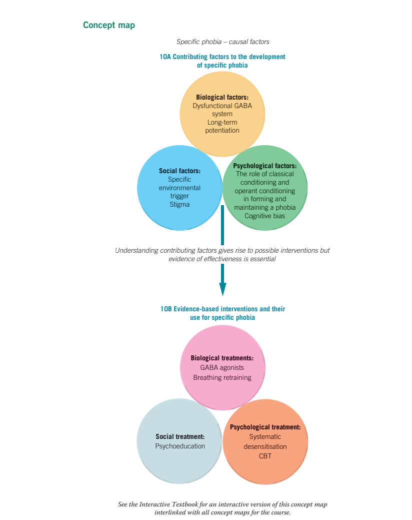
Chapter 8 Importance of sleep to mental wellbeing



Chapter 9 Mental wellbeing



Chapter 10 Specific phobia



KEY SCIENCE SKILLS

CHAPTER 1 SCIENTIFIC INVESTIGATION, PLANNING, ETHICS AND SAFETY

Introduction

How do we know that the left half of our brain controls the right side of our body? How do we know that the memories of eyewitnesses can be unreliable? How do we know that our sense of taste can be influenced by what we see? In psychology, we learn about the behaviour and mental processes of humans by conducting scientific research.

It is important to distinguish between scientific ideas, such as proposed by these questions, and non-scientific ideas, such as horoscopes or palm reading. The key difference is that scientific ideas are formed by using the scientific method. They are observable and testable. In this chapter, we begin to cover the key science skills that are required for conducting scientific investigations in psychology and evaluating the research of other investigators. This includes important safety and ethical considerations, including in respect to research with Aboriginal and Torres Strait Islander peoples, with additional digital resources provided. Further key science skills are covered in Chapter 2.

Curriculum

Key Science Skills

Study Design	Learning objectives – at the end of this chapter I will be able to:
Develop aims and questions, formulate hypotheses and make predictions • Identify, research and construct aims and questions for investigation	**1A Investigation aims, questions, hypotheses and variables** **1A.1** Identify and research aims and questions for investigation **1A.2** Construct aims and questions for investigation
• Identify independent, dependent and controlled variables in controlled experiments	**1A.3** Distinguish between independent, dependent, controlled, extraneous and confounding variables **1A.4** Identify the independent, dependent and controlled variables within controlled experiments **1A.5** Identify extraneous variables to be controlled in a controlled experiment **1A.6** Explain the effect of extraneous and confounding variables on the results of a controlled experiment
• Formulate hypotheses to focus investigations	**1A.7** Write a hypothesis to focus an investigation
• Predict possible outcomes of investigations	**1A.8** Predict the possible outcomes of an investigation

ISBN 978-1-009-25416-8 Gallagher et al

Study Design	Learning objectives – at the end of this chapter I will be able to:
Plan and conduct investigations • Determine appropriate investigation methodology: case study; classification and identification; controlled experiment (within subjects, between subjects, mixed design); correlational study; fieldwork; literature review; modelling; product, process or system development; simulation	**1B Planning and conducting investigations** **1B.1** Describe and identify examples of the use of different investigation methodologies, including case study; classification and identification; controlled experiment; correlational study; fieldwork; literature review; modelling; product, process or system development; and simulation **1B.2** Describe and identify the use of within subjects, between subjects and mixed designs in a controlled experiment **1B.3** Evaluate strengths and limitations of different investigation methodologies and select an appropriate investigation methodology for a proposed investigation **1B.4** Evaluate strengths and limitations of different investigation designs for a controlled experiment and select an appropriate design for a proposed investigation
• Design and conduct investigations; select and use methods appropriate to the investigation, including consideration of sampling technique (random and stratified) and size to achieve representativeness, and consideration of equipment and procedures, taking into account potential sources of error and uncertainty; determine the type and amount of qualitative and/or quantitative data to be generated or collated	**1B.5** Describe and identify the use of random and stratified sampling techniques in an investigation **1B.6** Evaluate strengths and limitations of different sampling techniques and select an appropriate technique to achieve representativeness **1B.7** Select and use appropriate equipment and procedures for an investigation, and select an appropriate sample size to achieve representativeness
• Work independently and collaboratively as appropriate and within identified research constraints, adapting or extending processes as required and recording such modifications	**1B.8** Work independently and collaboratively within constraints, adapting or extending processes as required and recording modifications
Comply with safety and ethical guidelines • Demonstrate ethical conduct and apply ethical guidelines when undertaking and reporting investigations	**1C Safety and ethical understanding** **1C.1** Describe and evaluate the use of general ethical concepts to be followed in psychological investigations, including integrity, justice, beneficence, non-maleficence and respect **1C.2** Describe and evaluate the use of the additional ethical guidelines to be followed in psychological investigations, including confidentiality, voluntary participation, informed consent procedures, withdrawal rights, use of deception and debriefing

ISBN 978-1-009-25416-8 Gallagher et al

Study Design	Learning objectives – at the end of this chapter I will be able to:
	1C.3 Consider the ethical implications of investigations when planning an investigation and demonstrate ethical conduct and apply ethical guidelines when recording data, using data and reporting outcomes of investigations
• Demonstrate safe laboratory practices when planning and conducting investigations by using risk assessments that are informed by safety data sheets (SDS), and accounting for risks	**1C.4** Demonstrate safe laboratory practices by identifying areas of risk and using risk assessments that are informed by safety data sheets when planning and conducting investigations
• Apply relevant occupational health and safety guidelines while undertaking practical investigations	**1C.5** Evaluate the use of and apply relevant occupational health and safety guidelines while planning and undertaking practical investigations
• Analyse and evaluate psychological issues using relevant ethical concepts and guidelines including the influence of social, economic, legal and political factors relevant to the selected issue	**1C.6** Analyse and evaluate psychological issues with reference to the influence of relevant social, economic, legal and political factors **1C.7** Analyse and evaluate psychological issues using ethical concepts of integrity, justice, beneficence, non-maleficence and respect

Glossary

Allocation
Beneficence
Between subjects design
Case study
Classification and identification
Confidentiality
Confounding variable
Control group
Controlled experiment
Controlled variable
Correlational study
Debriefing
Deception in research
Dependent variable
Ethical concepts
Ethical guidelines
Experimental group
Extraneous variable
Fieldwork
Hypothesis
Independent variable
Informed consent procedures
Integrity
Investigation aim
Investigation design
Investigation methodology
Investigation question
Justice
Literature review
Mixed design
Modelling
Non-maleficence
Occupational health and safety (OHS)
Population
Primary data
Product, process and system development
Random allocation
Random sampling
Respect
Risk assessment
Safety data sheet (SDS)
Sample
Sampling technique
Secondary data
Simulation
Stratified sampling
Voluntary participation
Withdrawal rights
Within subjects design

Concept map

Developing aims and questions, formulating hypotheses and making predictions for investigations

1A Investigation aims, questions, hypotheses and variables

Determining and using appropriate investigation methodology to conduct investigations

1B Planning and conducting investigations

Population of interest: the wider group of people that the researcher is interested in understanding

Sampling: participants are chosen through a random or stratified sampling technique

Sample: the participants selected from the population, who participate in the investigation

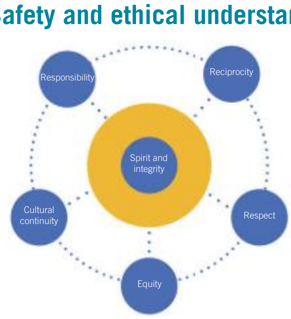
Allocation: participants are divided between the experimental and control groups

Experimental group: the participants who are exposed to the IV

Control group: the participants who are not exposed to the IV

The importance of complying with safety and ethical guidelines when undertaking investigations, including consideration of Aboriginal and Torres Strait Islander peoples' culture

1C Safety and ethical understanding



See the Interactive Textbook for an interactive version of this concept map interlinked with all concept maps for the course.

ISBN 978-1-009-25416-8 Gallagher et al

1A Investigation aims, questions, hypotheses and variables

Study Design:
Develop aims and questions, formulate hypotheses and make predictions

- Identify, research and construct aims and questions for investigation
- Identify independent, dependent and controlled variables in controlled experiments
- Formulate hypotheses to focus investigations
- Predict possible outcomes of investigations

Glossary:
Confounding variable
Controlled experiment
Controlled variable
Dependent variable
Extraneous variable
Hypothesis
Independent variable
Investigation aim
Investigation question

ENGAGE

What does a research psychologist do?

There are many different areas of psychology, including clinical, counselling, forensic, health, educational and sport psychology. Instead of solely practising in one of these fields, many psychologists conduct research in their field of interest or combine research with practice. Research psychologists work in universities or organisations to conduct their studies. Here is a personal account of what a research psychologist's job can look like in the field of neuropsychology.

Figure 1A–1 Research is conducted in all areas of psychology to help us understand more about every aspect of the human experience.

Working in research psychology

By Jason Mattingley

Australian Psychological Society

Most research psychologists spend long hours devising experiments, gathering data, analysing the evidence and preparing their findings for the scientific community in the form of articles and conference presentations. In a typical day, I might plan and conduct research projects with other members of the laboratory group, analyse new data, write articles for scholarly publications, and provide anonymous reviews of manuscripts submitted by other researchers. Other tasks include: lecturing to undergraduate psychology students; supervising research projects and providing career advice; managing budgets for the laboratory's research grants; preparing applications for research funding; and reviewing grant applications.

Understanding the way the brain represents different aspects of our perceptual world has helped us to devise more effective ways of managing and rehabilitating people

ISBN 978-1-009-25416-8 Gallagher et al

with neurological disabilities, such as stroke and Alzheimer's disease. Revealing the brain bases of emotion processing may also help us to better understand some of the symptoms of psychiatric conditions such as schizophrenia and post-traumatic stress disorder.

Source: Australian Psychological Society

Figure 1A–2 Understanding the way the brain works is a significant part of research in psychology.

EXPLAIN

Investigation aims and questions

Psychology is considered to be a science because it follows a scientific approach when conducting research. When a researcher has an idea about a study they wish to investigate, they first decide on an **investigation aim**, which is the purpose of the study. It is written as a statement that includes the variables being studied. For example, the aim for an investigation might be 'To investigate the effect of sugar consumption on attention levels in children.' Variables are elements that change or vary in an investigation, and can be modified, measured or controlled. These will be discussed in more detail later in this section.

The researcher also develops an **investigation question**, which is the question the study intends to solve, or what the researcher is trying to find out. For example, the investigation question could be 'Does consuming sugar affect attention in children?' The investigation aim and question come from identifying a gap in current knowledge or from observing an interesting experience that the researcher wishes to explore further.

Investigation aim
the purpose of a study

Investigation question
the question that is to be solved by a study

Hypothesis
a statement predicting the probable outcomes of an investigation

Hypotheses

Researchers begin an investigation with an idea of the possible results. They will use current theory to form a **hypothesis**, a statement predicting the probable outcomes of an investigation. The investigation will test whether the hypothesis is supported, partly supported or refuted (not supported). For example, a hypothesis for the earlier investigation question is 'It is hypothesised that children who consume sugar will have a lowered level of attention compared to those who do not consume sugar' (Figure 1A–3). The hypothesis predicts whether one variable (the dependent variable (DV)) will change as a result of another variable (the independent variable (IV)). Independent and dependent variables will be discussed in detail next.

Begins with | **IV (experimental group)** | **Strength/direction**

It is hypothesised that children who consume sugar will have a lowered level of attention compared with those who do not consume sugar.

DV | **Finish with a comparison** | **IV (control group)**

Figure 1A–3 An example of a hypothesis. The key parts are identified.

ISBN 978-1-009-25416-8 Gallagher et al

1A–1 SKILLS

VIDEO 1A–1
SKILLS: WRITING HYPOTHESES

Writing hypotheses

The hypothesis should be written in one sentence and include three key parts:

- the IV and DV being investigated
- an indication of the strength or direction of the variable (whether the DV is going to increase, decrease, improve, worsen, show more or less etc.)
- a comparison of the groups being investigated (what the experimental group will show compared with the control group).

In VCE Psychology, you are not required to include the population in a hypothesis, and a generic reference such as writing 'those who' is sufficient. You do not need to operationalise the variables (describe how they will be measured) in a hypothesis; however, if you do, you should do this consistently for each variable. Additionally, a hypothesis should not include a reason or explanation for the prediction.

Question:

Yuri is examining whether exposure to violence could affect aggression levels during social sport. His participants were 20 volunteers from a local basketball club. He randomly assigned the participants to one of two groups – the experimental group or the control group. Participants in the experimental group were told they would be playing the highest-ranking team in the basketball league in a week's time and they were provided with two films to watch over the week. The participants did not know the films were regarded as violent. Participants in the control group were also told they would be playing the highest-ranking team and were given no films to watch. In the basketball match one week later, the participants were observed, and their aggressive behaviours recorded.

Write a possible hypothesis for Yuri's investigation.

Attempted answer:

I hypothesise that the experimental group will be aggressive, and the control group will not show aggressive behaviours during their basketball match one week later because they did not watch the violent films.

Marking comments:

This response would receive 0/3 marks. It incorrectly includes an explanation for the prediction and does not correctly identify the IV, and the strength or direction of the prediction could be clearer.

Suggested answer for full marks:

It is hypothesised that those who watch violent films before playing in a basketball match will have a higher level of aggression during the match than those who do not watch violent films before their basketball match.

Check-in questions – Set 1

1 What is the difference between an aim and a hypothesis?
2 What are the key three pieces of information to include in a hypothesis?

ISBN 978-1-009-25416-8 Gallagher et al

Variables

Independent and dependent variables

VIDEO 1A–2
VARIABLES

Some scientific investigations aim to study the relationship between two or more variables, and the hypothesis will have predicted the relationship between the variables. Variables are elements that change or vary in an investigation, and can be modified, measured or controlled. For example, for the research question 'Does consuming sugar affect attention in children?', the variables are 'consuming sugar' and 'attention'. There are two main types of variables in a research question – the **independent variable** and the **dependent variable**. Other variables, including extraneous, controlled and confounding, are discussed next.

The independent variable (IV) is the variable that the researcher manipulates (controls, selects or changes), and the dependent variable (DV) is the variable that the researcher measures. Research seeks to find out the effect of an independent variable on a dependent variable. For example, for the research question 'Does consuming sugar affect attention in children?', the independent variable is the consumption of sugar and the dependent variable is the level of attention (Figure 1A–4). The consumption of sugar may affect attention levels. The researcher manipulates the consumption of sugar and then measures the child's attention.

Independent variable the variable that is being manipulated (controlled, selected or changed) by the researcher

Dependent variable the variable that is being measured by the researcher

The DV depends on the IV.
The level of attention depends on whether sugar has been consumed.

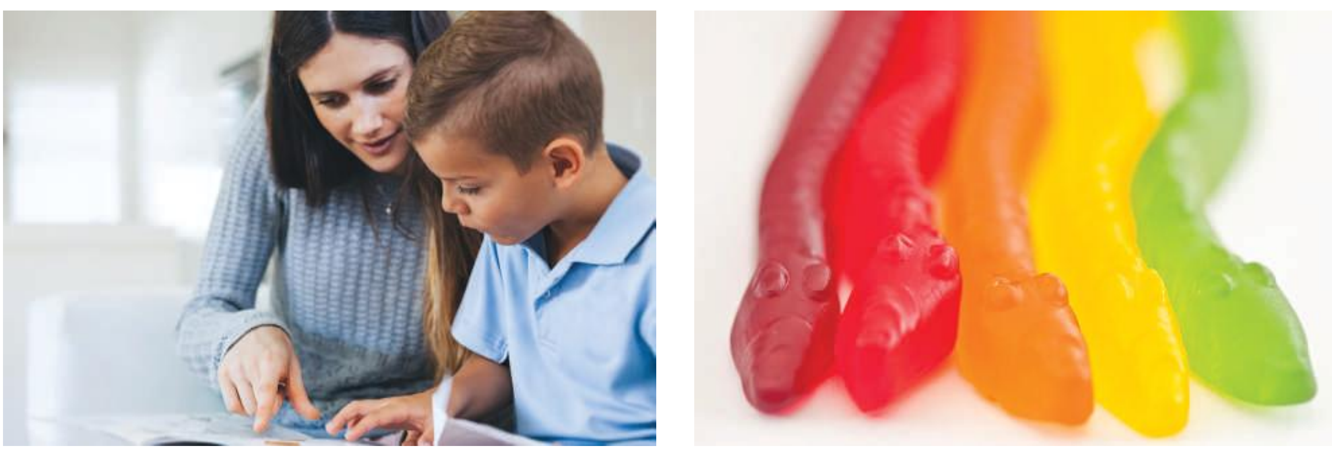


Figure 1A–4 The variables can be identified by understanding that the dependent variable depends on the independent variable.

1A–2 SKILLS

VIDEO 1A–3
SKILLS: IDENTIFYING THE IV AND DV

Identifying the IV and DV
A way to help identify the IV and DV in an investigation is to understand that the DV depends on the IV. Level of attention (DV) depends on sugar consumed (IV), as shown in Figure 1A–4.

Another way to identify the variables is to think about what the two groups of participants do differently (this will be the IV) and what the two groups of participants do the same (this will be the DV) (Figure 1A–5). For example, one group will consume sugar, and the other group will not consume sugar, then both groups will perform a test of their attention.

ISBN 978-1-009-25416-8 Gallagher et al

So, the IV is consuming sugar because the two groups do this differently, and the DV is level of attention because the two groups do this the same way.

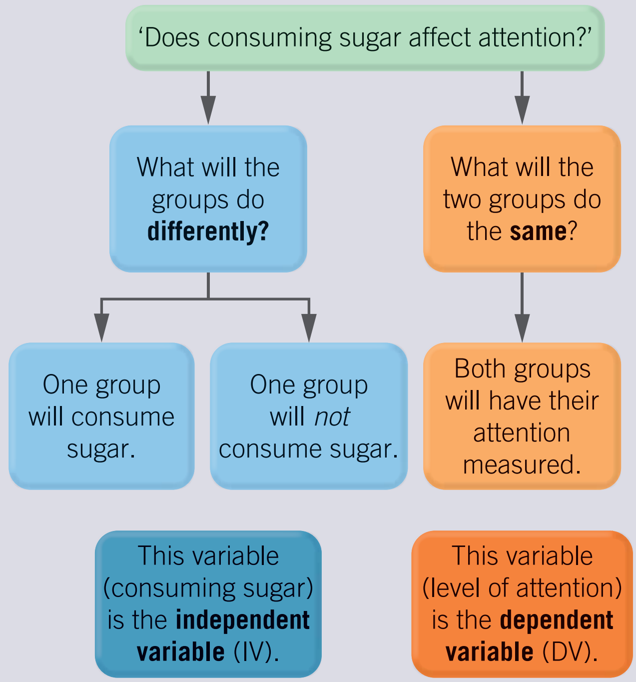


Figure 1A–5 You can identify the variables by thinking about what the groups of participants will do the same and what they will do differently.

Check-in questions – Set 2

1 What is the difference between the independent variable and the dependent variable?

2 Copy the following table of research scenario examples and tick whether the **bolded** variable is the IV or the DV.

Research scenario	IV	DV
The effect of diet on **happiness** levels.		
Whether **using an air purifier** nightly decreases asthma symptoms.		
Do households with a higher income have more **television streaming service subscriptions**?		
Students remember more content when they **write their own exam notes**.		
Soft-drink companies sell more sugar-free drinks when they are **placed in the middle of the fridge**.		

Controlled experiment an experimental investigation of the relationship between one or more independent variables and a dependent variable, in which all other variables are controlled

Extraneous, controlled and confounding variables

A **controlled experiment** is an investigation methodology that aims to test the effects of an IV on a DV, with all other variables controlled. In addition to the IV and DV, other variables need to be considered when conducting an investigation, including extraneous variables and confounding variables. It is important that all other variables are controlled for, as much as possible, so that researchers can be sure that it was the IV affecting the DV, and not another variable.

ISBN 978-1-009-25416-8 Gallagher et al

Extraneous variables are variables other than the independent variable that may have an unwanted effect on the dependent variable and results. For example, in an experiment testing the effect of sugar consumption on attention, a child with an attention-related disorder may perform poorly on the attention test because of their disorder, not because they did or did not consume sugar (Figure 1A–6). Or in an experiment testing a new drug for migraines, a person may be in a more positive mindset because they think they have received a drug that is going to help them. It may not be clear whether their headaches have eased because of the drug or because of their new positive mindset, which may bring about other healthy behavioural changes that could help migraines. Extraneous variables threaten the internal validity of an investigation, that is, whether the study actually investigates what it sets out or claims to investigate. There are several types of extraneous variables, including:

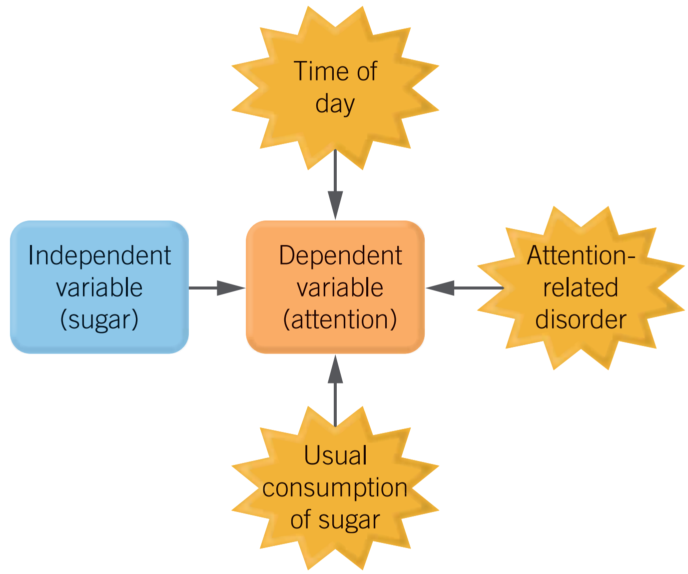


Figure 1A–6 Extraneous variables such as time of day, attention-related disorders and usual consumption of sugar can all influence the dependent variable of attention.

Extraneous variable
a variable other than the independent variable that may have an unwanted effect on the dependent variable and results of an investigation

LINK **2A** PROCESSING AND ANALYSING DATA

Controlled variable
a variable that is held constant to ensure that the only influence on the dependent variable is the independent variable

LINK **1B** PLANNING AND CONDUCTING INVESTIGATIONS

- individual differences between participant variables, such as age, sex, personality traits, previous experiences, behavioural differences and current feelings
- differences in the experimental setting between the groups, such as temperature, noise level, light level or time of day
- aspects of the experiment or environment that provide the participants with cues to the study's aim or expected findings, influencing their natural behaviour
- the influence of the experimenter on participant responses or on the procedures in a study
- the effect of practice or boredom when a participant completes multiple trials.

Researchers try to determine which extraneous variables may be a problem in a study, and then design the methods in their investigation to control them before they begin the study. **Controlled variables** are variables that are held constant to ensure that the only influence on the dependent variable is the independent variable. When an extraneous variable has been accounted for, it becomes a controlled variable. Controlled variables help to ensure validity of the results, because it can be more clearly seen that the results have changed because of the effects of the IV alone, and not another factor (Figure 1A–7).

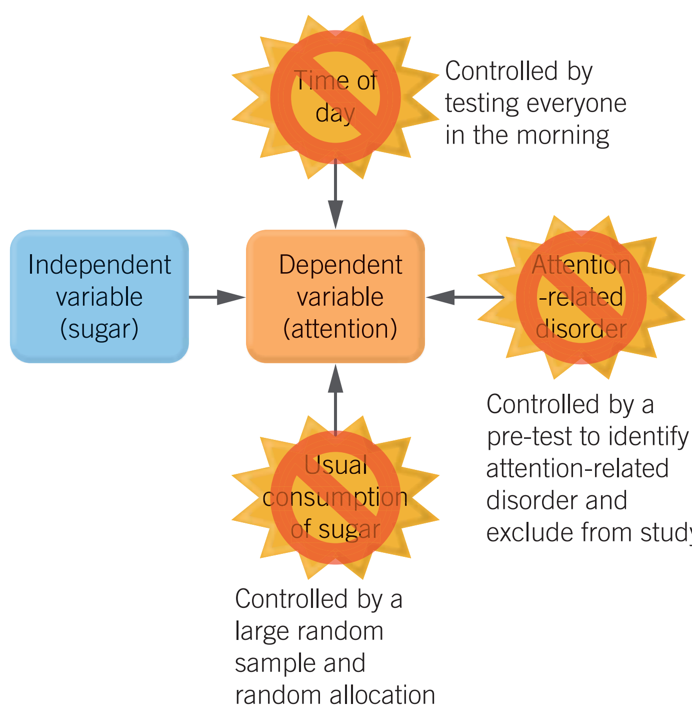


Figure 1A–7 Extraneous variables such as time of day, attention-related disorders and usual consumption of sugar can all be controlled for before the investigation begins, to prevent them from influencing the dependent variable of attention.

ISBN 978-1-009-25416-8 Gallagher et al

Controlled variables are not of direct relevance to the research, and they are not the same as the control group in an investigation, because they are kept constant for both the experimental and control conditions. For example, in a study on the effect of caffeine on subjects' time of reaction to images appearing on a screen, it would be necessary to control for vision impairment, comfort levels and screen brightness, because these are all potential extraneous variables that could influence a participant's reaction time results. Different procedures can be used to control for extraneous variables, including:

- using an appropriate investigation design
- using an appropriate sampling technique and random allocation
- increasing the sample size
- using written scripts for verbal instructions and ensuring the experimental setting remains constant among groups
- using deception and preventing the participants and/or researcher from knowing which group is exposed to the experimental and control conditions
- providing a placebo or fake treatment to the control group
- selecting a different investigation methodology where variables do not need to be controlled, such as fieldwork.

1B PLANNING AND CONDUCTING INVESTIGATIONS LINK

When an extraneous variable cannot be controlled, it should at least be monitored closely throughout the investigation to determine any unwanted effect on the results.

Confounding variable an unwanted variable that has affected the results of an investigation

Extraneous variables that are not controlled before a study begins can become confounding variables. **Confounding variables** are unwanted variables that affect the DV and results in an investigation, and it cannot be determined whether the IV or the confounding variable caused the change in the DV. In research, as far as possible, only the IV should influence the DV. If an extraneous variable is not controlled for, it is possible that both the IV and the confounding variable have affected the results, and it is not possible to determine the degree of influence of each. This means that the internal validity has been compromised and no conclusions can be made for the study because there is more than one possible explanation for the results. In addition to extraneous variables that were not controlled for, confounding variables may also be a type of variable that simply cannot be controlled for by the researcher.

2A PROCESSING AND ANALYSING DATA LINK

WORKSHEET 1A–1 IDENTIFYING VARIABLES

Check-in questions – Set 3

1 What is the difference between extraneous variables and confounding variables?
2 What is the purpose of controlled variables in an investigation?

ISBN 978-1-009-25416-8 Gallagher et al

ACTIVITY 1A–1 IDENTIFYING INVESTIGATION VARIABLES

For investigation scenarios 1–3, identify the:

a IV
b DV
c controlled variable
d confounding variable.

Investigation scenario 1: A researcher is testing whether increased screen time before a child is four years old will increase the amount of tantrum behaviours they display. The researcher only includes children whose screen time involves watching television shows and not mobile devices. They do not pre-test for diagnosed conditions that may affect a child's behaviour.

Investigation scenario 2: A researcher is interested in helping people with a phobia of needles relieve their phobic symptoms. The researcher obtains a sample of people aged between 10 and 60 years; half of them are males and half are females, and each has a needle phobia. They are allocated to one of three groups, each trialling a different treatment therapy.

Investigation scenario 3: A researcher is designing a new laptop keyboard. They have two new designs they wish to trial with participants. They use fourth-year undergraduate university students to trial each design and then report on their experiences via a rating scale. Most participants report a preference for keyboard B; however, one participant reports that keyboard A was excellent for writing assignments but not suitable for gaming.

Figure 1A–8 Extraneous variables, such as individual differences between participants, can have an unwanted effect on the results.

ISBN 978-1-009-25416-8 Gallagher et al

Section 1A questions

1 A researcher is trying to find ways to encourage people to not use poisonous sprays on their gardens because they kill bees. The researcher works with a local beekeeper to include poison information on their jars of honey that they sell at markets. Write an investigation aim, question and hypothesis for this scenario.

2 An academic psychologist is investigating ways to help children with dyslexia with their reading. They wish to test some different colours of paper and think they will find that children read more quickly and accurately on coloured paper than on white paper. Identify the IV and the DV in this scenario.

3 Maisie is a university lecturer and notices that her students' attendance drops over the semester. She wants to see whether completing more engaging activities during lectures will increase the attendance of her students. For her Monday lecture on brain plasticity, Maisie gets her students to complete a five-minute juggling activity in the middle of the lecture. For her repeat lecture on Tuesday, she conducts a normal lecture without any additional activities. Maisie tells her Monday lecture students that they will practise juggling during each lecture for the remainder of the semester. Maisie keeps a record of student attendance by counting the number of students each day, and compares the final numbers in the last lecture at the end of the semester. For Maisie's study, outline her possible:

   a aim
   b investigation question
   c hypothesis
   d IV
   e DV.

4 Identify an extraneous variable in the following research scenarios and explain how the researcher could control them.

   a A primary school is looking into ways to help motivate Year 5 students to complete homework. The school aims to try some different extrinsic methods, including a star rewards chart and free time. The students in class 5Z receive a star on their chart for completing their Maths homework each week for a term. The students in class 5N who have completed their English homework receive 10 minutes of free time.

   b A sleep psychologist wants to test whether drinking a new herbal tea before bed helps people fall asleep more quickly. Half of the participants are instructed to drink a mug of the herbal tea an hour before they go to bed. The other half of the participants are instructed not to drink the herbal tea and to go to bed as usual that night. One of the participants in the experimental group regularly meditates before bed, and decides to meditate as well as drink the herbal tea as instructed. No participants in the control group practise meditation.

5 Identify an extraneous variable in the following research scenario and explain the effect on the results if the researcher does not control for this variable.

   The employees of a company regularly give presentations where they are required to remember a lot of information. The company conducts some research where half of the employees use a particular mnemonic technique to help them remember the information. The control group is not given any method to help their memory. One employee in the experimental group really wants the method to work so that they can continue using it, and they decide to try harder than they usually would at remembering their presentation. This employee works on the presentation for twice as long as the group who were not given the method.

ISBN 978-1-009-25416-8 Gallagher et al

1B Planning and conducting investigations

Study Design:

Plan and conduct investigations

- Determine appropriate investigation methodology: case study; classification and identification; controlled experiment (within subjects, between subjects, mixed design); correlational study; fieldwork; literature review; modelling; product, process or system development; simulation
- Design and conduct investigations; select and use methods appropriate to the investigation, including consideration of sampling technique (random and stratified) and size to achieve representativeness, and consideration of equipment and procedures, taking into account potential sources of error and uncertainty; determine the type and amount of qualitative and/or quantitative data to be generated or collated
- Work independently and collaboratively as appropriate and within identified research constraints, adapting or extending processes as required and recording such modifications

Glossary:

Allocation
Between subjects design
Case study
Classification and identification
Control group
Correlational study
Experimental group
Fieldwork
Investigation design
Investigation methodology
Literature review
Mixed design
Modelling
Population
Primary data
Product, process and system development
Random allocation
Random sampling
Sample
Sampling technique
Secondary data
Simulation
Stratified sampling
Within subjects design

ENGAGE

Current research topics in psychology

The Australian Psychological Society (APS) is the peak body for psychologists in Australia, dedicated to advancing the discipline and profession of psychology. Psychologists who are members of the APS can submit their research project to the APS to increase awareness about their project and to invite psychologists and participants to be involved. The APS website lists some of the current research projects that are open to participants, and is an interesting source for seeing how psychologists are responding to current issues with research. For example, in the months following the devastating bushfires in Victoria and New South Wales in 2019–2020, several research projects were conducted to investigate various aspects of those events, such as the mental health of the workers who are supporting the bushfire victims. Visit the APS website at www.psychology.org.au and search for current research projects.

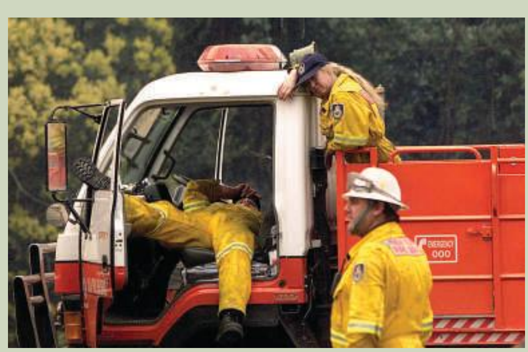


Figure 1B–1 Tired rural volunteer firefighters take a well-earned break. The mental health of firefighters and those who work with bushfire victims is an example of research listed on the APS Current Research page.

ISBN 978-1-009-25416-8 Gallagher et al

VIDEO 1B–1 SAMPLING TECHNIQUES

EXPLAIN

Selecting a sample for an investigation

Population
the wider group of people that a study is investigating

Sample
the smaller group of people selected from the population who will be participants in the investigation

An investigation question is created with a particular group of people in mind, known as the **population**. For example, a researcher may wish to find out how sugar affects attention in *children* or how energy drinks affect driving performance in *P-plate drivers*. A population of interest is the wider group of people that a study is investigating. A population is not necessarily all people in the world, but it is whichever group of people the researcher is aiming to provide conclusions about; for example, children, P-plate drivers, females in Victoria, people with dementia.

Once the population is decided, the researcher can select their **sample**; that is, the smaller group of people selected from the population who will be participants in the investigation (Figure 1B–2). When describing the sample, the researcher needs to include all the specific characteristics, such as the number of participants, their age, sex, location, and any other characteristics deemed to be relevant to the study. For example, an Australian researcher studying the effect of sugar on attention in children might determine their population to be all Australian children under 10 years old, and their sample might be 100 children (50 males and 50 females) aged 5–10 years from Victorian public primary schools.

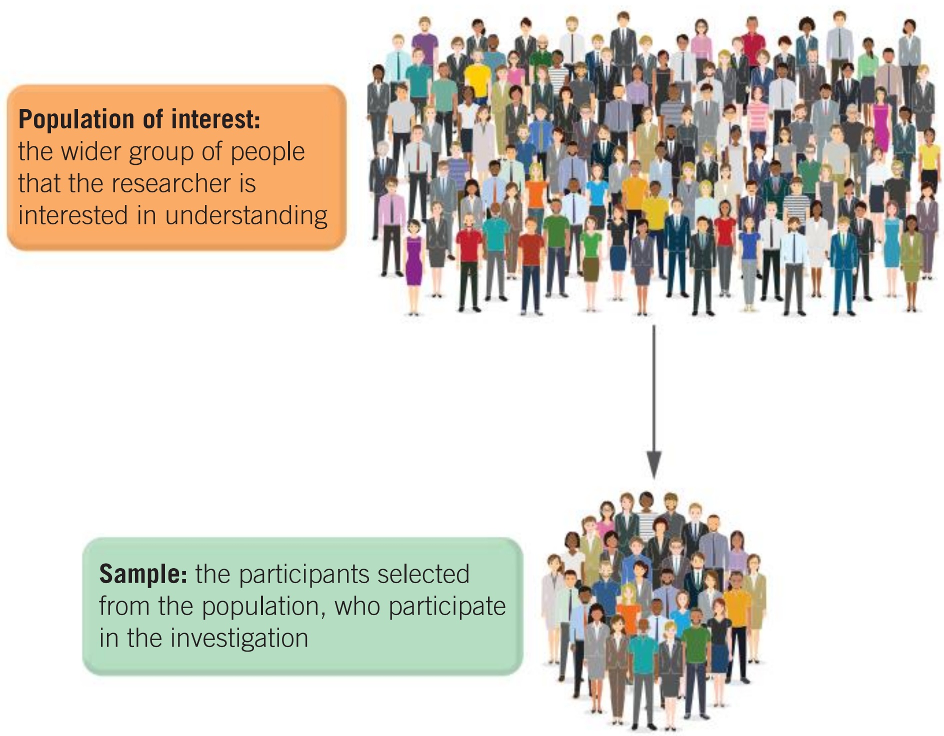


Figure 1B–2 A sample is a small group of participants taken from the wider population.

VIDEO 1B–2 SKILLS: IDENTIFYING POPULATIONS AND SAMPLES

1B–1 SKILLS

Identifying populations and samples

When asked to identify the population from a research scenario, think about who the researcher is interested in applying the results to. Often the population can be found in the aim of a study. The population is rarely 'all people in the world.'

A description of the population would typically not include the number of people, just the broad characteristics that make them similar. When describing the sample, specific details such as the number of participants, where they were selected from, and any other common characteristics should be included, such as age or sex.

ISBN 978-1-009-25416-8 Gallagher et al

Question:

A researcher wanted to investigate whether children with motor development delays will improve their fine motor skills by using building block toys. A total of 150 two-year-old children with motor delays from Melbourne participated.

Identify the population and describe the sample for this study.

Suggested answer for full marks:

Population: children with motor development delays

Sample: 150 two-year-old children with motor delays from Melbourne

Sample size

LINK **2A** PROCESSING AND ANALYSING DATA

A sample should be representative of the population, meaning that the characteristics of people within the sample should represent those in the population. There is no set limit for an ideal sample size, but the chosen sample needs to be large enough compared to the population to represent variables such as age, sex, geographical location or socio-economic status. For example, in an investigation on Victorian children, a sample of 50 children is not very proportionate to the approximately 740 000 children under 10 in Victoria. However, a sample of 5000 children is more appropriate.

Large samples are important to help ensure the sample is as representative of the population as possible, and to minimise any particular participant variables that could influence the results. A small sample may not be representative of the population and may also allow a single participant to have a large effect on the results.

Figure 1B–3 A large sample size can help the sample be more representative of the population, and minimise any extreme individual differences between participants that could affect the results.

For example, in a test on memory on two samples of 10 and 30 people, one participant within the top IQ range could influence results to a larger degree in the smaller sample. In sample 1 (10 people), the unique participant's score pushes up the mean score to 5 out of 10. However, in sample 2 (30 people), this person's results would not have as much influence. In sample 2, the unique participant's score is evened out by the 20 extra participants, to give a mean of 4.5 out of 10.

Sample 1:

4, 5, 5, 5, 3, 4, 5, 5, 4, 10

$$\text{mean} = \frac{50}{10} = 5$$

Sample 2:

4, 5, 5, 5, 3, 4, 5, 5, 4, 10, 4, 5, 5, 5, 3, 4, 5, 5, 4, 3, 4, 5, 5, 5, 3, 4, 5, 5, 4, 3

$$\text{mean} = \frac{136}{30} = 4.5$$

ISBN 978-1-009-25416-8 Gallagher et al

Sampling technique different procedures for selecting participants from the population

Random sampling selecting participants from the population in a way that means each member of the population has an equal chance of being selected to participate in the study

Sampling techniques

There are different ways to select the sample from the population. Two types of **sampling techniques** are random sampling and stratified sampling. Each sampling technique has its own strengths and weaknesses, but the most important feature for all samples is that they are representative of the population.

Random sampling

Random sampling involves selecting participants from the population in such a way that each member of the population has an equal chance of being selected to participate in the study. There are different ways of achieving a random sample, but all of them begin with all members of the population being available to be chosen. This means that if there is a large enough sample, the participants are likely to be representative of the population, thereby allowing results to be generalised or applied to the population.

A simple example of how a random sample can be obtained is by putting all names of the people in the population into a box and pulling out the required number of people to form the sample. In large-scale research, a common method of selection is to assign a unique number to each member of a population and then select those numbers at random using software (Figure 1B–4). The participants assigned those numbers will then form the sample.

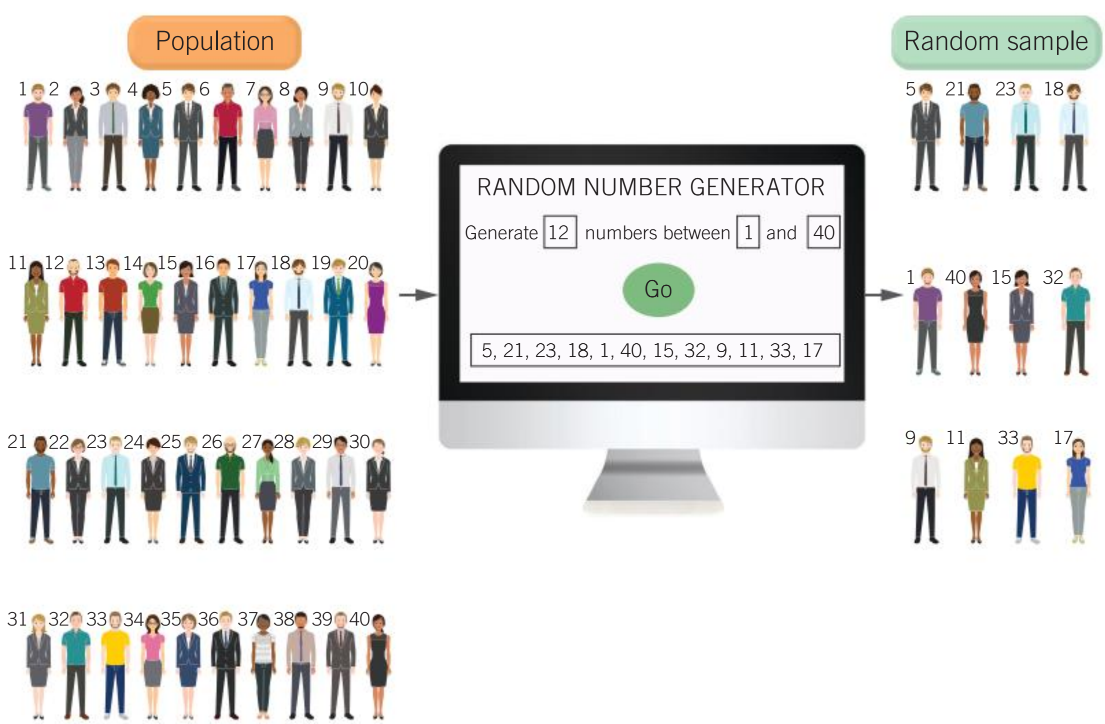


Figure 1B–4 A random sample can be obtained by assigning all members of the population a number and using random number generator software to select the required number of participants.

2A PROCESSING AND ANALYSING DATA LINK

Table 1B–1 Strengths and limitations of random sampling

Strengths	Limitations
• A large enough random sample is likely to be representative of the population, improving external validity.	• Small random samples may not be representative of the population, reducing the external validity. • It may be difficult, time consuming, impossible or unethical to obtain names of all members of the population.

ISBN 978-1-009-25416-8 Gallagher et al

Stratified sampling

In some investigations, it is important that the different subgroups within a population are fairly represented in a sample. A way to ensure this is to use a **stratified sampling** technique. This is where the population is first divided into subgroups, and participants are randomly selected from each subgroup, in the proportion that they appear in the population (Figure 1B–5). The subgroup can be based on any characteristic deemed important to the study, such as age, sex, geographic location or socio-economic status. This sampling method produces a more representative sample than using random sampling, which reduces bias and improves external validity, allowing results to be generalised to the population.

Stratified sampling first dividing the population into subgroups, and then randomly selecting participants from each subgroup in the proportion that they appear in the population

For example, in high schools there are usually more students in Years 7 and 8, and fewer students in Years 11 and 12. If a local high school wanted a sample of their students to complete a study, a stratified sample would ensure all year levels are represented fairly, and would include more Year 7 and 8 students than Year 11 and 12 students, as appears in the student population. For a study on Units 3 & 4 Psychology students, there need to be more female students in the sample than male students, because the current ratio of females to males studying Psychology is approximately 3:1. So, the sample should have this same ratio too.

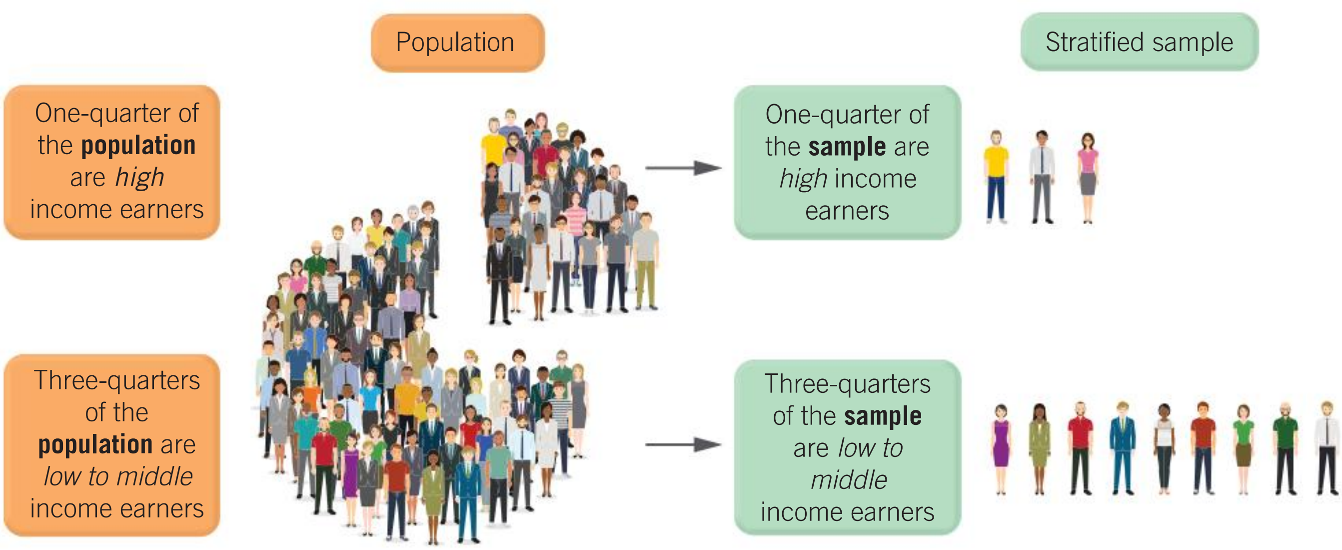


Figure 1B–5 A stratified sampling technique allows for any important subgroup of the population, such as those with certain levels of income, to be proportionately represented in the sample.

Table 1B–2 Strengths and limitations of stratified sampling

Strengths	Limitations
• A large enough stratified sample is likely to be representative of the population, improving external validity. • Important subgroups of a population are ensured fair representation.	• It may be difficult, impossible or unethical to obtain names of all members of the population. • It is more time consuming than using a random sampling technique because of the need to form subgroups and any pre-testing required.

LINK **2A** PROCESSING AND ANALYSING DATA

ISBN 978-1-009-25416-8 Gallagher et al

VIDEO 1B–3 SKILLS: IDENTIFYING SAMPLING TECHNIQUES

1B–2 SKILLS

Identifying sampling techniques

You may be asked to identify the sampling technique used in a research scenario and explain whether it was a suitable choice for the investigation. Alternatively, you may need to identify when neither random nor stratified sampling was used, and explain how this resulted in a poor representativeness of the sample.

Both random and stratified sampling require the researcher to have access to every member of the population of interest. This means that a sample will probably be a good representation of the population and the investigation will have good external validity.

Use the following steps to determine whether random or stratified sampling was used.

Random sampling:

1 Determine the researcher's population of interest, which can usually be found in the investigation's aim.
2 Decide whether the sampling technique gave each member of that population an equal opportunity of being selected. For example, the technique might be a lottery method ('picking a name out of a hat') or using random number generator software.

Stratified sampling:

1 Determine the researcher's population of interest, which can usually be found in the investigation's aim.
2 Determine whether the sampling technique first involved dividing the population into specific strata or subgroups, based on a characteristic such as age, sex, geographical location or another personal characteristic. For example, a researcher may divide the population into age brackets, determining the proportions of those age brackets, and then selecting participants from each age bracket, ensuring that the numbers are kept proportionate to the population.
3 Decide whether the final sample was pulled from those subgroups in the same proportion in which they existed in the population.

If the researcher's population of interest was 'people' or 'all children' or 'all Australian basketball players', it is unlikely that they would have access to every single member in order to use either a random or a stratified sampling technique.

If neither of these sampling techniques was used, you should consider that the sample may not be a good representation of the population. This may have detrimental effects on the external validity of the investigation.

Check-in questions – Set 1

1 Describe the difference between a sample and a population.
2 What is the most important requirement when using a random sampling technique?
3 How is a sample chosen by the stratified sampling technique?

ISBN 978-1-009-25416-8

Selecting an investigation methodology

Research investigations can be conducted in different ways by using different methodologies. The type of **investigation methodology** chosen depends on what a researcher is studying and what data they wish to obtain. Some studies require strict controlled conditions, while others can be completed in the participant's own home.

Investigation methodology the particular type of research study

Not every study is an 'experiment'. A controlled experiment is only one possible type of investigation methodology that can be used for research. Other types of methodologies are case study; classification and identification; controlled experiment; correlational study; fieldwork; literature review; modelling and simulation; and product, process or system development. Each type of investigation methodology has its own strengths and limitations, and the one that is chosen will depend on the type of data required and a consideration of its potential sources of error and uncertainty.

Controlled experiment

A controlled experiment involves an experimental investigation of the relationship between one or more IVs and a DV; all other variables are controlled. The aim of a controlled experiment is to find out whether an IV has an effect on a DV. For example, a researcher could test whether drinking energy drinks affects driving performance on a driving simulation test.

LINK 1A INVESTIGATION AIMS, QUESTIONS, HYPOTHESES AND VARIABLES

In controlled experiments, participants are randomly allocated to an experimental group or a control group, and the results of the groups are then compared. For example, before completing a driving simulation, one group of P-plate drivers consumes a can of an energy drink, and the other group does not. The results are compared to see if there was a difference in driving performance due to consuming the energy drink. These two types of groups in a controlled experiment are discussed next.

LINK 2A PROCESSING AND ANALYSING DATA

Table 1B–3 Strengths and limitations of controlled experiments

Strengths	Limitations
• Controlled experiments can identify a cause-and-effect relationship between an IV and a DV. • Results may be generalised to the population of interest if the study is deemed to have good validity. • Controlled experiments can be repeated to gather more data and test the reproducibility and repeatability of results.	• Controlled experiments require strictly controlled conditions, which may be difficult to maintain, so results may be influenced by extraneous variables. • Participant behaviour may be influenced by the artificial nature of the setting. • It may be unethical or impossible to conduct a controlled experiment on a particular variable. • External validity may be low if the conditions are too artificial to extrapolate results to the population of interest outside the experiment.

Allocating participants to groups

Once the sample has been chosen, the participants are divided into the different groups required in the study. This is known as **allocation**. **Random allocation** involves dividing the sample into groups in such a way that each participant has an equal chance of being placed into the experimental group or the control group. A simple random allocation procedure can be achieved by placing the names of all participants of the sample into a box, drawing them out one by one and placing into alternating groups.

Allocation dividing a sample into groups in an investigation

Random allocation dividing a sample into groups in such a way that each participant has an equal chance of being placed into the experimental group or the control group

ISBN 978-1-009-25416-8 Gallagher et al

Random allocation helps to ensure the groups of a study are equal in participant characteristics, and therefore any change to the results of a study is more likely to be due to the effect of the independent variable, not the extraneous variable of unwanted differences in participant variables between the groups.

Experimental group the group that is exposed to the independent variable and receives the experimental treatment

Control group the group that forms a baseline level to compare the experimental group with

In a simple controlled experiment the participants are allocated to one **experimental group** and one **control group** (Figure 1B–6). The experimental group is exposed to the independent variable and receives the experimental treatment. Members of the experimental group participate in the experimental condition. For example, in the study on whether sugar consumption in children affects attention, the experimental group would consume sugar by eating lolly snakes. The control group forms a baseline level to compare with the experimental group. Members of the control group participate in the control condition and are not exposed to the independent variable and do not receive the experimental treatment. For example, the control group would not consume sugar and therefore would not have any lolly snakes. A control group is necessary to see the natural baseline levels of the dependent variable, before any influence of an independent variable. For example, we need to know what children's attention levels are like without any sugar before we can see the influence of consuming sugar on their attention.

There is only ever one control group in a study, but more complex controlled experiments may have more than one experimental group. For example, participants in one experimental group may consume five lolly snakes before their attention test, and participants in a second experimental group may consume 10 lolly snakes before their attention test.

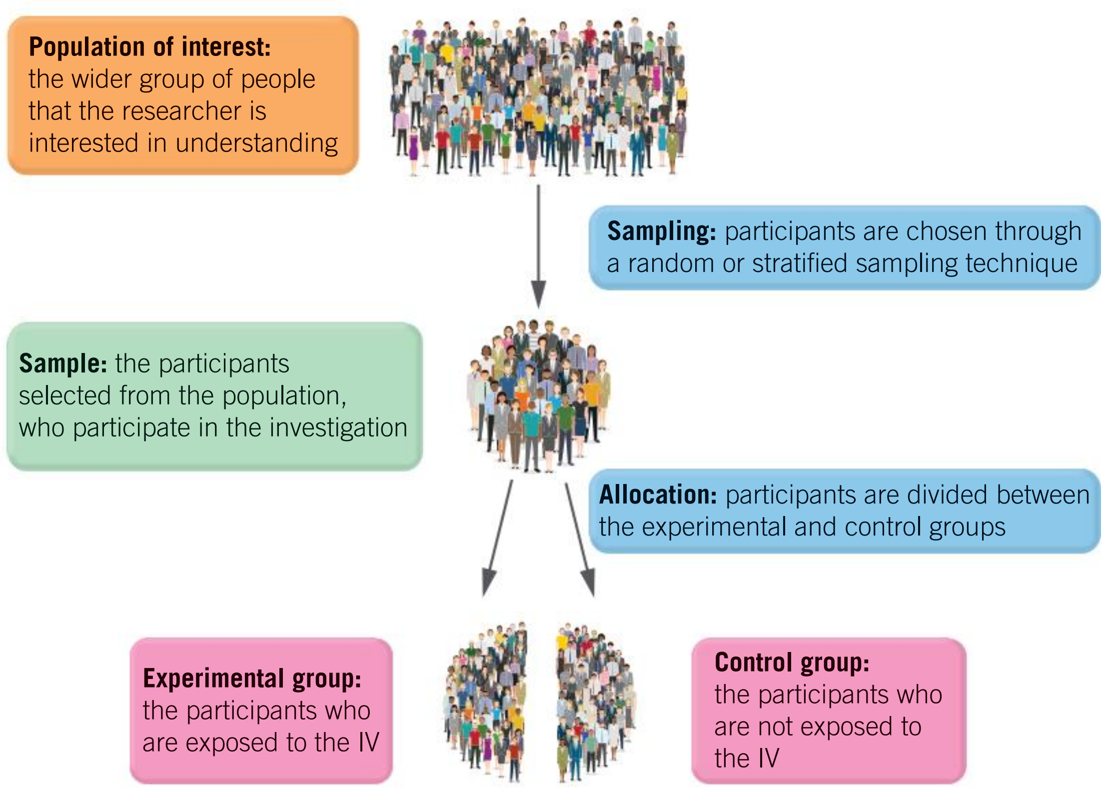


Figure 1B–6 The sample is chosen from the population, and then participants are allocated to the experimental and control groups.

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 2

1 What is the difference between sampling and allocation?
2 What is the purpose of a control group?

Selecting an investigation design

Allocating participants to the conditions in a considered way can help reduce unwanted effects on the results. There are three **investigation designs** that involve different ways that participants experience the experimental and control conditions. Each design has strengths and limitations, and which design is chosen will depend on the goals of the study, what type of data is being collected and what kinds of variables are most important to control.

A **between subjects design** is when participants are randomly allocated to either the control or the experimental condition (Figure 1B–7). For example, a participant in an investigation on whether sugar affects attention is required to either consume sugar (experimental condition) or not consume any sugar (control condition). Participants in the different groups in an investigation must be equal in characteristics of importance; otherwise, differences in participant variables can be an extraneous variable that can affect the DV. For example, if half the children in the experimental group usually eat sugar every day, but only a quarter of children in the control group eat sugar every day, then the groups are not equal on an important characteristic for this study. So, ensuring the groups are matched on participant characteristics is a challenge with using a beween subjects design.

Investigation design a framework that determines how participants experience the experimental and control conditions

Between subjects design an investigation design in which participants are randomly allocated to either the control or the experimental condition

LINK 1A INVESTIGATION AIMS, QUESTIONS, HYPOTHESES AND VARIABLES

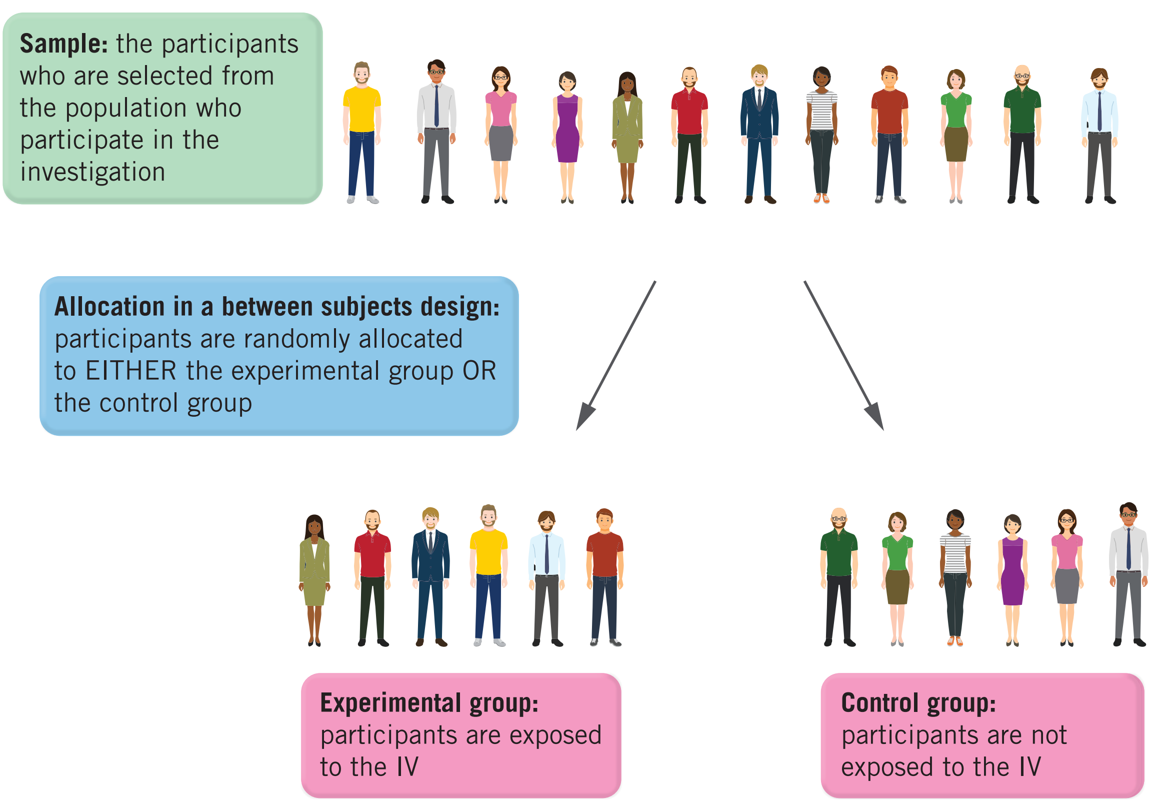


Figure 1B–7 Participants in a between subjects design complete only one condition in the study.

ISBN 978-1-009-25416-8 Gallagher et al

Table 1B–4 Strengths and limitations of a between subjects design

Strengths	Limitations
• A between subjects design is the most time-efficient design because both groups can be tested at the same time and no pre-testing is required. • It has a lower rate of participant withdrawal than a within subjects design because participants only complete one condition. • There is better control of participant knowledge of the study and there is no effect of prior participation extraneous variables influencing results compared with a within subjects design.	• More participants are needed in a between subjects design than a within subjects design. • There is less control over the extraneous variable of participant variables between groups, which may influence results in an unwanted way, lowering validity.

2A PROCESSING AND ANALYSING DATA LINK

1A INVESTIGATION AIMS, QUESTIONS, HYPOTHESES AND VARIABLES LINK

Within subjects design an investigation design in which all participants in the sample are involved in both the experimental and control conditions

The second type of investigation design is a **within subjects design**. A within subjects design involves all participants in the sample completing both the experimental and control conditions. In a within subjects design, any effect of participant variables can be completely removed because the same participants are in both the experimental and control conditions (Figure 1B–8). For example, all children in the sample will first complete the attention test without consuming any sugar, and then complete the attention test again after consuming sugar. Because the same participants complete both conditions, each participant's unique characteristics influence the results in both conditions, so there is no weighted influence to either condition. For example, one child who has an attention disorder may react to sugar more or less than a child without an attention disorder. Either way, by participating in both conditions, their disorder will affect their attention results in the control condition equally to their attention results in the experimental condition, so therefore the effect is equal among groups.

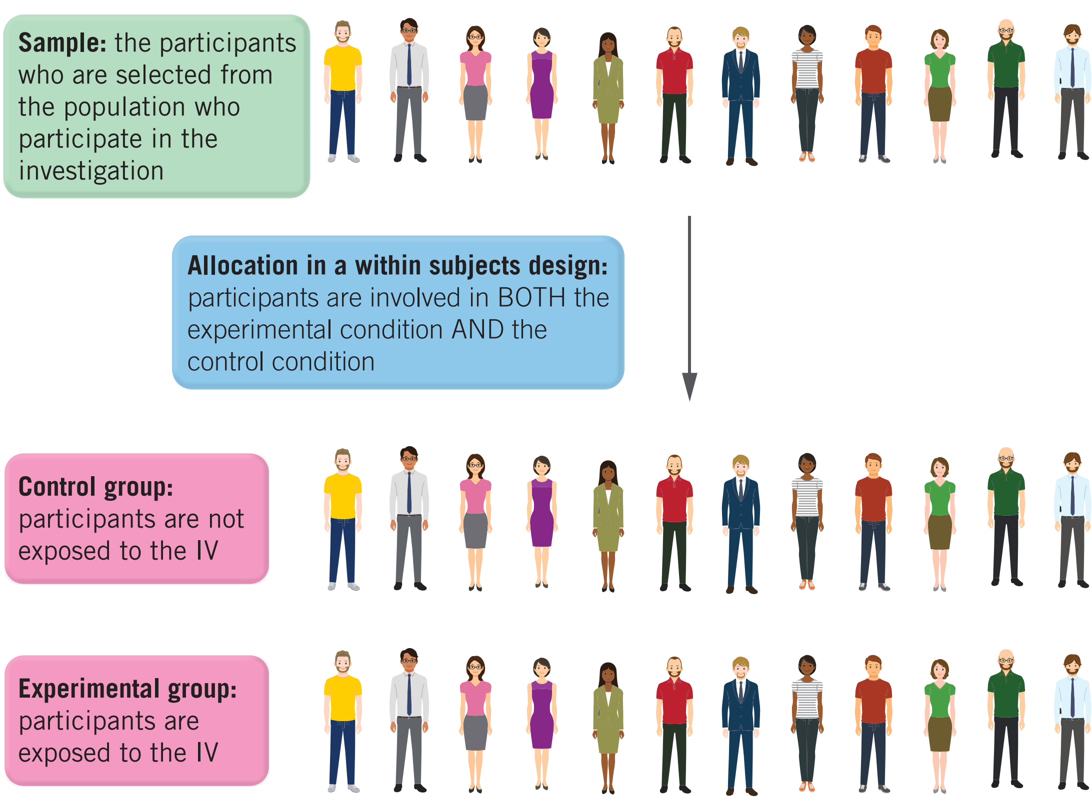


Figure 1B–8 Participants in a within subjects design complete all conditions in the study.

ISBN 978-1-009-25416-8 Gallagher et al

Table 1B–5 Strengths and limitations of a within subjects design

Strengths	Limitations
• In a within subjects design, there is no extraneous variable of participant variables between groups, improving validity. • Fewer participants are needed than in a between subjects design.	• There is less control over participant knowledge of the study. The extraneous variable of prior participation in the first condition may influence their behaviour while completing the second condition. • It is more time consuming than a between subjects design because both conditions cannot be tested at the same time. • There is a higher rate of participant withdrawal from the study than in a between subjects design because the DV has to be measured multiple times.

LINK 2A PROCESSING AND ANALYSING DATA

A third option for investigation design is the **mixed design**. A mixed design involves a combination of a between subjects design and a within subjects design. This design combines some of the strengths of within subjects and between subjects designs and may reduce some of each design's limitations.

Mixed design an investigation design that combines elements of a between subjects design and a within subjects design

A simple mixed design investigation may test the effect of one independent variable at two time periods, such as through a pre-test and a post-test. For example, in an investigation testing whether listening to classical music while studying improves performance, each participant is allocated to either the experimental or the control condition (the between subjects design element) and then completes a pre-test to determine their baseline score before studying while listening to classical music or no music. They then complete a post-test to determine whether their score improved (demonstrating the within subjects design element).

LINK 1A INVESTIGATION AIMS, QUESTIONS, HYPOTHESES AND VARIABLES

A mixed design may also involve two independent variables, whereby one variable is tested through a between subjects design and the second variable is tested through a within subjects design. For example, in an investigation testing whether male or female students benefit from listening to classical music or pop music while studying for a test, the between subjects element is whether the student is male or female, and the within subjects element is listening first to classical music and then to pop music while studying. One of these variables could also be a naturally occurring variable that the researcher has not manipulated, such as age, sex, geographical location or the presence of another particular characteristic.

LINK 2A PROCESSING AND ANALYSING DATA

Table 1B–6 Strengths and limitations of a mixed design

Strengths	Limitations
• Differences in participant variables between groups are controlled in the within subjects design element. • Can test the effect of multiple independent variables on a dependent variable in one investigation. • Testing multiple independent variables in one investigation can be time and cost effective compared to completing two or more separate investigations.	• There is a higher rate of participant withdrawal from the study than using a between subjects design alone, which can be detrimental to the internal validity. • There is less control over participant knowledge of the study. Prior participation in the first condition may influence their behaviour while completing the second condition, than when using a between subjects design alone. • There is less control over differences in participant variables between groups in the between subjects element, which may influence results in an unwanted way, lowering validity.

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 3

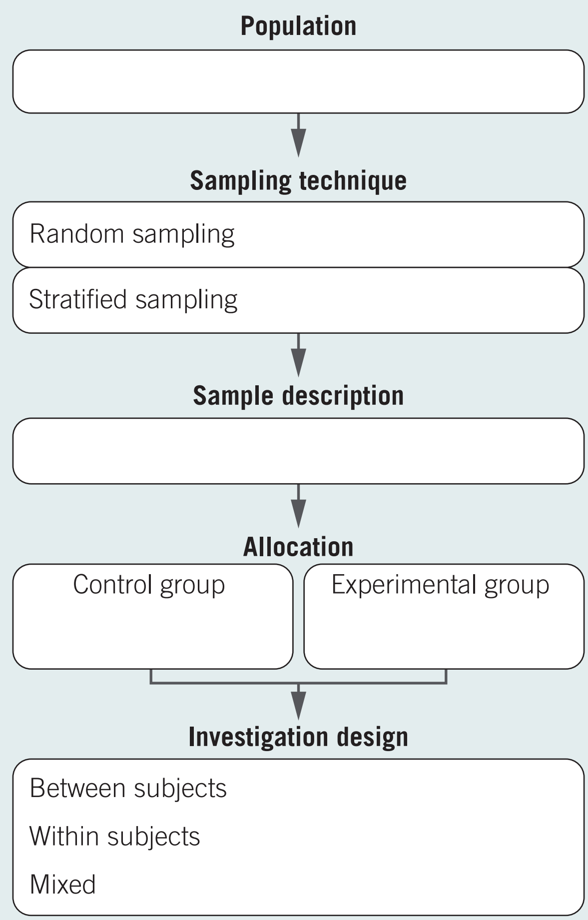
1 What is an investigation design?
2 Which condition(s) are participants allocated to in a:
  a between subjects design?
  b within subjects design?
3 What is involved in a mixed design?

ACTIVITY 1B–1 USING SAMPLING TECHNIQUES AND INVESTIGATION DESIGNS

Zoe is a high school teacher whose students believe that working in groups while they study helps them learn better. She decides to investigate this by conducting a controlled experiment and needs some suggestions on how to set it up.

Copy and complete the flow chart on the right for Zoe's study, or write down answers to these questions on it:

a determine her possible population of interest
b explain how she could use different sampling techniques to obtain her sample
c describe the characteristics of her sample
d explain what the control group and experimental group would each do
e explain how she could use different investigation designs to conduct her study.



Case study
a type of investigation of a particular activity, behaviour, event or problem that contains a real or hypothetical situation and includes real-world complexities

Using case studies

A **case study** is an investigation of a particular activity, behaviour, event or problem that contains a real or hypothetical situation and includes real-world complexities.

There are several formats for a case study. A case study can:

- be historical, with analysis of causes, consequences and what has been learned from the case; for example, learning about the role of the frontal lobe from investigating the case of Phineas Gage (Figure 1B–9)

ISBN 978-1-009-25416-8 Gallagher et al

- involve a real situation or a role-play of an imagined situation where plausible recommendations are to be made; for example, studying language acquisition due to neglect in the Genie 'the Wild Child' case, where a child raised in social isolation and who suffered abuse did not develop speech until she was rescued.
- be based around problem-solving where developing a new design, methodology or method is needed; for example, identifying a unique situation where a new process of treatment is required.

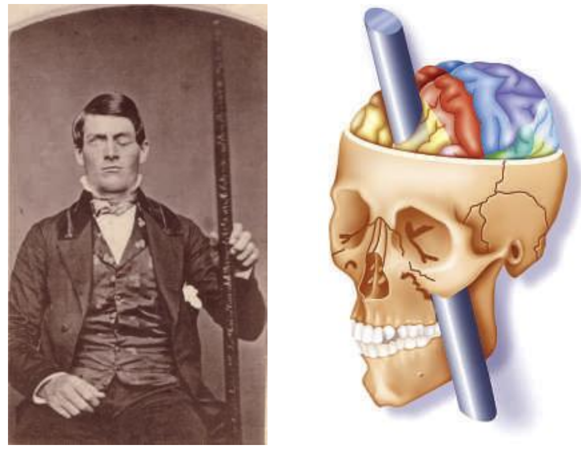


Figure 1B–9 Phineas Gage (1823–1860) was a US railway worker who experienced a traumatic brain injury in which a large iron rod was driven through his head, destroying much of his frontal lobe. The research on Gage involved a case study investigating the effects of frontal lobe damage on a person.

Case studies typically involve an individual or a small group of people and are used when it is only possible to have a limited number of participants, such as when looking at the effects of a rare experience or when it would be unethical or impossible to expose a person to a particular variable. For example, for research into a rare disorder such as fatal familial insomnia (a brain disorder characterised by an inability to sleep), it would be difficult to find a very large sample of eligible participants. Additionally, it would be unethical for a researcher to try to cause a person to develop fatal familial insomnia in order to study its effects. In a case study, the person or small group of people may undergo various tests, observations and questionnaires in order to collect data.

Table 1B–7 Strengths and limitations of case studies

Strengths	Limitations
• Case studies are useful when a limited number of participants are available. • They can be used to study experiences where it would be unethical or impossible to design and conduct a controlled experiment. • They can provide rich qualitative data. • They can act as a basis for further research.	• One person or a small group of people cannot be representative of a population, so results from a case study cannot be generalised to the population, and there is a low external validity. • Researcher bias may influence the recording, collation and treatment of data. • They may not be repeatable to gain more data or to test reliability of results. • They are typically time consuming.

LINK 2A PROCESSING AND ANALYSING DATA

Classification and identification

Classification and identification is another type of investigation methodology that involves two distinct components. Classification in research involves arranging phenomena, objects or events into manageable sets (Figure 1B–10). Identification involves recognising phenomena as belonging to a particular set or being part of a new or unique set. In psychology, classification is used for organising human behaviour, mental processes and events into common groupings with similar features, from which an individual's experience can then be identified.

Classification and identification a type of investigation that involves arranging phenomena, objects or events into manageable sets, and recognising phenomena as belonging to a particular set or part of a new or unique set

ISBN 978-1-009-25416-8 Gallagher et al

Classification and identification can help people in ways such as determining whether their experience is usual or unusual, and can lead to further research into areas of need. For example, the *Diagnostic and Statistical Manual of Mental Disorders* or *DSM*, is a classification system that groups together mental health disorders into categories based on similar characteristics, such as the experience of anxiety, psychosis or mood-related symptoms.

Standardised classification allows for consistent identification using a common language; that is, based on rules. For example, using a common language helps the identification process to pinpoint a particular mental health disorder based on symptoms and allows a person to seek specific treatment for that disorder, at the exclusion of other similar disorders.

Figure 1B–10 Classification involves arranging things such as the behaviour of people into sets, from which phenomena can later be identified.

Classification and identification can be used to determine learning difficulties in a child or behaviours that are considered abnormal for their age of development. Being able to classify a particular animal species as endangered allows countries to make laws that direct the behaviours of people. Being able to differentiate between agricultural pests allows farmers to use the right products to protect their crops. Classification and identification can allow us to make the correct decisions and predict expected behaviour.

Table 1B–8 Strengths and limitations of classification and identification

Strengths	Limitations
• Classifications can allow for a narrowed focus of research. • People identified as having a similar classification can feel a sense of belonging and support. • Using classifications can allow for efficient processing of large amounts of information. • Classifications can help make predictions and inferences.	• Labelling through identification can lead to stereotyping, prejudice or discrimination. • Classifications may be based on subjective criteria. • Large amounts of information are required to create classifications.

Correlational study
a type of investigation that involves planned observation and recording of events and behaviours that have not been manipulated or controlled to understand the relationships or associations existing between variables, to identify which factors may be of greater importance, and to make predictions

Correlational study

A **correlational study** involves planned observation and recording of events and behaviours that have not been manipulated or controlled in order to:

- understand the relationships or associations existing between variables
- identify which factors may be of greater importance
- make predictions.

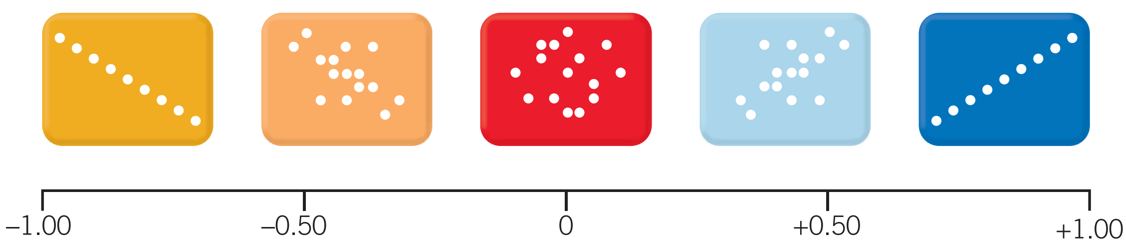
ISBN 978-1-009-25416-8 Gallagher et al

Correlational studies describe the statistical association and strength of the relationship between two variables; however, the variables are not controlled by the experimenters. Therefore, correlational studies cannot find how changing one variable causes a change in another variable, and therefore a cause-and-effect relationship is not found as in controlled experiments.

Figure 1B–11 Many mental health disorders have a bi-directional relationship with sleep trouble or sleep disorders, and there is a correlation between them.

Correlational studies collecting quantitative (numerical) data can present the relationship between the variables in a scatterplot, with three main interpretations (Figure 1B–12):

- A positive correlation demonstrates a relationship in which both variables together increase or decrease. For example, as an adult gets older, the likelihood of greying hair increases.
- A negative correlation demonstrates a relationship in which an increase in one variable results in a decrease in the other variable. For example, as an adult gets older, their memory ability tends to decline.
- A zero correlation demonstrates that there is no relationship between the variables. For example, as an adult gets older, the weather gets neither colder nor hotter.



Negative correlation			Zero correlation	Positive correlation		
Strong	Moderate	Weak		Weak	Moderate	Strong
For example: As an adult gets older, their memory ability tends to decline.			For example: As an adult gets older, the weather gets neither hotter nor colder.	For example: As an adult gets older, the likelihood of greying hair increases.		

Figure 1B–12 The strength of a correlation is described according to Pearson's *r*, which ranges from –1.00 to +1.00.

The strength of a correlational relationship is measured by statistical tests to determine correlation coefficients such as Pearson's *r* (Figure 1B–12). Correlation coefficients range from –1.00 (the strongest possible negative relationship) to +1.00 (the strongest possible positive relationship), and a zero correlation has a Pearson's *r* value of 0.

For example, a researcher could use a correlational study to measure the extent of the relationship between happiness and the number of hours people spend at their job. Participants could complete a questionnaire in which they indicate the number of hours they work each week and their self-reported level of happiness on a scale of 1 to 10. Statistical analysis of the results might determine a negative correlation whereby an increased number of hours worked each week is associated with a decreased level of happiness. However, it could not be determined that working more caused a decrease in happiness because many other variables could affect happiness that were not controlled for, such as the type of job the participants were working in.

ISBN 978-1-009-25416-8 Gallagher et al

Table 1B–9 Strengths and limitations of correlational studies

Strengths	Limitations
• The direction and strength of a relationship between variables can be determined using a correlational study. • They can be used to gather initial information that is investigated further or to research behaviours where controlled experiments cannot be used for practical or ethical reasons. • Observation of real-life behaviours with no manipulation of variables may result in behaviours that are more natural. • Secondary data can be used. • If a relationship between two variables is determined, the value of one variable can then be used to predict the value of the other variable. • They can be used to determine the repeatability, reproducibility and validity of measurements, and they are often high in external validity. • Extra procedures to control for extraneous variables are not needed.	• Correlation does not equal or imply causation, so even if a strong relationship is determined, you cannot assume that one variable causes a change in the other. • The relationship is bi-directional, and you cannot determine which variable has more influence. • A large amount of data is required. • As extraneous variables are not controlled for, you cannot determine that there was not an influence of a third variable, meaning there is a low internal validity.

2A PROCESSING AND ANALYSING DATA LINK

Check-in questions – Set 4

1 What does a controlled experiment aim to find out?
2 When would a researcher choose to use a case study instead of a controlled experiment?
3 What is the difference between classification and identification?
4 When is a correlational study used instead of a controlled experiment?

Fieldwork

Fieldwork a type of investigation that involves collecting information through observing and interacting with a selected environment

Fieldwork is a type of investigation methodology that involves collecting information by observing and interacting with a selected environment. Often the environment is a real-life setting (Figure 1B–13), rather than a controlled laboratory setting, and can be based on enquiry or the investigation of an issue. Usually a correlation between variables is being sought, rather than a cause-and-effect relationship, because extraneous variables are not being controlled. Fieldwork may be conducted through a range of methods, including direct qualitative and/or quantitative observations and sampling, participant observation, qualitative interviews, questionnaires, focus groups and yarning circles. Each of these methods will be discussed, and they each have their own strengths and limitations.

Figure 1B–13 Fieldwork often involves observing behaviour in real-life settings.

ISBN 978-1-009-25416-8 Gallagher et al

Direct observations and sampling

Fieldwork using direct observations and sampling involves watching and recording participant behaviour, including how they interact with their environment, typically without interference or intervention from the researcher. Qualitative and quantitative data can be collected, and data sampling methods determine the acquisition of a representative sample through:

- time sampling (e.g. only recording behaviour over a particular time interval, such as recording student behaviour for only one minute out of every 10 minutes in class)
- event sampling (e.g. only recording the behaviour when a specific event occurs, such as recording how many students react to a teacher asking a question in class)
- situational sampling (e.g. recording the same behaviour over multiple circumstances, such as recording student and teacher interactions in class, in the playground and at the bus bay after school).

Participant observation

Fieldwork conducted through participant observation involves the researcher becoming an active participant in the group that is being studied, either in a disguised way, where the researcher is 'undercover' posing as a genuine member of the group, or in an overt way, where the researcher's participation is not concealed, and the participants are aware of the researcher's identity and presence.

Participant observation allows the researcher to guide the direction of the study and prompt in-depth and honest discussions that may have been impossible to access by an outsider. For example, in a well-known experiment, psychiatrist David Rosenhan pretended to be 'insane' by simulating psychiatric symptoms such as hallucinations and was admitted to a psychiatric hospital. Once admitted, Rosenhan observed the behaviours of hospital staff and other patients under the guise of being a patient himself.

Interviews, questionnaires, focus groups and yarning circles

Fieldwork conducted through interviews, questionnaires, focus groups and yarning circles involve self-report methods where the participant responds to questions and statements about the way they think, feel and behave.

Interviews consist of structured or unstructured questions that are answered verbally by the participant. Interviews can be conducted face to face, by phone, or by video conference, and the responses are recorded by the interviewer. Interviews allow participants to give more emphasis and elaborate on certain points, and participants can use their own words to describe their experiences. For example, an interview on mobile phone preferences might include questions such as 'Explain why Android is your preferred mobile phone operating system'.

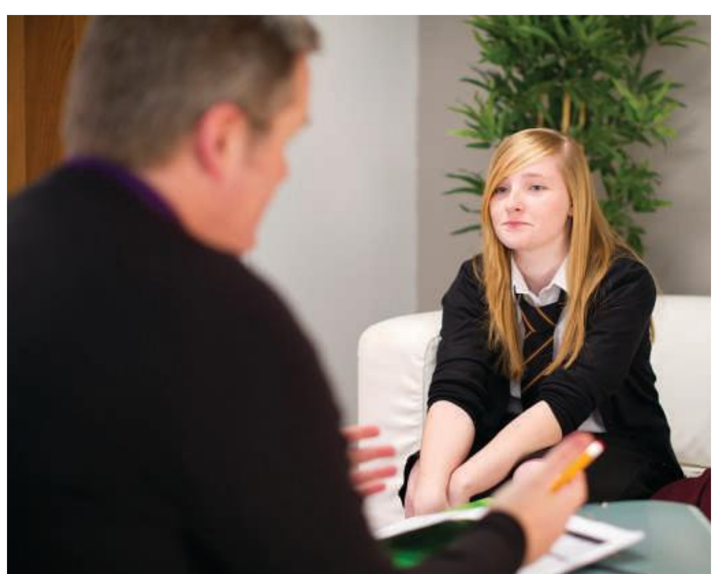


Figure 1B–14 Student leaders and captains are often interviewed for their opinion on school-related issues.

ISBN 978-1-009-25416-8 Gallagher et al

Questionnaires are a set of structured, written, open- or close-ended questions that are answered in a set format. They can be conducted face to face, on paper, online or by phone. For example, a questionnaire on mobile phone preferences might include questions such as 'Select your preferred mobile phone operating system: Android or iOS', or 'How many years have you owned Android devices?' or 'What is the model of your current mobile phone?'

Focus groups involve a trained moderator conducting a collective interview of multiple participants. Focus groups allow for dialogue and dynamic interaction between participants to gather a rich understanding of the perspectives, opinions, ideas and beliefs of the group. For example, a school may conduct a focus group with eight students from different year levels to determine their perspectives on using either tablets or laptops for schoolwork.

Yarning circles are a culturally informed alternative to focus groups. They are used to explore topics with Indigenous participants through reciprocal dialogue, storytelling and informal conversations to provide an insight into the Indigenous participants' thoughts and feelings about a topic. Yarning circles have been used by Indigenous peoples for centuries to learn from the collective group, build respectful relationships and pass on cultural knowledge. Yarning provides an opportunity to speak in a non-judgemental place where inclusion, respect and collaboration are of most importance. In a yarning circle, verbal statements can be a word, sentence or longer explanation, and can aid a scientific investigation to collect information in a culturally respectful manner. For example, a yarning circle could be used to evaluate the effectiveness of a new youth sporting program aimed at increasing student attendance at a high school in an Indigenous community.

Through these different methods of fieldwork, researchers can gather a wide range of data on a person's own experiences, behaviour, attitudes, beliefs and opinions, particularly ones that may be difficult or impossible to observe.

Table 1B–10 Strengths and limitations of fieldwork

Strengths	Limitations
• Information on sensitive topics can be obtained using fieldwork. • A large amount of quantitative data can be gathered in a questionnaire in less time than for a controlled experiment. • Participant anonymity in questionnaires can reduce dishonest or biased answers. • Rich qualitative responses can be obtained in the participant's own words. • Natural settings are more likely to show behaviour that reflects real life. • If participants are unaware that they are being studied, there is no change in their behaviour due to their belief of how they are expected to behave. • Fieldwork can be used when it would be impossible or unethical to investigate by controlled experimental methods. • Fieldwork can help to gain insight into existing data or behaviours that were not expected.	• Observed behaviour is subjective and open to interpretation and bias by the researcher. • Fieldwork is prone to social desirability bias, whereby participants respond in a way that they think they should respond, particularly if the researcher is present. • In questionnaires, interviews, focus groups and yarning circles, participant responses may be inaccurate because of dishonesty, memory issues, difficulty communicating, language abilities or misunderstanding the question. • Qualitative data can be difficult to summarise. • Interviews, focus groups and yarning circles can be time consuming. • There is minimal control over extraneous variables and results may not be replicable. • There are ethical concerns with the lack of informed consent in some cases.

2A PROCESSING AND ANALYSING DATA LINK

ISBN 978-1-009-25416-8 Gallagher et al

Literature review

A **literature review** involves collating and analysing **secondary data** findings and/or viewpoints. The findings can come from multiple published sources, including scholarly books and journal articles (Figure 1B–15). Literature reviews combine theories and results that evaluate a body of literature to answer a research question, provide background information to help explain observed events or provide a starting point for **primary data** collection.

Literature review a type of investigation that involves collating and analysing secondary data findings and viewpoints

Secondary data data obtained second hand through research conducted by another person for another purpose

Primary data data collected through first-hand research for an intended purpose

Figure 1B–15 To gather a wide range of information when writing your literature review, you can use a variety of books, publications and scientific journals.

Literature reviews do not present new research but are comprehensive and critical reviews that provide an overview on current understanding in a particular area of interest. Multiple sources are compared and critiqued, and relevant information is summarised by:

- discussing how knowledge has evolved over time
- acknowledging what research has already been completed
- highlighting the key researchers and evaluating their methodologies
- identifying areas of controversy
- describing what knowledge is currently accepted
- identifying emerging knowledge trends or gaps in current research to justify a proposed investigation.

A literature review is conducted over three main steps in which researchers:

- find the key literature relevant to their topic of investigation
- review and analyse the literature
- synthesise and organise the literature into a logical order so they can then write the review.

Literature reviews can be presented in different ways or for different purposes. They can form part of the introduction section of a larger work or stand alone as a separate full-length journal article. A stand-alone literature review is usually structured into three main sections: introduction, body and conclusion. The body typically contains subheadings to organise the various parts of the review.

ISBN 978-1-009-25416-8 Gallagher et al

2A PROCESSING AND ANALYSING DATA LINK

Table 1B–11 Strengths and limitations of literature reviews

Strengths	Limitations
• A literature review can determine what is already known and whether there is a solid foundation of knowledge, based on multiple sources. • They help introduce existing understanding and context for primary research. • They can identify expert researchers in the field. • They identify gaps in current understanding and areas for future research. • They identify methodologies that have been successful or not successful at generating significant findings.	• Key studies may be missed if the search criteria or focus of a review is too narrow, resulting in a review that lacks depth. • A selection bias in the chosen studies may result in the review being unrepresentative of current understanding or provide unbalanced conclusions. • A literature review may not comment on the validity of the original research or how the studies were selected, resulting in the reader being unable to determine the quality of each study within the review, or the review as a whole. • Literature reviews may describe multiple studies but lack a deeper analysis of the individual studies. • Only secondary data is acquired.

Modelling and simulation

Modelling
a type of investigation in which a physical or conceptual model is constructed and/or manipulated to simulate a system

Simulation
a type of investigation that uses a model to replicate and study the behaviour of a system

In psychology, **modelling** is an investigation methodology that involves constructing and/or manipulating a physical or conceptual model of a system. Once a model is made, a **simulation** uses the model to replicate and study the behaviour of a real or theoretical system.

Models are made to replicate a small or large physical object, or to represent a system involving concepts that help people know, understand or simulate the system (Figure 1B–16). Simulations then aim to imitate the real experience. Modelling and simulations are useful for studying psychological concepts that cannot logistically or ethically be tested in controlled experiments because of complexity, size, speed, accessibility or danger. For example, it is important to know how a new aeroplane pilot responds in emergency situations; however, it would not be ethical to put a new pilot directly into real and dangerous situations. By creating a model of an emergency in-flight situation, a pilot can practise their responses and skills safely. Also, investigators can compare the responses of multiple pilots by using the same controlled simulation testing conditions. Mice and rats are often used as models for the human condition before human trials are possible, such as in the study of neuroscience and addiction.

Simulations can take various formats. For example, virtual reality technology can simulate therapeutic procedures, or simulated people in a simulated environment can be used to create a model of the transmission rates of COVID-19 and then the predicted outcomes can be simulated by various transmission prevention strategies.

Modelling and simulation can precisely replicate events. For example, researchers can construct a computational model of a complex neurological medical case that requires brain surgery, then use simulation technology to safely practise the surgical procedure with the actual equipment. This can help reveal problems in surgical procedures, equipment and techniques before they are used in real life.

Modelling and simulation are useful in psychology because of the complex interaction of factors that influence behaviour that a controlled experiment may not take into consideration. An ongoing study called the Blue Brain Project aims to create the first computer simulation of the entire rodent brain.

ISBN 978-1-009-25416-8 Gallagher et al

Figure 1B–16 Creating a model and then simulating its use can help to safely investigate new techniques or tools.

Researchers have modelled a group of neurons that make up a small functional part of a mouse's brain known as a neocortical column, thought to be responsible for conscious thought. The aim is to expand the model to a full mouse brain which can then be used to simulate the mammalian brain and identify the fundamental principles of brain structure and function.

Models can help advance our understanding of psychology as well as our ability to predict probable occurrences. Researchers created a mathematical model of consciousness and, by using simulations, could anticipate and explain cognitive processes such as decision-making as well as behavioural reactions. The model was used to experiment with different cases of psychological illnesses.

LINK 2A PROCESSING AND ANALYSING DATA

Table 1B–12 Strengths and limitations of modelling and simulation

Strengths	Limitations
• Modelling can allow unobservable events to be visualised. • Once established, a computer simulation can run quickly with multiple trials in a short amount of time, including events that would usually be long running. • Modelling and simulation can be used to safely study new devices, therapies or treatments that would be too dangerous or unethical or logistically impossible to conduct in controlled experiments. • Simulations can allow us to predict future events and 'what if' situations. • Modelling and simulations can test a product before it is created.	• A large amount of valid source data may be needed in the creation of a model. • Computer simulations require precise, consistent statistical analysis in order to function accurately as a valid, repeatable and replicable measure. • A psychological theory may be well understood but difficult to apply as a working model. • Simulations are not the real thing and people may respond differently in real life, so simulations involve assumptions about behaviour that lower external validity because of artificiality. • Complex models and simulations may be expensive.

Product, process and system development

Product, process and system development in research involves the design of a product, a process or a system to meet a human need. These may involve technological applications in addition to scientific knowledge and procedures.

Product, process and system development a type of investigation in which a product, a process or a system is designed to meet a human need

Constant advances in technology and scientific understanding mean that researchers can review the effectiveness of current products, processes and systems in order to find solutions that best aid people to function most effectively. This principle applies to all aspects of life, and some examples of general applications, and applications in psychology, now follow.

ISBN 978-1-009-25416-8 Gallagher et al

Examples of the development of new *products* and improvement of existing ones:

- the continued development of reusable bags, coffee cups and drink bottles has allowed more Australians to reduce their plastic waste and move towards a healthier and safer environment
- developments in wearable technology mean we can track our sleep and movement 24/7
- AI-powered chatbots can provide virtual support for our mental wellbeing
- recent developments in electroencephalography (EEG) technology to produce portable and relatively cheap EEG devices mean a wider range of people can now monitor real-time brain activity. EEG headsets can be used for everyday functions, such as monitoring drowsiness of long-haul drivers or mining machine workers to reduce fatigue-related accidents, or to monitor the brain activity of elite athletes.

The design of a *process* that meets the need of people can help streamline a series of events into a logical order. This can improve repeatability, efficiency and predictability in many aspects of life. For example, reliable processes are important for:

- making laws safely and ethically
- enabling safe and ethical organ donations
- developing and trialling new drugs so they can be safely used by the public.

The development of new processes or refinement of current processes can help fill a gap in providing for people's needs or solve an existing problem.

Systems allow for the structure and organisation of multiple parts working together, in order to have an efficient framework for behaviour. Having 'the right systems in place' improves productivity and enhances the wellbeing of people. For example:

- the *Diagnostic and Statistical Manual of Mental Disorders* gives health professionals a reliable structure for diagnosing mental illness in patients
- in 2021, the World Health Organization created a system for naming the emerging coronavirus strains according to the Greek alphabet instead the places where they were discovered (Figure 1B–17). This system has helped reduce the geographical stigma and discrimination that was observed in the first year of the pandemic.

Figure 1B–17 New products such as prosthetic limbs, new processes such as methods to safely transport organ donations, and new systems such as ways to classifying the coronavirus strains have been developed to meet the ever-changing needs of humans.

ISBN 978-1-009-25416-8 Gallagher et al

WORKSHEET 1B–1 INVESTIGATION METHODOLOGIES SUMMARY TABLE

Check-in questions – Set 5

1 What is involved in a fieldwork investigation?
2 What can a literature review be used for?
3 Why would a researcher use modelling and simulation?
4 What is involved in product, process and system development?

ACTIVITY 1B–2 IDENTIFYING EXAMPLES OF INVESTIGATION METHODOLOGY

Match scenarios A to H to the investigation methodologies 1-8 which they represent.

Investigation methodology		Scenario
1 Controlled experiment		A Before a researcher conducts their own experiment, they need to conduct in-depth research into current knowledge of the effect of screen time on children.
2 Case study		B A patient known as 'HM' had a lobectomy to help control his severe epileptic seizures. Researchers studied his memory problems resulting from the surgery.
3 Classification and identification		C A researcher is collecting characteristics and behaviours of successful elite athletes to see which qualities the national team possesses.
4 Correlational study		D A surgeon needs to practise removing a complex tumour from a person's spinal cord before undertaking the surgery in real life.
5 Fieldwork (questionnaires and interview)		E A researcher wants to find out whether students who use a device for schoolwork are worse at spelling than students who handwrite their work at school.
6 Literature review		F A supermarket wants to find out shoppers' regular patterns of behaviour. The supermarket emails all supermarket rewards members a series of quick questions to answer online. Shoppers who come into the store are asked verbal questions to find out more information.
7 Modelling and simulation		G A neonatal surgeon requires an adaption to a regular-sized instrument to perform delicate surgery on an infant.
8 Product, process or system development		H An educational researcher wants to find the relationship between a student's Year 12 results and their performance in their first-year university course.

ISBN 978-1-009-25416-8 Gallagher et al

VIDEO 1B–4
SKILLS: DESCRIBING STRENGTHS AND LIMITATIONS OF RESEARCH METHODS

1B–3 SKILLS

Describing strengths and limitations of research methods

There is no one perfect choice of sampling technique, investigation design or investigation methodology, because it depends on the investigation being conducted. There are advantages and disadvantages for using each type.

When describing the strengths and limitations of different research method concepts, it is important to ensure that you:

- describe an advantage/disadvantage of using that choice of research method; do not just define the concept
- describe an advantage/disadvantage of using that choice of research method over another method. Something cannot be a strength or limitation of that method if it applies to all method options.

If a question asks you to compare the strengths or limitations of two methods, make sure you use a comparative term such as 'whereas' and select one feature to directly compare.

Question:

Provide a strength of using a correlational study over a controlled experiment.

Attempted answer:

A correlational study describes the statistical association and strength of the relationship between two variables. A controlled experiment allows a conclusion to be determined for an investigation.

Marking comments:

This response describes what a correlational study involves, rather than providing a strength. The statement for the controlled experiment is actually true for all investigation types, so it is not a strength of controlled experiments alone. This response also does not directly compare the two concepts. This response would receive 0/2 marks.

Suggested answer for full marks:

A correlational study does not require extra procedures to control for extraneous variables, whereas a controlled experiment requires strictly controlled conditions to control for extraneous variables.

ISBN 978-1-009-25416-8 Gallagher et al

Section 1B questions

1 In the following research scenarios, describe the population and sample, and identify and explain the type of sampling technique used.
   a Mrs Ally is the Year 11 Coordinator at Ferny High School and wants to find out how students are coping with the increased amount of homework coming into Year 11 compared to Year 10. She prints the school photos of all 270 students in Year 11, cuts them up, and places them into a box. Without looking, she selects 50 photos and emails these students a short questionnaire to complete.
   b A chocolate company wants to test whether consumers can tell the difference between their brand of chocolate and their competitor's. The company thinks that children might prefer their brand but adults would prefer the competitor's chocolate, so they need to ensure that children and adults are both represented proportionally in their study. They obtain 100 participants.
   c A local Melbourne council is gathering data from people who use a new park in the community. The council wishes to find out people's opinions on the new park's facilities. A researcher stands at the park's entry gate and surveys 55 people between the ages of 18 and 65 who come to the park one weekend.

2 Current Australian Census data states that the percentage of females and males in Victoria is 51% and 49% respectively. In a stratified sample of 100 participants from Victoria, how many males and females should there be?

3 An optometrist wants to test a new glasses lens coating that she has created to help reduce the glare from lights at night-time. She seeks out 150 participants to test the effectiveness of the old lens coating compared to the new coating. Participants are randomly assigned to wearing glasses with either the new coating or the old coating. They then complete a driving simulation under different lighting conditions while connected to a device that measures how much they squint.
   a Justify why this study is an example of a controlled experiment, and outline one strength and one limitation of using this type of investigation for this study.
   b Justify why the investigation design used in this study is classified as between subjects.
   c Explain how the researcher could use a within subjects investigation design in this study, and why it would be beneficial.
   d Explain why a case study is not an appropriate investigation methodology to use for this study.

4 A local basketball club wants to increase the number of players that attend their end-of-season awards function. The function is currently held at the basketball stadium and the club thinks that moving the function to a local trampoline park will make more players want to attend.
   Outline how the club could use fieldwork questionnaires and interviews to source data on the players' opinions of their end-of-season functions.

5 Provide an example of a health-related study that could be completed using the modelling and simulation investigation methodology.

6 Create a table to compare one strength and one limitation of a controlled experiment and a correlational study.

ISBN 978-1-009-25416-8 Gallagher et al

1C Safety and ethical understanding

Study Design:

Comply with safety and ethical guidelines

- Demonstrate ethical conduct and apply ethical guidelines when undertaking and reporting investigations
- Demonstrate safe laboratory practices when planning and conducting investigations by using risk assessments that are informed by safety data sheets (SDS), and accounting for risks
- Apply relevant occupational health and safety guidelines while undertaking practical investigations
- Analyse and evaluate psychological issues using relevant ethical concepts and guidelines, including the influence of social, economic, legal and political factors relevant to the selected issue

Glossary:

Beneficence
Confidentiality
Debriefing
Deception in research
Ethical concepts
Ethical guidelines
Informed consent procedures
Integrity
Justice
Non-maleficence
Occupational health and safety (OHS)
Respect
Risk assessment
Safety data sheet (SDS)
Voluntary participation
Withdrawal rights

ENGAGE

Examples of unethical research

Psychological and medical research use animal and human subjects, and are therefore probably the two disciplines with the most examples of unethical research in the past. In addition to the notoriously cruel experiments carried out by Nazi German and Japanese authorities in the twentieth century, there are many other examples, including in Australia. For example, in 2000 the University of Adelaide apologised for scientific experiments conducted on Aboriginal peoples in the 1920s and 1930s that were deemed 'degrading and, in some cases, barbarous.'

Some of the historical psychological research you may encounter in this course would be considered unethical today, although this may not be apparent until you consider the details of the methodology. Examples are the Little Albert studies, the Bobo doll experiment, the Stanford Prison experiment, and the Milgram experiment. Some of these experiments have been made widely known to the general public through films (Figure 1C–1).

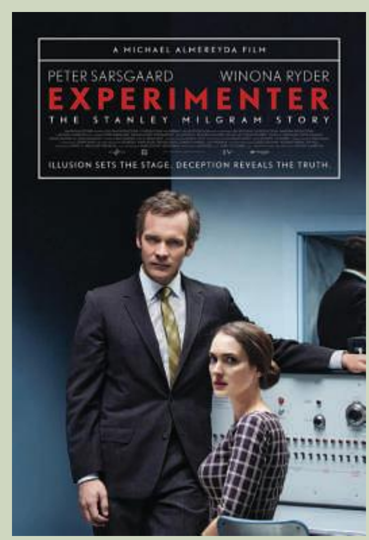


Figure 1C–1 The Milgram experiment was infamous enough for a 2015 movie, *Experimenter*, to be made about its lead researcher, Stanley Milgram.

Although examples of specific unethical research are not assessed as part of this course, you may be asked questions that require you to determine what might be unethical about certain research scenarios. You may gain some insights by reading about examples of unethical research in psychology. As always, consider the reliability and reputation of any sources you find.

ISBN 978-1-009-25416-8 Gallagher et al

EXPLAIN

Ethical concepts in psychological issues

VIDEO 1C–1
ETHICAL CONCEPTS

Ethical understanding is critical when conducting and analysing research, but also when evaluating psychological issues that are relevant to society. It is important to have an ethical understanding to consider the implications of investigations, use integrity and reach a position on science-related ethical issues. There is a need to recognise the importance of values, and social, economic, political and legal factors in responsible science-related decision-making. For example, when investigating the issue of global mental health, it is relevant to consider factors such as government policies; socio-economic status; the relationship between mental health, poverty and debt; human rights, funding and the economic burden of disease; the various risks for children and youth; and the impact of the criminal justice system.

Some general **ethical concepts** can be considered when analysing and evaluating the ethical and moral aspects of conduct in relation to psychological issues. These concepts are general in nature and are separate from any codes, legislation and ethical guidelines that apply to the ethical conduct of psychological investigations. These ethical concepts are integrity, justice, beneficence, non-maleficence and respect.

Ethical concepts general ethical considerations used to analyse the ethical and moral aspects of conduct surrounding psychological issues and psychological investigations

Integrity an ethical concept involving the commitment to searching for knowledge and understanding and the honest reporting of all sources of information and results

Integrity

Integrity is the commitment to searching for knowledge and understanding and the honest reporting of all sources of information and results.

Whether results are favourable or unfavourable to the initial intentions of a study, a researcher has an obligation to report them truthfully in a way that permits scrutiny and contributes to public knowledge and understanding. Findings should be published even if they are negative or inconclusive. The actions of researchers and practising psychologists should be consistent with their internal core values core values, and these practitioners and researchers should maintain accountability for their actions. When reporting the results of an investigation, researchers should provide a complete and accurate representation of the facts, without manipulation, fabrication or misconduct. For example, in 2011, a Dutch psychologist Diederik Stapel was found to have manipulated data and fabricated experiments that were then used in at least 30 published, peer-reviewed papers. After this case was investigated, it was recommended that there should be a ‘research integrity’ moderator within research departments to monitor for such behaviour.

Justice

Justice involves the moral obligation to ensure that competing claims are considered fairly, that there is no unfair burden on a particular group from an action, and that there is fair distribution and access to the benefits of an action.

Justice an ethical concept involving fair consideration of competing claims, no unfair burden on a particular group, and fair access to benefits of an action

Justice means ensuring the right to be treated fairly, such as equal access to psychological treatment regardless of age, place of residence, social status, culture or disability. However, treating all people equally is not always fair, and therefore justice means ensuring people’s differences are also accounted for. For example, providing all participants, including those who are blind or have low vision, with a written informed consent form would be ‘equal’, but providing participants with the form in Braille or having the information read out verbally would be considered fair.

ISBN 978-1-009-25416-8 Gallagher et al

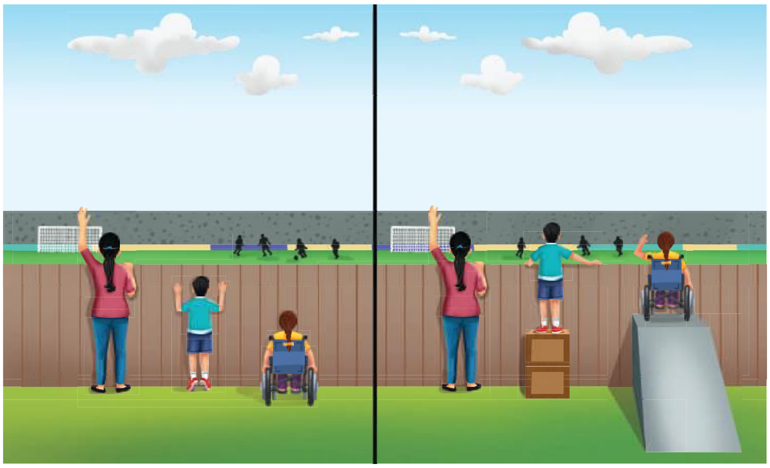


Figure 1C–2 The ethical concept of justice means ensuring people's differences are accounted for.

There is a responsibility to ensure all people have the right to access advances in psychology such as knowledge acquired from research and the distribution of benefits and resources. This could mean selecting an appropriate format for reporting the research outcomes. Denying a person a benefit they are entitled to without good reason would be considered unjust.

The process of recruiting participants should be fair in terms of the selection, exclusion and inclusion of categories of research participants, and there should be no unfair burden on the participant. For example, some groups of people are at risk of being exposed to 'over research' because only a small number of people form that group or because they are easily available, such as those confined to psychiatric hospitals, those who are terminally ill, or those from a small, minority ethnic group.

Beneficence and non-maleficence

Beneficence an ethical concept involving the commitment to maximising benefits and minimising risks and harms

Non-maleficence an ethical concept involving the avoidance of causing harm

Beneficence is the commitment to maximising benefits and minimising the risks and harms. This is important in psychology when taking a particular position or completing a course of action, such as a research investigation. A benefit is something of positive value, such as contributing to psychological knowledge, and improving individual and societal wellbeing, and it is important that all actions are in the best interest of others.

Non-maleficence means to avoid causing harm. Determining a position or conducting scientific research in psychology may lead to a degree of harm or discomfort, so it is necessary that the possible harm resulting from any position or course of action is scientifically justifiable and is not disproportionate to the possible benefits.

Harm can include physical harm such as injury, psychological harm such as distress, social harm such as discrimination, economic harm such as costs, and legal harm such as criminal conduct. The primary concern is to do no harm, and any acceptable level of harm must be kept to a minimum.

The two ethical concepts of beneficence and non-maleficence can be considered together, in an understanding that one must act in a manner that promotes the benefit to others, while also minimising the harm to others.

Before a research investigation starts, an assessment of risk is made. This includes determining the likelihood and severity of the harm, and the short-term and longer-term risks and benefits. The researcher must always prioritise participants' wellbeing. These risks and benefits may affect the participants directly, but also their families, the wider community or particular groups they identify with.

To maintain ethical compliance, the benefit of the research must outweigh or justify any participant discomfort. For example, a person with severe form of an illness might choose to participate in a clinical trial for a new treatment; however, a person with a less severe form might not. In a clinical example, a person considering electroconvulsive therapy for the treatment of major depression would weigh up the benefits of potentially reducing their

ISBN 978-1-009-25416-8 Gallagher et al

symptoms against the risk of memory loss. During an investigation, if the balance tips so that the benefits do not outweigh the risks, then the risks are no longer justified, and the research must be stopped and reassessed.

Respect

The ethical concept of **respect** involves considering the value of living things, giving due regard, and considering the capacity of living things to make their own decisions.

Respect an ethical concept involving the consideration of the value of living things, giving due regard, and consideration of the capacity of living things to make their own decisions

To have consideration of the value of living things means to respect the extent to which a person or animal has an:

- intrinsic value, which is value for its own sake, in its own right
- instrumental value, which is value as a means to an end, resulting in some final intrinsic value.

For example, this would mean understanding that each person has worth in and of themselves, and that their value is not just as a participant in a study without any dignity.

Giving due regard to both an individual and the wider collective involves explicitly considering their welfare, liberty and autonomy, beliefs, perceptions, customs and cultural heritage. This means respecting a person's need to be treated in their best possible interest, according to their individual characteristics and with respect to their cultural sensitivities.

Researchers need to consider the capacity of living things to make their own decisions, such as a person determining their participation in research. When animals are involved, or when people have a diminished capacity to make their own decisions, such as due to age, intellectual ability or level of consciousness, they must be empowered where possible and protected as necessary.

Figure 1C–3 The ethical concept of respect involves considering the value of an individual in their own right. This also includes protecting the welfare of animals.

Check-in questions – Set 1

1. What is integrity as an ethical concept?
2. What is justice as an ethical concept?
3. What is the difference between beneficence and non-maleficence?
4. What is respect as an ethical concept?

ISBN 978-1-009-25416-8 Gallagher et al

Ethical guidelines guidelines that ensure the protection and welfare of all participants in research

Ethical guidelines in research investigations

In Australia, researchers using human participants in an investigation must follow the **ethical guidelines** set out by the National Health and Medical Research Council (NHMRC) in their document the 'National Statement on Ethical Conduct in Human Research', to ensure the protection and welfare of all participants in research. This document can be found and downloaded through an Internet search.

Figure 1C–4 A research ethics committee should include people with a variety of expertise to best represent the ethical interests of the participants.

Human research ethics committees are involved throughout all stages of an investigation to ensure that researchers are following the mandated ethical guidelines. Ethics committees are responsible for approving research before it begins. The committee considers the level of risk of harm to participants, including the likelihood and severity of harm. Research is ethically acceptable only when its potential benefits justify any risks in the research. Once a proposal is accepted, an ethics committee will monitor the duration of the study to ensure the researchers continue to follow all ethical responsibilities.

A researcher must follow the NHMRC guidelines and ensure that their proposed research has merit and reflects the overarching ethical concepts of integrity, justice, beneficence, non-maleficence and respect.

Once an investigation begins, the researcher must follow several additional ethical guidelines that are specifically relevant to research, to ensure participants' rights are met while they are involved. These guidelines include confidentiality, voluntary participation, informed consent, withdrawal rights, use of deception and debriefing.

Confidentiality

Confidentiality an ethical guideline that ensures participants remain anonymous, and their personal information is kept private, protected and secure throughout the study

Confidentiality means ensuring that the participants remain anonymous, and their personal information is kept private, protected and secure throughout the study. Participants have the right for their details to remain confidential. For example, a participant's name should not be included with their published results. Instead, participants may be de-identified and data should be coded to allow each participant to remain anonymous. The exception to this would be when consent is explicitly given to allow data to be shared; for example, in video recordings where identity cannot be hidden. If researchers plan to share personal data, they should inform participants during the consent process, and let them know how their data will be used.

Figure 1C–5 Participant information such as medical tests collected during studies must be de-identified and kept private.

ISBN 978-1-009-25416-8 Gallagher et al

Voluntary participation

Voluntary participation ensures that each participant freely agrees to participate in a study, with no pressure or coercion. It is common and acceptable for participants to be paid or receive compensation for their involvement in a study if it is deemed proportionate to the burden of the research. However, the payment must not be used to persuade a person to participate or persuade them to take undue risks. Additionally, participants must not be disadvantaged if they decide not to participate. For example, a university must not force students to be involved in a study in order to pass their university course.

Voluntary participation an ethical guideline ensuring that each participant freely agrees to participate in a study, with no pressure or coercion

Informed consent procedures

Informed consent procedures are conducted before a study begins, where participants agree to participate in the research after they have received all the details of the investigation including the nature and purpose, methods of data collection and potential risks. Participants usually receive this information in a written document that they must sign as their agreement to participate. Participant consent should be based on a sufficient understanding of their involvement requirements, and the possibilities for psychological or physical risk.

Informed consent is also the stage when participants are told about their withdrawal rights and confidentiality rights, and a researcher must provide an opportunity for participants to discuss the provided information and ask questions.

Participants who are under the age of 18 or who lack the capacity to consent for themselves, such as someone with a severe intellectual disability, cannot legally give consent for themselves and must have a parent or legal guardian read and sign the informed consent on their behalf. However, researchers must still attempt to obtain informed consent as far as practically possible from these groups. In all cases, it is necessary for informed consent forms to be written in plain language that the participant can understand. See the Interactive Textbook for an example of an informed consent form.

Informed consent procedures an ethical guideline conducted before a study begins – participants agree to participate after they have received all the details of the study, including the purpose, procedures and potential risks

DOC **DOCUMENT 1C–1** INFORMED CONSENT FORM FOR PARTICIPATING IN RESEARCH

Withdrawal rights

Withdrawal rights ensure that participants are free to discontinue their involvement in a study without receiving a penalty. Once a participant begins a study, they cannot be forced to continue if they want to stop. They can withdraw their involvement during the study or withdraw their results after the study has concluded. Withdrawal rights should be outlined to participants in the informed consent process so that they are aware of their rights before agreeing to begin the study.

Withdrawal rights an ethical guideline that ensures the participants are free to discontinue their involvement in a study at any point during or after the conclusion of the study, without receiving any penalty

Use of deception in research

Deception in research involves withholding the true nature of the study from participants if their knowledge of the true purpose may affect their behaviour and the subsequent validity of the investigation. Sometimes it is necessary to not tell the participants exactly what is going to happen in a study. For example, if you tell a group of children that their ability to follow the rules of a game is going to be measured, then this might cause the children to behave in a way that is different from normal. Instead, you could tell the children that the study will be measuring something else inconsequential, such as how often a particular score comes up.

Figure 1C–6 In an investigation into the themes of children's drawings, the children may instead be told that the researchers are observing their painting skills, in order to prevent any change to their natural behaviour.

Deception in research an ethical guideline involving withholding the true nature of the study from participants, when their knowledge of the true purpose may affect their behaviour and subsequent validity of the investigation

ISBN 978-1-009-25416-8 Gallagher et al

Deception brings up issues about informed consent and is discouraged in psychological research; however, it is allowed if the benefits are sufficient to justify the deception, when there is no alternative method, when there is no risk of harm to participants, and when debriefing procedures at the conclusion of the investigation clarify the true nature of the study and the reason for deception. Informed consent forms should also outline the possibility of the use of deception in the study.

Debriefing an ethical guideline involving provision of information to participants at the end of the study, including the true aims, results and conclusions, and answering any questions, clarifying misunderstandings or deception, and providing support to ensure no lasting harm

Debriefing

Debriefing is conducted at the end of the study and is when participants are informed of the true aims, results and conclusions of the study. Debriefing includes answering any questions, clarifying misunderstandings or deception, and providing support to ensure no lasting harm occurs to participants. During debriefing procedures, the participants are told of the findings and conclusions of the study, and informed that they may have access to their own results. It is also an opportunity to provide participants with additional contact details if they want further information and to provide them with counselling services should they need them.

Research involving Aboriginal and Torres Strait Islander peoples

In addition to the ethical guidelines already described in this section, any research involving Aboriginal and Torres Strait Islander peoples should also follow additional guidelines to ensure their wellbeing and that they are also able to benefit from the research.

WORKSHEET 1C–1 ANALYSING ETHICS IN RESEARCH

In 2018, the NHMRC developed the document 'Ethical Conduct in Research with Aboriginal and Torres Strait Islander Peoples and Communities: Guidelines for Researchers and Stakeholders'. These guidelines define six core values: spirit and integrity, cultural continuity, equity, reciprocity, respect, and responsibility. These values ensure that all research conducted with or for Aboriginal and Torres Strait Islander peoples is conducted ethically, with the aim of improving the way all researchers work with First Australians, developing and/or strengthening their research capabilities, and enhancing their rights as researchers, research partners, collaborators and participants in research. Additionally, dedicated ethics committees representing Aboriginal and Torres Strait Islander focused organisations are required to oversee these studies.

WORKSHEET 1C–2 RESEARCH WITH FIRST AUSTRALIANS

Worksheet 1C–2 in the Interactive Textbook provides an information research activity with links to the NHMRC guidelines and further resources on this topic.

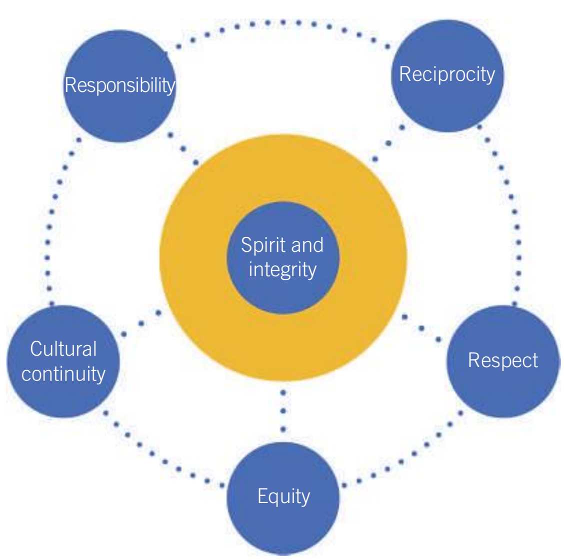


Figure 1C–7 The NHMRC's document 'Ethical Conduct in Research with Aboriginal and Torres Strait Islander peoples and Communities: Guidelines for Researchers and Stakeholders' outlines the six core values shown on the left.

ISBN 978-1-009-25416-8 Gallagher et al

Safety in research investigations

In addition to following all ethical considerations, when planning and conducting investigations at school, you must demonstrate safe laboratory practices, follow occupational health and safety guidelines, and account for risks by using risk assessments that are informed by safety data sheets (SDS).

Figure 1C–8 When conducting scientific investigations, it is important to follow all health and safety guidelines.

Occupational health and safety (OHS) refers to issues of health, safety and welfare that must be protected in a workplace. When conducting investigations in VCE Psychology, you should adhere to the rules and guidelines provided by your teacher to ensure that everyone remains safe.

OHS guidelines should be at the forefront of risk management when planning an investigation. **Risk assessment** is a process that considers, identifies and reduces physical and psychological risk. As with research conducted in real life, teachers and students conducting practical investigations in schools must ensure that there is no harm to participants or other people involved. A risk assessment allows you to assess the likelihood of each possible risk and its consequences before identifying a way to control the risk. Risks could involve things such as hazards in the physical surroundings, hazards formed from the activity or equipment, and hazardous substances such as chemicals. When you are using chemical substances, you should review the relevant **safety data sheet (SDS)** as part of the risk assessment. SDSs are documents that provide important information about the substance, such as its ingredients, precautionary statements and first aid measures. See the Interactive Textbook for examples of a risk assessment template and associated risk matrix chart and an SDS.

Occupational health and safety (OHS) issues of health, safety and welfare that must be protected in a workplace

Risk assessment a process involving the consideration, identification and reduction of physical and psychological risk

Safety data sheet (SDS) a document that provides all the important information about a substance, such as its ingredients, precautionary statements and first aid measures

DOCUMENT 1C–2 RISK ASSESSMENT TEMPLATE AND RISK MATRIX CHART

DOCUMENT 1C–3 SAFETY DATA SHEET EXAMPLE

Check-in questions – Set 2

1 What is involved in maintaining the ethical guideline of confidentiality?
2 What does voluntary participation mean?
3 When does informed consent occur?
4 What are three things included in an informed consent form?
5 When can a participant withdraw from a controlled experiment?
6 Why might deception be used in research?
7 When does debriefing occur and what is its purpose?

ISBN 978-1-009-25416-8 Gallagher et al

ACTIVITY 1C–1 ETHICAL GUIDELINES IN RESEARCH

Read the following research scenario and then copy and complete the table by adding definitions of each ethical guideline and how they should be used in the research scenario.

Xavier is a researcher who is testing how children cooperate in group situations. He samples 30 children from a local primary school. He does not want the children to know what he is studying, so he tells them that he is testing their ability to pay attention to instructions.

Ethical guideline	Definition	How should it be used in Xavier's study?
Confidentiality		
Voluntary participation		
Informed consent		
Withdrawal rights		
Deception		
Debriefing		

1C SKILLS

VIDEO 1C–2 SKILLS: DEFINING KEY TERMS

Defining key terms

Answering questions in VCE Psychology SACs and exams often requires you to use key terms and their definitions. When defining or describing a key term, avoid using any part of the key term in its own definition.

For example, when describing withdrawal rights procedures, it is not clear enough to say that 'withdrawal rights involve participants having the right to withdraw from a study at any point'.

Try to pick a different word to describe the key term, such as 'withdrawal rights involve participants being able to leave a study at any point'.

This helps show that you understand what the key term actually means.

Question:

Explain the ethical guideline of voluntary participation.

Attempted answer:

Voluntary participation involves participants participating in an investigation voluntarily.

Suggested answer for full marks:

Voluntary participation involves each participant agreeing to take part in an investigation of their own accord and free from any coercion.

ISBN 978-1-009-25416-8 Gallagher et al

Section 1C questions

1 A researcher is formulating a new drug for migraines and needs participants for a clinical trial. They stick up fliers about their research in a doctor's clinic, so patients can take a flier if they want to participate. Ten adults volunteer for the study. During the trial, one participant feels the medication is not working and decides they want to stop the study. The researcher tells this participant that if they continue the study, then they will receive some free medical supplies, so they decide to continue. The researcher has an overseas colleague who is interested in the study too, and so the researcher sends a photo of a participant's files, including their medical test results, to the colleague.
   - a Identify and explain one ethical guideline that was followed correctly in this study.
   - b Identify and explain two ethical guidelines that were not followed correctly in this investigation. Explain what the researcher should do to fix these ethical issues.
   - c Explain how the ethical concept of integrity needs to be maintained in this study.

2 A developmental psychologist is interested in studying aggression in children. They advertise to some local primary schools for participants. The researcher does not tell the selected children or their parents that they are studying the children's aggression during the day, and instead tell them that they are there to see how children use imagination in their play. At the end of the day, the researchers thank the children and their parents for participating but decide not to tell them what they were really looking for, in case the parents got upset about their child being seen as aggressive.
   - a Identify and explain one ethical guideline that is evident in this investigation.
   - b Explain why this ethical guideline needed to be used, and what the researcher should do to ensure it is used correctly.
   - c Explain how beneficence and non-maleficence should be considered in this study.
   - d Identify one risk that should be considered in the risk assessment completed before beginning this investigation.

3 A local newspaper is reporting on the experience of local residents after a severe flood that destroyed many homes in the community. Explain how the ethical concepts of respect and integrity should be maintained by the newspaper in their coverage of this event.

Figure 1C–9 Always review ethical concepts and safety measures before starting a research project.

ISBN 978-1-009-25416-8 Gallagher et al

Chapter 1 review

Summary

Create your own set of summary notes for this chapter on paper or in a digital document. A model summary is provided in the Teacher Resources, which can be used to compare with yours.

Checklist

In the Interactive Textbook, the success criteria are linked from the review questions and will be automatically ticked when answers are correct. Alternatively, print or photocopy this page and tick the boxes when you have answered the corresponding questions correctly.

Success criteria – I am now able to:		Linked questions
1A.1	Identify and research aims and questions for investigation	1 ☐
1A.2	Construct aims and questions for investigation	10a ☐
1A.3	Distinguish between independent, dependent, controlled, extraneous and confounding variables	11b ☐
1A.4	Identify the independent, dependent and controlled variables within controlled experiments	2 ☐
1A.5	Identify extraneous variables to be controlled in a controlled experiment	11c ☐
1A.6	Explain the effect of extraneous and confounding variables on the results of a controlled experiment	10b ☐
1A.7	Write a hypothesis to focus an investigation	11a ☐
1A.8	Predict the possible outcomes of an investigation	10d ☐
1B.1	Describe and identify examples of the use of different investigation methodologies, including case study; classification and identification; controlled experiment; correlational study; fieldwork; literature review; modelling; product, process or system development; and simulation	7 ☐
1B.2	Describe and identify the use of within subjects, between subjects and mixed designs in a controlled experiment	3 ☐
1B.3	Evaluate strengths and limitations of different investigation methodologies and select an appropriate investigation methodology for a proposed investigation	5 ☐
1B.4	Evaluate strengths and limitations of different investigation designs for a controlled experiment and select an appropriate design for a proposed investigation	10e ☐
1B.5	Describe and identify the use of random and stratified sampling techniques in an investigation	4 ☐
1B.6	Evaluate strengths and limitations of different sampling techniques and select an appropriate technique to achieve representativeness	12b ☐
1B.7	Select and use appropriate equipment and procedures for an investigation, and select an appropriate sample size to achieve representativeness	12a ☐
1B.8	Work independently and collaboratively within constraints, adapting or extending processes as required and recording modifications	12f ☐
1C.1	Describe and evaluate the use of general ethical concepts to be followed in psychological investigations, including integrity, justice, beneficence, non-maleficence and respect	10c ☐

ISBN 978-1-009-25416-8 Gallagher et al

Success criteria – I am now able to:		Linked questions
1C.2	Describe and evaluate the use of the additional ethical guidelines to be followed in psychological investigations, including confidentiality, voluntary participation, informed consent procedures, withdrawal rights, use of deception and debriefing	6☐
1C.3	Consider the ethical implications of investigations when planning an investigation and demonstrate ethical conduct and apply ethical guidelines when recording data, using data and reporting outcomes of investigations	12c☐
1C.4	Demonstrate safe laboratory practices by identifying areas of risk and using risk assessments that are informed by safety data sheets when planning and conducting investigations	12d☐
1C.5	Evaluate the use of and apply relevant occupational health and safety guidelines while planning and undertaking practical investigations	12e☐
1C.6	Analyse and evaluate psychological issues with reference to the influence of relevant social, economic, legal and political factors	8☐
1C.7	Analyse and evaluate psychological issues using ethical concepts of integrity, justice, beneficence, non-maleficence and respect	9☐

Multiple-choice questions

The following information relates to Questions 1 and 2.

Elizabeth Loftus is a researcher who conducted many studies on how eyewitness testimonies can be influenced by leading questions – questions that influence a person to give a desired answer. Leading questions can propose incorrect information that is then incorporated into the original memory.

1 Which of the following is a possible research question or aims for one of Loftus's studies?

A Leading questions will lead to inaccurate eyewitness testimonies.
B Can eyewitness testimonies be influenced by leading questions?
C To investigate whether eyewitness testimonies can be influenced by leading questions.
D Eyewitness testimonies can be inaccurate due to leading questions adding in false information during memory reconstruction.

2 Which of the following would be a suitable independent variable and dependent variable for Loftus's study?

	Independent variable		Dependent variable
	Control group	Experimental group	
A	no leading question included	accuracy of eyewitness testimony	leading questions
B	eyewitness testimony	memory reconstruction	eyewitness testimony
C	whether the question is a leading question	whether the question is a leading question	type of question
D	no leading question included	questions including one leading question	accuracy of eyewitness testimony

The following information relates to Questions 3–6.

A researcher is studying how a new rehabilitation method can help the brain recover from damage. They want to use neuroimaging techniques to monitor the changes to the brain's function, four times over a period of 12 months.

ISBN 978-1-009-25416-8 Gallagher et al

3 Which type of investigation design would be most appropriate for this study?

A within subjects because the participants will be scanned multiple times and the individual differences between participant variables needs to be controlled for

B within subjects because it can control for the effect of experimenter bias

C between subjects because participants will be allocated to either the new or old rehabilitation method

D mixed design because a within subjects design will be used for the multiple scans over 12 months, and a between subjects design will be used because participants will be allocated to the new rehab method or the old method

4 Adaptive plasticity describes how the brain can recover from injury, and it tends to be more effective in children than in adults. The researcher wants to obtain a sample that allows for a proportionate representation of ages. The sampling technique that would best satisfy this requirement is

A an independent sampling technique because a large enough sample may be generalised to the population.

B a non-random sampling technique because it is more time effective.

C a stratified sampling technique because it can allow for the most accurate representation of children and adults.

D a random sampling technique because subgroups may be based on age.

5 The researcher asks the participants to keep a record of their own opinions of their progress. Each fortnight they rate their progress on a scale from 1 to 5. A limitation of using a fieldwork method such as this one is that

A results could be biased because participants may respond in a way that they think they should respond.

B participants cannot remain anonymous.

C only qualitative data can be obtained.

D researcher bias may influence the recording of data.

6 When the researcher reports the results and conclusions of the study, they must ensure the participants' details are kept private. This maintains the ethical guideline of

A informed consent.

B voluntary participation.

C confidentiality.

D debriefing.

7 Bandura conducted a study investigating how children's behaviours can be influenced by observing adults. Bandura video recorded an adult playing roughly with a life-size inflatable clown, known as a Bobo doll. The video was then shown to children before they were allowed to play with the Bobo doll themselves. The children's behaviour was recorded on video, and a description of their actions was recorded.

The investigation methodology used in Bandura's study was a

A correlational study, where children's and adults' behaviours were compared.

B case study, where the adults recorded their own behaviours.

C controlled experiment, measuring the effect of adult behaviours on children.

D fieldwork study, where the children's behaviours were recorded as they occurred through direct observation.

The following information relates to Questions 8 and 9.

A remote community is approached by a film production company to film a movie in their town and surrounding bushlands. The company is informing the community about the potential benefits to the town, such as an increase in tourism.

8 The possibility of an increase in money coming into the community would be considered which type of factor, relevant to this issue?

A economic

B legal

C political

D social

ISBN 978-1-009-25416-8

9 Before giving the film production company permission to begin filming, the community considers the beneficence of this project, which would involve

- **A** the commitment to the honest reporting of all sources of information and results.
- **B** the commitment to maximising benefits and minimising the risks and harms.
- **C** no unfair burden on a particular group from an action.
- **D** considering the capacity of living things to make their own decisions.

Short-answer questions

10 Akeno works in an after-school care centre and is trying to get the children to wash their hands properly to help prevent the spread of illness. He has heard that it is recommended that people spend 20 seconds to wash their hands thoroughly enough to remove germs. Akeno decides to trial getting the children to sing the song 'Twinkle Twinkle Little Star' while washing their hands, to ensure they are washing for long enough to be effective. When each student in the centre arrives at the sink to wash their hands, Akeno flips a coin. If he flips 'Heads', he asks the child to sing the song while washing. If he flips 'Tails', he does not tell them to sing a song. Akeno times how long each child spends washing their hands over the afternoon.

- **a** Write an aim for this study. (1 mark)
- **b** One child does not know all the words to 'Twinkle Twinkle Little Star' and only sings half the song while washing their hands. Identify this type of variable and explain its effect. (2 marks)
- **c** Outline what would be involved in Akeno maintaining the ethical concept of respect during this study. (2 marks)
- **d** Predict the likely outcome of this investigation. (1 mark)
- **e** Justify the type of investigation design Akeno has used in his study and outline one disadvantage of using this type of design. (3 marks)

11 An educational researcher is conducting an investigation into the amount of sleep secondary students have received when they are absent for the first period of school the next day. Research states that adolescents should be sleeping around nine hours a night, and the researcher believes that receiving less sleep than required may affect students' school attendance for the first period of the day. The researcher samples 50 students from a local secondary school to participate in the study, and finds that students who are absent for the first period of school are obtaining less than nine hours of sleep 79% of the time.

- **a** Write a research hypothesis for this investigation. (3 marks)
- **b** The researcher identified the dependent variable as attendance at the first period of school. Are they correct? Justify your response. (2 marks)
- **c** Identify one extraneous variable to be controlled in this investigation. (1 mark)

12 An aged-care home wants to conduct a correlational study to determine whether there is a relationship between a resident's age and their participation in recreational activities.

- **a** If there are 120 residents in the aged-care home, identify an appropriate sample size for this investigation. (1 mark)
- **b** Justify whether random sampling or stratified sampling would be the most appropriate sampling technique to use in this investigation. (2 marks)
- **c** Describe how the researcher could ensure the ethical guideline of voluntary participation was followed correctly when conducting this investigation. (1 mark)
- **d** Identify two possible risks that should be included in a risk assessment before conducting this investigation. (2 marks)
- **e** Suggest how the risks identified in part **d** could be minimised by complying with occupational health and safety guidelines. (2 marks)
- **f** Describe how the researchers could extend this investigation to collect further data using another investigation methodology. (2 marks)

ISBN 978-1-009-25416-8 Gallagher et al

KEY SCIENCE SKILLS

CHAPTER 2 RECORDING AND ANALYSING DATA, DRAWING AND COMMUNICATING CONCLUSIONS

Introduction

In Chapter 1, we began looking into how we can learn about the behaviour and mental processes of humans by conducting scientific research. The first steps of research were discussed, including determining aims and hypotheses, selecting investigation methodology, and understanding the importance of complying with ethical guidelines.

In this chapter, we continue developing key science skills, focusing on those involved in data, including collecting, recording, analysing and presenting the results of an investigation. The final steps of research will then be covered, including concluding the study and communicating the findings of an investigation.

Curriculum

Key Science Skills

Study Design:	Learning objectives – at the end of this chapter I will be able to:
Generate, collate and record data • Systematically generate and record primary data, and collate secondary data, appropriate to the investigation	**2A Processing and analysing data** **2A.1** Distinguish between primary and secondary data **2A.2** Systematically generate and record primary data, and collate secondary data for an investigation
• Design and conduct investigations; select and use methods appropriate to the investigation, including consideration of sampling technique (random and stratified) and size to achieve representativeness, and consideration of equipment and procedures, taking into account potential sources of error and uncertainty; determine the type and amount of qualitative and/or quantitative data to be generated or collated	**2A.3** Determine the type and amount of qualitative and quantitative data to be generated or collected in an investigation **2A.4** Identify potential sources of error and uncertainty when designing and conducting investigations

ISBN 978-1-009-25416-8 Gallagher et al

Study Design:	Learning objectives – at the end of this chapter I will be able to:
• Record and summarise both qualitative and quantitative data, including use of a logbook as an authentication of generated or collated data	**2A.5** Distinguish between the features of qualitative and quantitative data **2A.6** Identify examples of qualitative and quantitative data and evaluate the appropriateness of their use in an investigation **2A.7** Accurately and systematically record and summarise qualitative and quantitative data, including using a logbook
• Organise and present data in useful and meaningful ways, including tables, bar charts and line graphs	**2A.8** Describe the features and uses of tables, bar charts and line graphs to organise and present data **2A.9** Select a meaningful and relevant presentation format, and then organise and present data using tables, bar charts and line graphs **2A.10** Interpret data presented in tables, bar charts and line graphs
Analyse and evaluate data and investigation methods • Process quantitative data using appropriate mathematical relationships and units, including calculations of percentages, percentage change and measures of central tendencies (mean, median, mode), and demonstrate an understanding of standard deviation as a measure of variability	**2A.11** Describe the features and purposes of using percentages, percentage change, measures of central tendency (mean, median, mode), and measures of variability (standard deviation) **2A.12** Select the appropriate mathematical relationships for a set of quantitative data and calculate the percentage, percentage change, mean, median, mode and standard deviation using the correct units of measurement **2A.13** Interpret quantitative data presented as percentages, percentage change, measures of central tendency (mean, median, mode), and measures of variability (standard deviation)
• Identify and analyse experimental data qualitatively, applying where appropriate concepts of accuracy, precision, repeatability, reproducibility and validity; errors; and certainty in data, including effects of sample size on the quality of data obtained	**2A.14** Describe the concepts of accuracy, precision, repeatability, reproducibility, true values, internal and external validity, errors and certainty in relation to a qualitative analysis of data **2A.15** Describe and analyse the effect of sample size on the quality of data obtained **2A.16** Analyse data qualitatively for accuracy, precision, repeatability, reproducibility, true values, internal and external validity, errors and certainty

Study Design:	Learning objectives – at the end of this chapter I will be able to:
• Identify outliers and contradictory or incomplete data	**2A.17** Identify outliers, contradictory data and incomplete data in a data set **2A.18** Analyse the effect of outliers, contradictory and incomplete data
• Repeat experiments to ensure findings are robust	**2A.19** Explain the benefit of repeating experiments to ensure findings are robust
• Evaluate investigation methods and possible sources of error or uncertainty, and suggest improvements to increase validity and to reduce uncertainty	**2A.20** Evaluate investigation methods and the effect of possible sources of error or uncertainty in an investigation **2A.21** Suggest improvements regarding sources of error or uncertainty in investigation methods to increase validity and to reduce uncertainty
Construct evidence-based arguments and draw conclusions • Distinguish between opinion, anecdote and evidence, and scientific and non-scientific ideas	**2B Drawing conclusions and communicating scientific ideas** **2B.1** Distinguish between opinion, anecdote and evidence, and scientific and non-scientific ideas **2B.2** Evaluate sources of information for the use of opinion, anecdote, evidence, scientific and non-scientific ideas
• Evaluate data to determine the degree to which the evidence supports the aim of the investigation, and make recommendations, as appropriate, for modifying or extending the investigation	**2B.3** Evaluate data to determine the degree to which the evidence supports the aim of an investigation **2B.4** Provide appropriate recommendations for modifications or extensions to an investigation
• Evaluate data to determine the degree to which the evidence supports or refutes the initial prediction or hypothesis	**2B.5** Evaluate data to determine the degree to which the evidence supports or refutes the initial prediction or hypothesis of an investigation
• Use reasoning to construct scientific arguments, and to draw and justify conclusions consistent with the evidence base and relevant to the question under investigation	**2B.6** Construct scientific arguments using reasoning **2B.7** Use reasoning and evidence to draw and justify conclusions for a question under investigation
• Identify, describe and explain the limitations of conclusions, including identification of further evidence required	**2B.8** Identify, describe and explain the limitations of conclusions **2B.9** Identify when further evidence is required, and suggest what further evidence would improve the limitations of an investigation's conclusions

ISBN 978-1-009-25416-8 Gallagher et al

Study Design:	Learning objectives – at the end of this chapter I will be able to:
• Discuss the implications of research findings and proposals, including appropriateness and application of data to different cultural groups and cultural biases in data and conclusions	**2B.10** Discuss relevant implications of research findings and proposals **2B.11** Evaluate cultural bias in data and conclusions to determine the appropriateness of application to different cultural groups
Analyse, evaluate and communicate scientific ideas • Use appropriate psychological terminology, representations and conventions, including standard abbreviations, graphing conventions and units of measurement	**2B.12** Use appropriate psychological terminology, representations and conventions, including standard abbreviations **2B.13** Use appropriate graphing conventions and units of measurement when presenting data from investigations
• Discuss relevant psychological information, ideas, concepts, theories and models and the connections between them	*This dot point is covered in Chapters 4 to 10*
• Critically evaluate and interpret a range of scientific and media texts (including journal articles, mass media communications, opinions, policy documents and reports in the public domain), processes, claims and conclusions related to psychology by considering the quality of available evidence	**2B.14** Access and interpret the information provided in a range of scientific and media texts including journal articles, mass media communications, opinions, policy documents and reports in the public domain **2B.15** Critically evaluate the quality of evidence provided by a range of scientific and media texts, processes, claims and conclusions
• Use clear, coherent and concise expression to communicate to specific audiences and for specific purposes in appropriate scientific genres, including scientific reports and posters	**2B.16** Identify relevant audiences for specific scientific communications and use clear, coherent and concise expression to communicate for specific purposes in appropriate scientific genres **2B.17** Describe and apply the requirements for writing a scientific report and a scientific poster to an investigation
• Acknowledge sources of information and assistance, and use standard scientific referencing conventions	**2B.18** Locate the required referencing details within scientific and media texts and use standard scientific referencing conventions to acknowledge sources of information and assistance used in research

Glossary

Abstract
Accuracy
Anecdote
Bar chart
Conclusion
Contradictory data
Discussion section
Evidence
External validity
Implications
Incomplete data
Internal validity
Introduction section
Limitations of conclusions
Line graph
Mean
Measurement error
Measure of central tendency
Measures of variability
Median
Methodology section
Mode
Opinion
Outlier
Percentage
Percentage change
Personal error
Precision
Primary data
Qualitative data
Quantitative data
Random error
References and acknowledgements section
Repeatability
Replicability
Reproducibility
Results section
Scientific poster
Scientific report
Secondary data
Standard deviation
Systematic error
Table
True value
Uncertainty
Validity

ISBN 978-1-009-25416-8

Concept map

Generating, recording, processing, presenting and analysing primary and secondary data in investigations

2A Processing and analysing data

Constructing evidence-based scientific arguments, drawing conclusions based on investigation data and effectively communicating scientific ideas

2B Drawing conclusions and communicating scientific ideas

See the Interactive Textbook for an interactive version of this concept map interlinked with all concept maps for the course.

ISBN 978-1-009-25416-8 Gallagher et al

2A Processing and analysing data

Study Design:

Generate, collate and record data

- Systematically generate and record primary data, and collate secondary data, appropriate to the investigation
- Design and conduct investigations; select and use methods appropriate to the investigation, including consideration of sampling technique (random and stratified) and size to achieve representativeness, and consideration of equipment and procedures, taking into account potential sources of error and uncertainty; determine the type and amount of qualitative and/or quantitative data to be generated or collated
- Record and summarise both qualitative and quantitative data, including use of a logbook as an authentication of generated or collated data
- Organise and present data in useful and meaningful ways, including tables, bar charts and line graphs

Analyse and evaluate data and investigation methods

- Process quantitative data using appropriate mathematical relationships and units, including calculations of percentages, percentage change and measures of central tendencies (mean, median, mode), and demonstrate an understanding of standard deviation as a measure of variability
- Identify and analyse experimental data qualitatively, applying where appropriate concepts of accuracy, precision, repeatability, reproducibility and validity; errors; and certainty in data, including effects of sample size on the quality of data obtained
- Identify outliers and contradictory or incomplete data
- Repeat experiments to ensure findings are robust
- Evaluate investigation methods and possible sources of error or uncertainty, and suggest improvements to increase validity and to reduce uncertainty

Glossary:

Accuracy
Bar chart
Contradictory data
External validity
Incomplete data
Internal validity
Line graph
Mean
Measurement error
Measure of central tendency
Measures of variability
Median
Mode
Outlier
Percentage
Percentage change
Personal error
Precision
Primary data
Qualitative data
Quantitative data
Random error
Repeatability
Reproducibility
Secondary data
Standard deviation
Systematic error
Table
True value
Uncertainty
Validity

ENGAGE

Correlation does not equal causation

It is important to understand that even though two variables appear to be correlated, it does not necessarily mean that one causes a change in the other. For example, the first line graph below shows that the yearly consumption of cheese in the US correlates almost perfectly with the yearly total revenue generated by golf courses in the US ($r = 0.99$). The second line graph shows that honey produced in bee colonies in the US correlates almost perfectly with the number of visitors to SeaWorld Florida. While these two sets of data feature almost perfect correlations, it does not mean an increase in the total revenue generated by golf courses actually causes an increase in cheese consumption in the US, or that the trend of honey produced in bee colonies causes the trend in visitors to SeaWorld Florida.

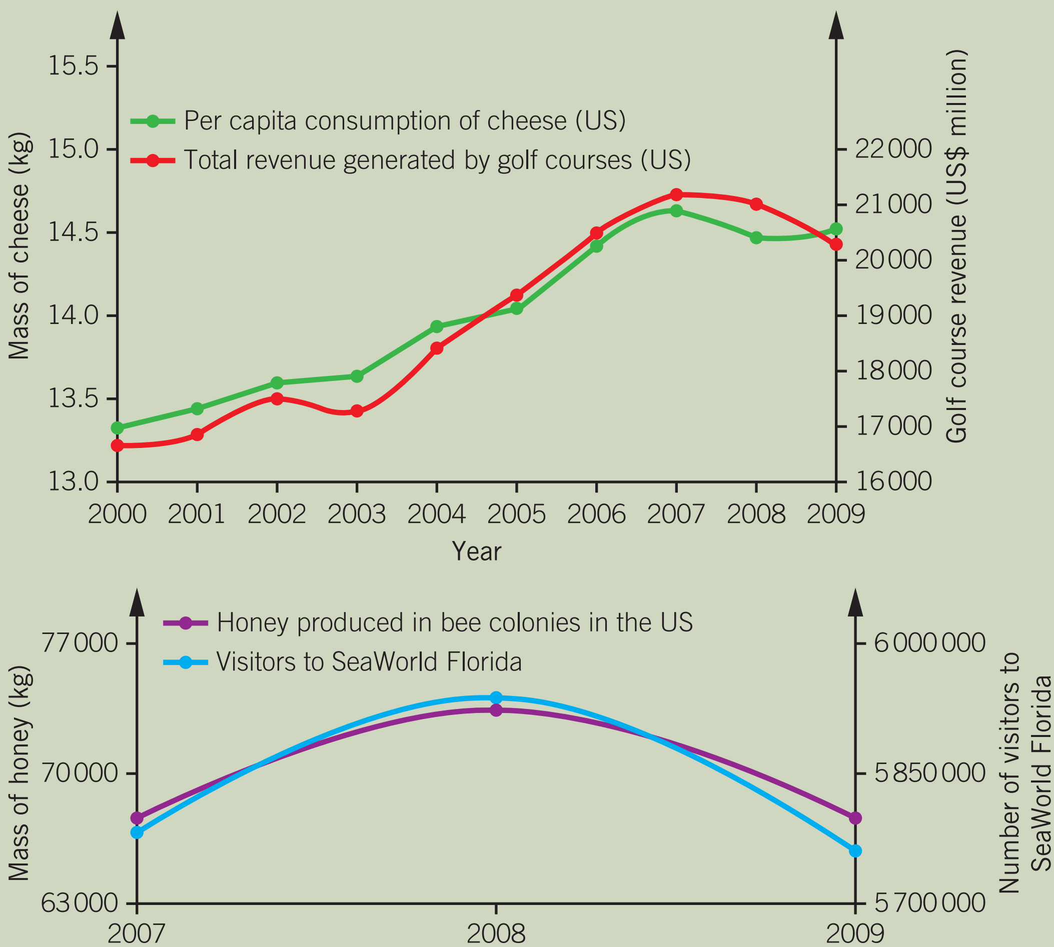


Figure 2A–1 Top: Graphs of yearly consumption of cheese in the United States and yearly total revenue generated by US golf courses. Bottom: Graphs of honey produced by US bee colonies and numbers of visitors to SeaWorld Florida.

EXPLAIN

Working with data

Collecting data is an essential part of research. Not all types of investigations are suited to collecting all types of data; so the type of data collected in a controlled experiment may be different from the data collected in a fieldwork interview. Once you have used an appropriate method to collect the data, you need to organise it and present it clearly so that you can analyse the data and draw conclusions.

ISBN 978-1-009-25416-8 Gallagher et al

1B PLANNING AND CONDUCTING INVESTIGATIONS LINK

Types of data

Primary and secondary data

Primary data data collected through first-hand research for an intended purpose

Secondary data data obtained second hand through research conducted by another person for another purpose

Primary data is collected through first-hand experience for an intended purpose; for example, a researcher using a questionnaire to conduct their own study. Primary data is useful because it can be tailored to the specific purpose of the investigation; however, conducting an original investigation to collect primary data can be costly and time consuming.

Secondary data is obtained second hand through research conducted or data collected by another person for another purpose. Secondary data may be used when it is not possible to collect primary data because of time or cost, or if participants are unavailable. For example, a researcher could use Australian Census data to track the amount of crime across time, after the implementation of a particular crime-prevention method in a community. Secondary data can also provide a baseline level to compare current primary data against. It is a cost- and time-effective way of collecting large amounts of data without the need for participants or equipment. Secondary data, however, must be considered carefully because the validity of the original study may not be known.

VIDEO 2A–1 ANALYSING QUALITY OF DATA

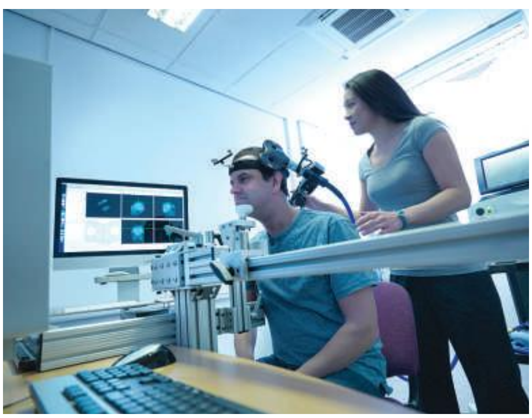


Figure 2A–2 Left: Primary data methods involve collecting new data such as measurements from medical equipment. Right: Secondary data methods involve using data from previous research, such as is found in archives.

Qualitative and quantitative data

Qualitative data data that describes characteristics and qualities

Qualitative data describes characteristics and qualities. Qualitative data can be in the form of words, photographs, videos, audio and other recordings that are not measured with a number. For example, in a study on the imaginative play behaviour of children, an observer might collect qualitative data by writing a description of behaviours that they see or recording a video of the child describing their game in their own words. Qualitative data can be collected through many types of investigations, including fieldwork interview questions, questionnaires, and observational methods. The results can be rich in detail and be used to further explain quantitative data. However, the use of qualitative data can be limited because it can be difficult to summarise and then compare, particularly when responses are in the participants' own words.

Quantitative data data that includes measurable values and quantities and can be compared on a numerical scale

Quantitative data involves measurable values and quantities and can be compared on a numerical scale. Quantitative data can be in the form of measurements such as length, weight or time, or in the form of frequencies and tallies. For example, in a study on the imaginative play behaviour of children, an observer could record the number of times they observe a child exhibiting a certain behaviour and the number of minutes that the behaviour was displayed.

ISBN 978-1-009-25416-8 Gallagher et al

Quantitative data can be collected through many types of investigations, such as controlled experiments and fieldwork observations. Unlike qualitative data, quantitative data can be summarised easily in the form of summary statistics, which allows for comparisons between groups.

Qualitative data

This cat:

- has brown spotted fur
- has white whiskers
- is small
- has large ears
- has yellow-green eyes.

Quantitative data

This cat:

- is 5 years old
- weighs 4.5 kg
- has 4 legs
- is 40 cm long
- has 18 claws.

Figure 2A–3 Both qualitative data and quantitative data can be used to describe this cat.

Check-in questions – Set 1

1 What is the difference between primary and secondary data?

2 What is the difference between qualitative and quantitative data?

Processing quantitative data

Large amounts of raw data alone do not tell us much about what a study has found. Once you have collected raw data, you need to summarise and then organise it to find patterns and relationships, compare groups, and interpret the findings. A conclusion can then be reached. Different types of statistics are used to make the raw data meaningful.

LINK 2B DRAWING CONCLUSIONS AND COMMUNICATING SCIENTIFIC IDEAS

Using percentages

A **percentage** is a part of a whole, expressed as a proportion out of 100. For example, 5% means 5 per 100, or 5 parts of 100, and is the same as the fraction $\frac{5}{100}$. Percentages allow us to see differences and make comparisons, and are useful when comparing values that are not out of the same number and that involved different sample sizes. Worksheet 2A–1 provides worked examples and practice questions on how to calculate a percentage.

Percentage a part of a whole, a proportion out of 100

WORKSHEET 2A–1 CALCULATING SUMMARY STATISTICS

For example, the Australian Bureau of Statistics collects census data on the occupations of people across the country. The 2016 Census found that 42 858 females in the Greater Melbourne region listed their occupation as Technician or Trade Worker, whereas only 15 255 females in the rest of Victoria listed their occupation as Technician or Trade Worker. This looks like a very large difference, but it does not take into account the larger number of people in total in the Greater Melbourne area than in the rest of Victoria. A fairer way of comparing the two groups is to look at the percentages of females working as technicians or trade workers out of the total number of females in each region (Table 2A–1). This shows that there is a similar proportion of females in this occupation group in both regions.

ISBN 978-1-009-25416-8 Gallagher et al

Table 2A–1 Statistics on female technicians and trade workers by region, sourced from the Australian Bureau of Statistics (2019)

	Number of females working as technicians or trade workers	Total number of females (>15 years old) in the region	Percentage of all females in the region working as technicians or trade workers (%)
Greater Melbourne	42 858	998 542	4.3
Rest of Victoria	15 255	296 681	5.1

Percentage change a calculation of the degree of change in a value over time

Percentage change is a calculation of the degree of change in a value over time. It allows you to compare an old value and a new value, and to see how the value has increased or decreased. Percentage change can be calculated for any quantity that has been measured over time to determine how much it has changed. A positive percentage change indicates a percentage increase, and a negative percentage change indicates a percentage decrease. For example, if there were 15 customers in a store on one day, and 20 customers on the following day, then the percentage change is 33%. This means that there was a 33% increase in the number of customers on the second day. Worksheet 2A–1 provides worked examples and practice questions on how to calculate a percentage change.

Measures of central tendency

Measures of central tendency a category of statistics that describes the central value of a set of data

Mean a statistic that is the average value of a set of data

Measures of central tendency are a category of statistics that describe the central value of a set of data. The mean, median and mode are all measures of central tendency.

Mean

The **mean** is the average value of a set of data. It represents a typical, central value and gives an overall idea of the data set. The mean is useful when analysing data because it summarises a large amount of data into a single value. Calculating the mean for each group of data allows you to compare the typical responses from each group. For example, in a study testing whether two new running shoe designs increase the performance of marathon runners, 20 participants use the first design and 20 participants use the second design. The mean time taken to run the marathon is calculated for each group to find the average time taken for each design, in order to see which design was the best. Worksheet 2A–1 provides worked examples and practice questions on how to calculate the mean.

One disadvantage of using a mean to calculate the average of a set of data is that it is vulnerable to extreme values known as outliers. For example, if a very low test score is included in a set of data, the mean is pulled down, which may not reflect the typical score as well. The mean is most meaningful when all the data values are normally distributed and not positively or negatively skewed. Outliers are further explained later in this section.

Median

Median the middle value in an ordered set of data

The **median** is the middle value in an ordered set of data. It is the value that splits the set of data in half. To find the median, you first need to put the set of values in increasing or decreasing order. The median can be useful if a data set has outliers because it is not affected by extreme values. The method to determine the median depends on whether there is an even or an odd number of values. If there is an odd number of values in the data set, the median is the middle value, and there is an equal number of values above and below. If there is an even number of values, then there is not one exact middle value, so the median is found by calculating the mean of the two middle values (Figure 2A–4). Worksheet 2A–1 provides worked examples and practice questions on how to calculate the median for even and odd data sets.

ISBN 978-1-009-25416-8 Gallagher et al

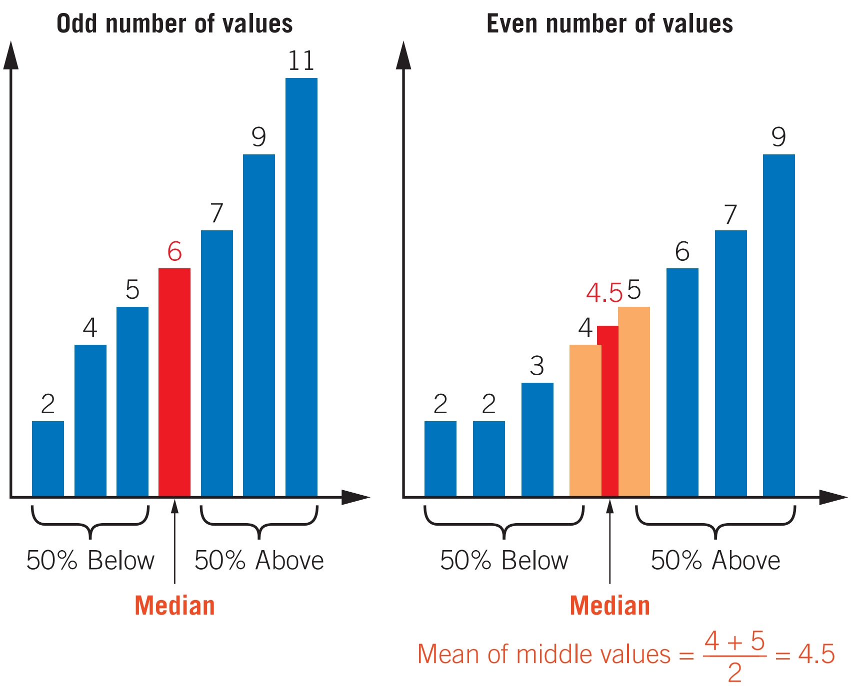


Figure 2A–4 Finding the median. Left: This data set has an odd number of values, which makes it easy to find the middle value once you put the values in order. Right: This data set has an even number of values, with two values in the middle after putting them all in order, so you must take the mean of these middle two values.

Mode
the value that occurs most frequently within a set of data

Mode

The **mode** is the value that occurs most frequently within a set of data. It is the most common value. There may be more than one mode for a set of data if there are multiple values that have the same highest frequency. There may be no mode if no one value is repeated in a data set. Worksheet 2A–1 provides worked examples and practice questions on how to calculate the mode.

The mean, median and mode are all measures of central tendency that describe the central location of a set of data. Which statistic should be used depends on the type of data being analysed (Table 2A–2).

Figure 2A–5 In a lottery, the mode is the number that comes out the highest number of times.

Table 2A–2 Uses of different summary statistics

Type of data	Mean	Median	Mode
Qualitative data, including categorical data			✓
Quantitative data that is continuous (e.g. height, weight, time, temperature) with a symmetrical distribution	✓	✓	✓
Quantitative data that is continuous with a skewed distribution		✓	
Data with outliers or small data sets		✓	✓

ISBN 978-1-009-25416-8 Gallagher et al

VIDEO 2A–2 SKILLS: INTERPRETING RESULTS TABLES

2A–1 SKILLS

Interpreting results tables

In the VCE Psychology exam, you will not have access to a calculator, so you will not be asked to calculate a difficult mean, percentage or percentage change. However, you will need to be able to interpret these statistics and relate them to key knowledge.

Table 2A–3 shows how sleep deprivation can affect performance on a cognitive task, including the time taken to complete the task and the percentage of errors occurring during the task.

Table 2A–3 Performance on a cognitive task according to the number of hours slept

	Hours of sleep					
	7	**6**	**5**	**4**	**3**	**2**
Mean time taken (min)	6	6	6.2	6.5	7	8.2
Percentage of errors	11	13	18	26	36	50

What does this table tell us? First consider the labels of the columns and rows, including the units of measurement. We can see that the independent variable (IV) of sleep deprivation has six levels, ranging from 7 hours of sleep through to 2 hours. The dependent variable (DV) is performance on a cognitive task, which has been measured by the mean time taken (in minutes) and the percentage of errors.

Once you understand the labels, then read each row and column separately to analyse the data.

In this table, reading across each row shows the trends in the DV (time and errors) as the IV (hours of sleep) changes.

Reading down each column shows how each level of the IV (hours of sleep) affects the DV (mean time taken and percentage of errors).

You can then determine some overall findings. This data shows that as the number of hours of sleep decreases, the time taken to complete the task and the percentage of errors both increase, with 2 hours of sleep resulting in the longest time and the highest percentage of errors.

Measures of variability a category of statistics that describe the distribution of data

Standard deviation a statistic that shows the spread of the data around the mean

Standard deviation as a measure of variability

Measures of variability are a category of statistics that describe the distribution of data. The standard deviation is one measure of variability; others are the range and interquartile range, which are not covered in VCE Psychology.

The **standard deviation** shows the spread of the data around the mean. It shows how close each data value lies to the average, or how far spread out they are – in other words, how much the values vary. The standard deviation has the same unit of measurement as the original data. For example, if a group's running times were recorded in minutes, the standard deviation value is also in minutes.

ISBN 978-1-009-25416-8 Gallagher et al

When comparing two sets of data, a smaller standard deviation shows that the values in that set are quite close together. A larger standard deviation shows that the values in that set are further apart. You do not need to calculate the standard deviation in VCE Psychology, but it is helpful to know how to find the standard deviation. The calculation involves using the squares of the differences from the mean, which means that larger differences have proportionately more effect on the value than smaller differences.

For example, Table 2A–4 displays the weights of three samples of dogs. In each sample, there are six dogs. The spread of the weights within the samples differs, as shown by the differences in the standard deviations.

Table 2A–4 The mean weights and standard deviations of three samples of dogs

	Sample A	Sample B	Sample C
Mean weight (kg)	25	25	25
Standard deviation (kg)	0	4.1	12.1

In sample A, all six dogs weigh 25 kg, so the mean is 25 kg, there is no spread and there is no standard deviation because no data value varies from the mean.

In sample B (Figure 2A–6), the six dogs weigh 20, 21, 22, 28, 29 and 30 kg, so the mean is 25 kg. These individual values are all quite close to the mean, so the spread is quite small (from 20 to 30 kg) and the standard deviation is small. The standard deviation is calculated to be 4.1 kg.

In sample C (Figure 2A–7), the dogs weigh 6, 16, 22, 28, 35 and 43 kg, so the mean is 25 kg. The spread of values is quite large (from 6 to 43 kg), so some of these values are further away from the mean, and the standard deviation is large. The standard deviation is 12.1 kg. This is larger than the standard deviation of sample B because sample C has a larger spread of data than sample B.

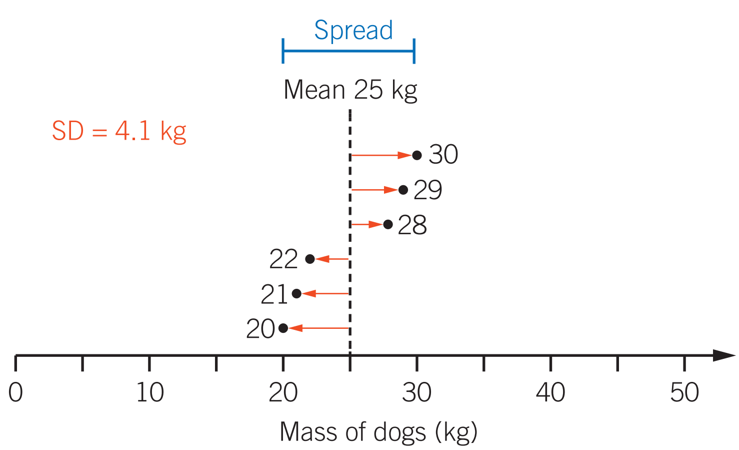


Figure 2A–6 Graph of weights of sample B dogs. These six dogs are all a similar weight, so their calculated standard deviation is small, which shows that their spread is small.

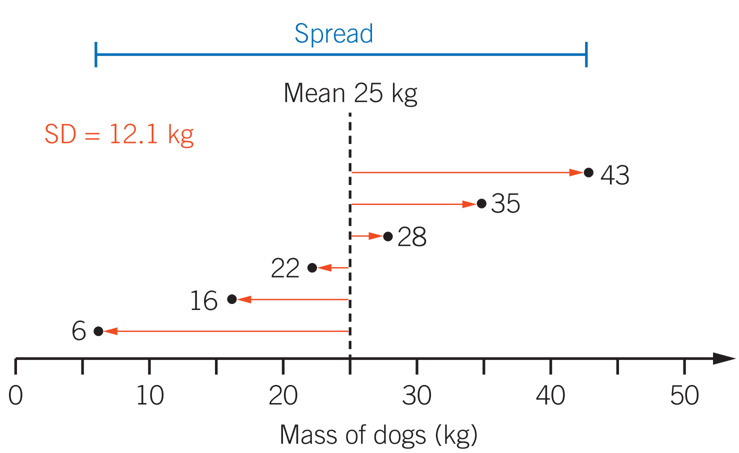


Figure 2A–7 Graph of weights of sample C dogs. These six dogs are all quite different weights, so the standard deviation of sample C is large, which shows that their spread is large.

ISBN 978-1-009-25416-8 Gallagher et al

VIDEO 2A–3 SKILLS: INTERPRETING STANDARD DEVIATIONS

2A–2 SKILLS

Interpreting standard deviations

In VCE Psychology, you do not need to calculate the standard deviation, but you do need to know how to interpret it.

When given two standard deviations representing two groups of data, the:

- larger value indicates that the spread of that data is larger
- smaller value indicates that the spread of that data is smaller.

Table 2A–5 shows the standard deviations for two groups. The standard deviation for group B is larger than that for group A. From this, we can infer that the individual data values in group B are spread out more than the individual data values in group A. This also tells us that the values in group A are more closely clustered around the mean than in group B, as displayed in Figure 2A–8.

Table 2A–5 Standard deviation for two groups

	Group A	Group B
Standard deviation	12	19

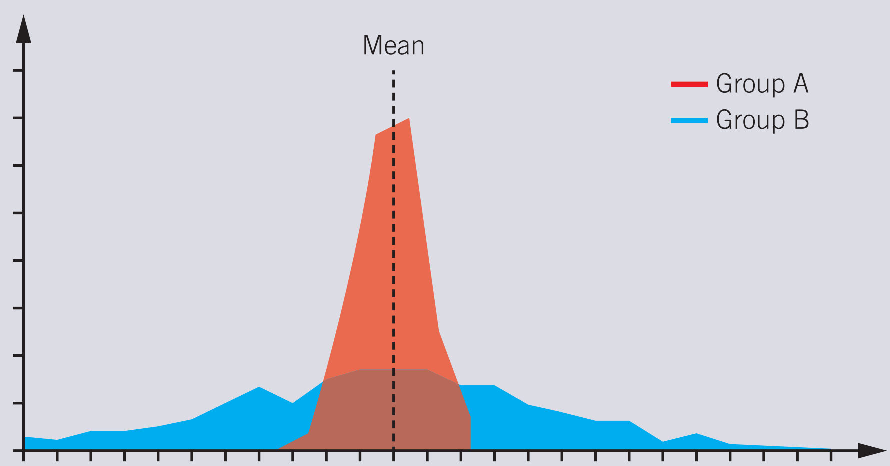


Figure 2A–8 The standard deviation shows the spread of the data. Group B has a larger spread than group A.

Check-in questions – Set 2

1 When is a percentage change used?
2 Name three measures of central tendency.
3 When is the mean not a good choice for determining the central value of data?
4 What does a small standard deviation tell you about the data? What does a large standard deviation tell you about the data?

Organising and presenting data

Large amounts of data can be too complex to explain as text, so summary statistics are presented in tables, graphs and charts for easy and quick visual interpretation.

ISBN 978-1-009-25416-8 Gallagher et al

Tables

Tables are a way of organising data and/or summary statistics to clearly compare the results of different groups in a study. If data cannot be presented in one or two sentences, then a table should be used instead of explaining the data in the text of a report. Tables are useful to highlight important data for the reader to find quickly. They are used instead of graphs when showing precise values is more important than showing trends and patterns. In a research report or scientific poster, data in a table should not be also written in the text or repeated in a graph. A table should have the features shown in Figure 2A–10.

Table
a way to display data and/or summary statistics clearly

Option A: Text

The National Basketball League is the top division in Australian Basketball. With only a few games left of the 2021–2022 season, the league leaders are showing their honed skills with their consistent shooting performances. Bryce Cotton from the Perth Wildcats leads the league statistics with an average of 23.58 points per game, and a field goal percentage of 41.8%. While runner-up in average points per game on 21.33, South East Melbourne Phoenix forward Mitchell Creek had a higher average field goal percentage of 48.7%. Cotton's Wildcats teammate Victor Law has proven to be another consistent performer with a 46.9% average field goal percentage and an average 20.08 points per game. Multiple reliable shooters in the league leaders shows the Wildcats are strong contenders for the upcoming finals. Taking out fourth position in the leader board is Jaylen Adams of the Sydney Kings, with an average of 18.9 points per game and an average field goal percentage of 36.6%

Option B: Table

Player name	Team	Average points per game	Average field goal percentage
Bryce Cotton	Perth Wildcats	23.58	41.8%
Mitchell Creek	SE Melbourne Phoenix	21.33	48.7%
Victor Law	Perth Wildcats	20.08	46.9%
Jaylen Adams	Sydney Kings	18.9	36.6%

Figure 2A–9 In a report displaying the average shooting performance of National Basketball League players, organising the players' points per game and field goal percentage statistics into a table (option B) makes the data easier to understand and compare than writing them in sentences in one large paragraph (option A).

A descriptive, numbered title is written above the table and gives a quick, clear indication of what the data is about.

Table 1 Amount of time new mothers spent exercising per week (minutes)

Time spent exercising (minutes)	Number of new mothers
0–29	8
30–59	16
60–89	29
90–119	23

Rows and/or columns should have clear headings to describe the variable that they are representing, including appropriate units.

Figure 2A–10 Features of a table that displays data

ISBN 978-1-009-25416-8 Gallagher et al

Charts and graphs

Charts and graphs are also ways of organising and presenting data and summary statistics. Charts and graphs are used instead of tables when it is more important to show the trends, patterns, relationships and overall pictures of the data, rather than exact data values. Charts and graphs should have the features shown in Figure 2A–11.

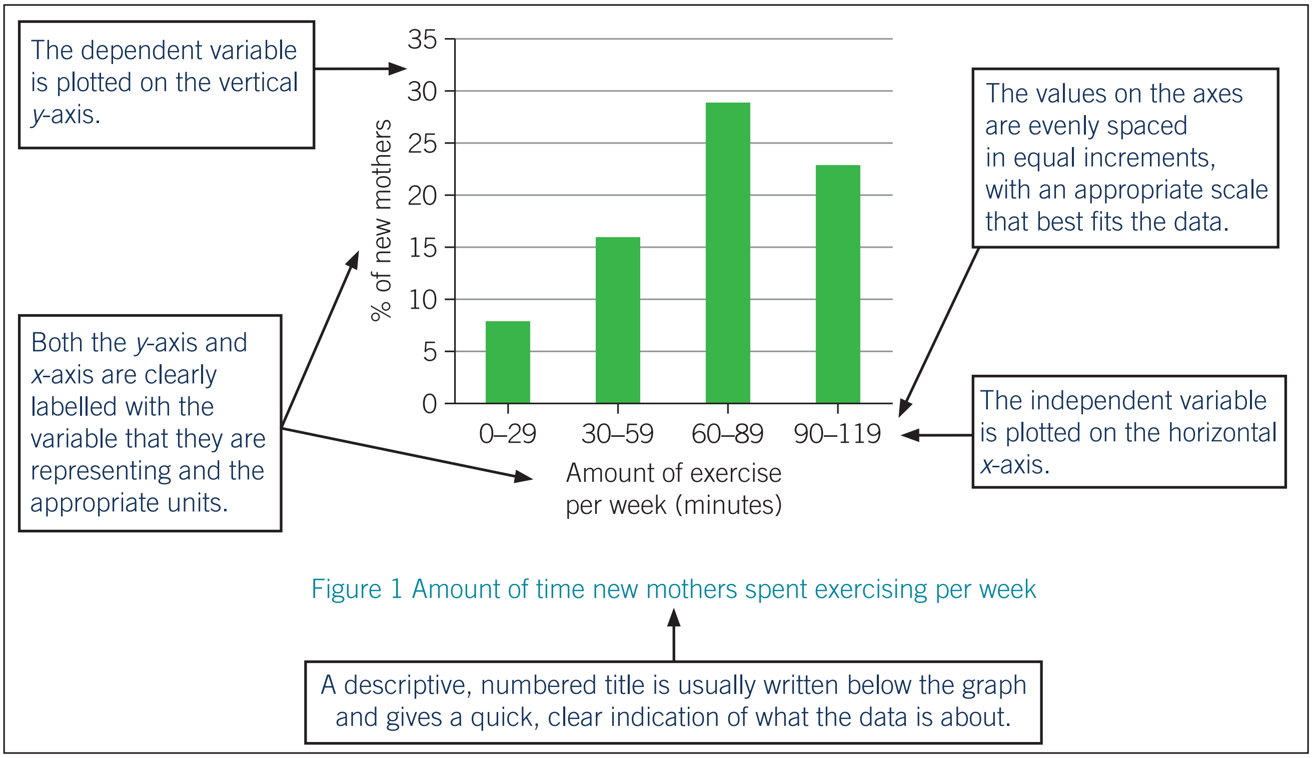


Figure 2A–11 Features of a graph displaying data

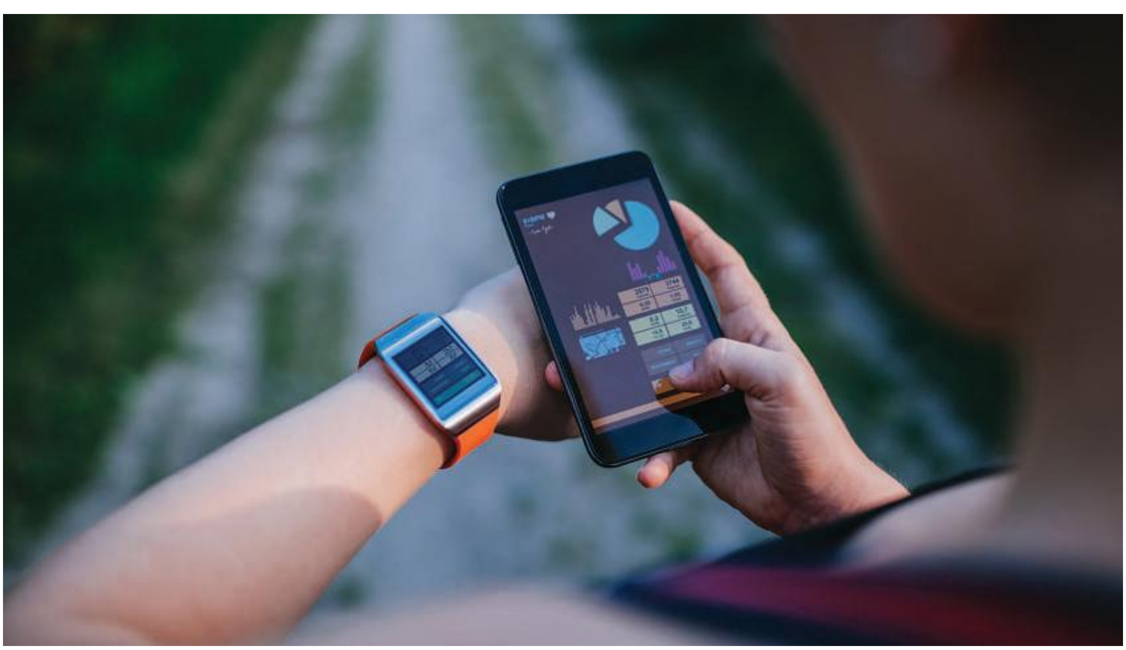


Figure 2A–12 Graphs, such as those in fitness tracking apps, are useful in everyday life to quickly judge trends.

ISBN 978-1-009-25416-8 Gallagher et al

It is important to select an appropriate type of chart or graph for the type of data being displayed; for example, bar charts and line graphs.

Bar charts (also known as bar graphs or column graphs) are used to display data that has discrete categories. The height of each bar represents the measured value of one data category. Bars can be drawn vertically or horizontally and should not touch because they represent separate categories. More complex bar charts can include grouped or stacked data to represent the subsections of a large category, and these types of charts should have a legend or key to clearly show what the subsections represent. You can compare several categories quickly using a bar chart and they are most useful for presenting data that has larger differences among categories.

Bar chart
a way to display data with discrete categories

Line graph
a way to display numerical and continuous data

For example, a maternal health centre is interested in how long new mothers can exercise each week after they have been cleared for exercise by their doctor. The maternal health centre conducted a survey asking new mothers to indicate how many minutes they exercise in a typical week. The results are shown in the vertical bar chart in Figure 2A–11. The results are also shown in the horizontal bar chart in Figure 2A–13, which also displays additional data about the minutes of exercise per week for new mothers both before and after the birth of their baby.

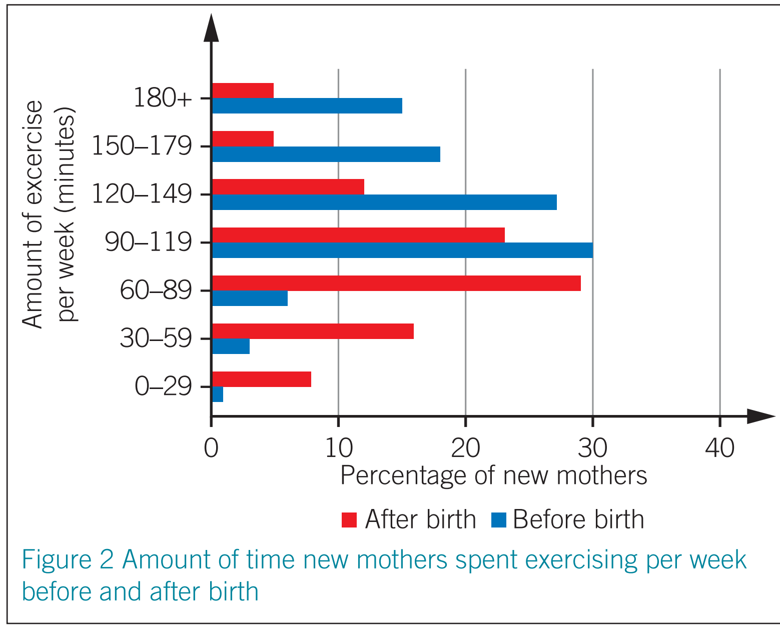


Figure 2A–13 An example of a horizontal bar chart displaying separate data sets, distinguished by colour, with a key

Line graphs are used when data is numerical and continuous. The straight line shows how one data point continues to the next, and estimates the values between the points. Line graphs are useful in tracking small changes over time to visualise overall trends and patterns in data. The IV should be represented on the horizontal x-axis and the DV on the vertical y-axis. Multiple sets of data can be compared by using multiple lines on one graph.

For example, two shops are tracking their busiest periods of the day by counting how many customers are in each shop on the hour, each hour, over one full day of trading. Their results are presented as a line graph in Figure 2A–14.

Figure 2A–14 An example of a line graph with two data sets plotted.

ISBN 978-1-009-25416-8 Gallagher et al

2A–3 SKILLS

VIDEO 2A–4
SKILLS: INTERPRETING GRAPHS

Interpreting graphs

In the VCE Psychology exam, you may be asked to draw a simple graph; however, more often you will be asked to interpret what is shown in a graph. You may be asked to interpret bar charts or line graphs representing the results from complex investigations.

To understand what the graph is showing, begin by considering the labels of the axes, including any legend or key for multiple data sets on the same graph. The graph in Figure 2A–15 shows the results of an investigation into how students spend their free time according to two variables: the activities and the students' year levels. There are multiple bars in this graph, so you need to understand what each bar represents before you try to interpret it. So look at the legend or key first.

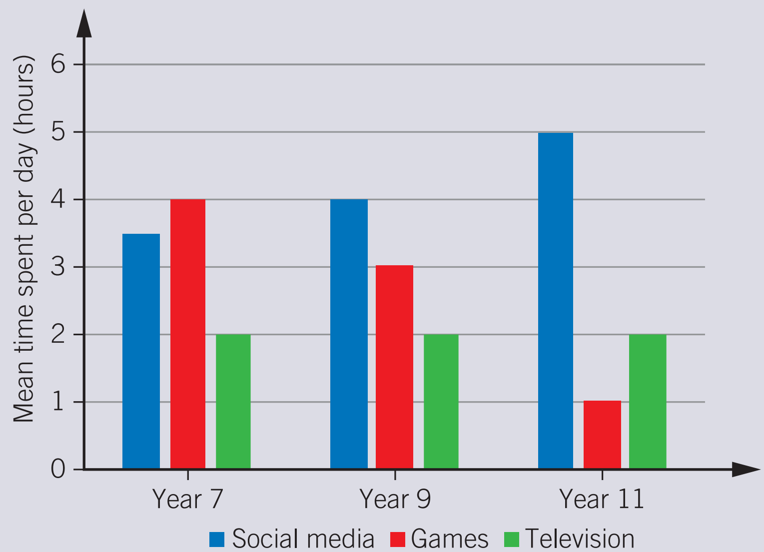


Figure 2A–15 How students spend their free time

When you are interpreting a graph, it is important to consider the scale of the axes. The two graphs in Figure 2A–16 show the same data, but the scales on their *y*-axis are different. In graph A, the differences between the values, and the values themselves, appear to be much larger than those in graph B.

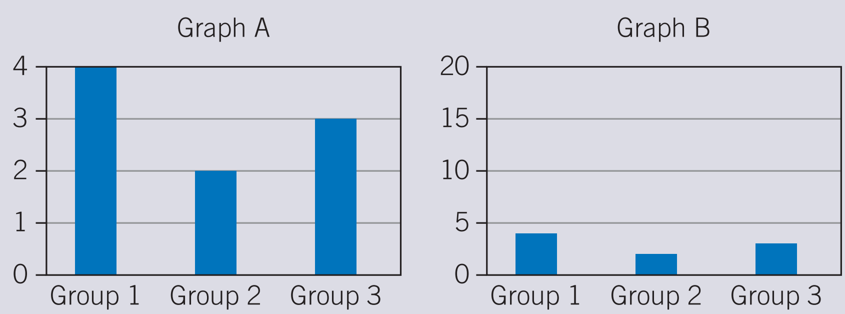


Figure 2A–16 It is important to consider the scale of a graph when interpreting the data presented.

Once you understand the labels of a graph, you can consider the differences between the groups or the overall trends being shown. This can be complex when the data contains multiple variables.

For the graph of how students spend their free time in Figure 2A–15, you could begin by looking at the trends for each of the three activities separately across the year levels, by focusing on one colour at a time. For example, the red bars tell you that as students get older, they spend less time on games.

Then you could compare all three activities in a single year level, by focusing on one group of bars at a time. For example, you can see that Year 11 students prefer to spend more of their time on social media than on games or television.

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 3

1 Why would a researcher use a table to display data?
2 When would a researcher use a bar chart to display their data and when would they use a line graph?

WORKSHEET 2A–2 MISLEADING GRAPHS

True value
the value, or range of values, that would be found if the quantity could be measured perfectly

Accuracy
how close a measurement is to the true value of the quantity being measured

Analysing the quality of data

Before researchers can conclude an investigation, they need to analyse the quality and quantity of the evidence they collected. This evidence will be used to make decisions, so researchers need to know how good it is. The data should be analysed for its true value, accuracy, precision, repeatability, reproducibility, validity, errors, certainty, outliers and contradictory or incomplete data.

True value

The **true value** is the value, or range of values, that would be found if the quantity could be measured perfectly. Obtaining a true value would require no error to occur when using instruments to take measurements and collect data and when processing and reporting the data. In practice, the true value cannot always be determined because measurements have a degree of uncertainty. Sometimes, instruments can be calibrated against their true value to test whether they are measuring perfectly. For example, a tool using biometric features to determine the age of a person could be compared against the true value of the person's known age as indicated by their date of birth on their birth certificate. Or a new watch could be tested against the true value of time known as 'Coordinated Universal Time'.

Figure 2A–17 The true value is the perfect measurement of a value, such as finding a person's age as determined by their birth certificate. Measuring a person's age by biometric data may not calculate the true value of a person's age, and its accuracy should be considered.

Accuracy

Accuracy relates to how close a measurement is to the true value of the quantity being measured. In VCE Psychology, accuracy is not quantifiable, and values are described in qualitative terms, such as being 'more accurate' or 'less accurate', or in terms such as 'good', 'expected', or 'poor'. A measured value is accurate if it is determined to be close to the expected, true value, and the level of accuracy can be judged by repeating the experiment.

For example, if a student's true value of their height is 172 cm, but they measure their height as 176 cm by using a small ruler, then their value is not accurate. The student could determine whether their result is accurate by repeating the measurement a couple more times to see how similar the values are.

Precision

Precision
how close a set of measurement values are to each other

Precision refers to how close a set of measurement values are to each other. It describes how exact a measurement is, and how much a value agrees or is consistent within a set of values that were measured under the same conditions. Precision is not the same as accuracy because it does not involve reference to the true value. However, both precision and accuracy can be affected by different types of errors, which are described later in this section.

ISBN 978-1-009-25416-8 Gallagher et al

For example, a fridge thermometer is checked every day for a week, and the following temperatures are obtained: 3.1, 3.2, 3.1, 3.1, 3.2, 3.2, 3.1°C. These results can be considered to be precise because the values are close together and quite consistent.

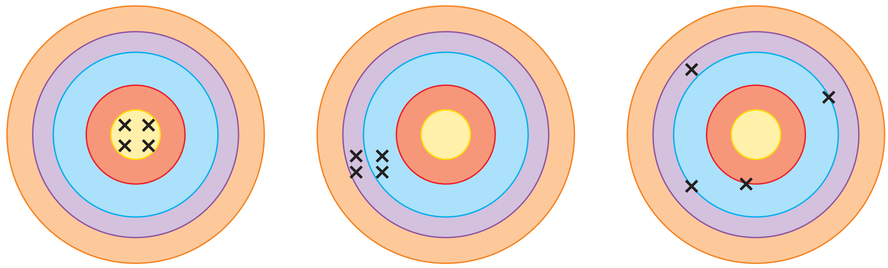


Figure 2A–18 Precise values are not necessarily also accurate values.

Repeatability

Repeatability is how close successive measurements of the same quantity are when carried out under the same conditions. Repeatability helps researchers verify their findings. If measurements can be repeated by the same investigator using the same method, instruments, location and within a short period of time, the results of a study can be verified and confirmed as true findings. For example, if an intelligence test on a participant produced one set of findings on one occasion and another set of findings on another occasion, it could indicate that the intelligence test was flawed in some way. If the results of a study are to be meaningful, then the study should be repeatable, with the same findings being determined every time the study is repeated under the same conditions.

Repeatability the closeness of the agreement between successive measurements of the same quantity, carried out under the same conditions

Reproducibility the closeness of the agreement between measurements of the same quantity, carried out under different conditions

Replicability giving the same answer to a scientific question when a different method is used and different data is obtained

Reproducibility

Reproducibility is how close measurements of the same quantity are when carried out under different conditions. Reproducibility also helps to verify research findings. If the results of an investigation can be reproduced by a different researcher using a different method of measurement, measuring instrument, location, time or culture, the results can be verified and confirmed as true findings. For example, if one research team determined one set of findings and a second research team determined a completely different set of findings despite conducting a similar investigation, then the original results are not reproduced and are irreplicable. This may be due to an error in one of the studies or an undetected difference in the way the second study was conducted, which should be considered before determining the overall credibility of the investigation.

Another term similar to reproducibility is **replicability**, applied to studies aiming to answer the same scientific question, each with its own methods and data. A study can be considered in terms of whether it is replicable, or whether it lacks credibility because it is irreplicable. If results from a study are to be meaningful, they should be reproducible

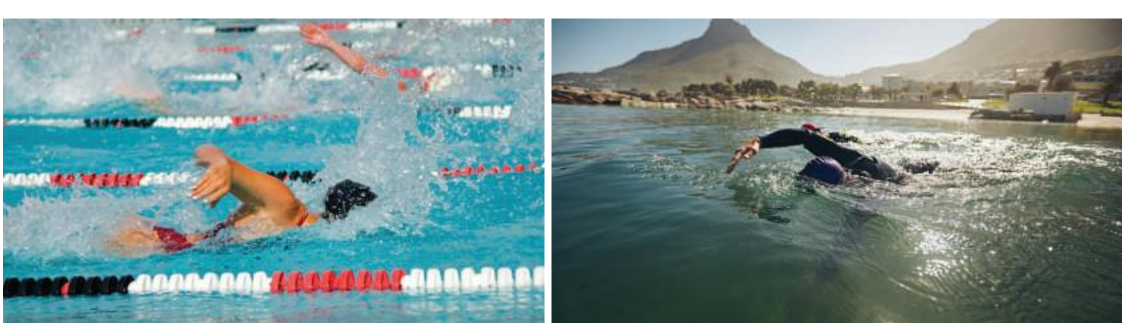


Figure 2A–19 Reproducibility means there is agreement between measurements of the same quantity under different conditions, such as measuring an athlete's swimming performance in a pool and in the ocean.

ISBN 978-1-009-25416-8 Gallagher et al

and replicable, with the same findings being determined when the study is reproduced or replicated under different conditions by a different researcher.

Validity

Validity refers to whether a measurement measures what it is supposed to be measuring. The validity of a psychological investigation refers to how well the results among the study participants represent true findings among similar individuals outside of the study. These descriptions represent two different types of validity in a study.

Internal validity refers to a study investigating what it sets out or claims to investigate. Internal validity can be affected by the appropriateness of the investigation design, sampling and allocation techniques, and the effect of extraneous and confounding variables. For example, an intelligence test should accurately measure the concept of intelligence, and not measure other traits such as memory ability or education level. If a study does not have good internal validity, such as by determining that confounding variables had influenced the results, the results of the study may not be truthful. This means that you cannot draw any conclusions. Additionally, if a study is found to be not internally valid, then its external validity is not relevant.

External validity refers to whether the results of the research can be applied to similar individuals in a different setting. For example, an intelligence test might determine the intelligence of a white, middle-class person with reasonable accuracy, but if the test does not consider cultural diversity, then it is biased and it cannot be used to accurately describe the intelligence of people from the wider, diverse population. External validity can be improved by using a sampling technique with broad inclusion criteria so that the sample better represents not only the study's population of interest but also the overall general human population. If a study does not have external validity, the results may not apply or be generalised to individuals who are different from the study population.

Validity whether a measurement measures what it is supposed to measure

Internal validity whether a study investigates what it sets out or claims to investigate

External validity whether the results of research can be applied to similar individuals in a different setting

LINK 1B PLANNING AND CONDUCTING INVESTIGATIONS

LINK 2B DRAWING CONCLUSIONS AND COMMUNICATING SCIENTIFIC IDEAS

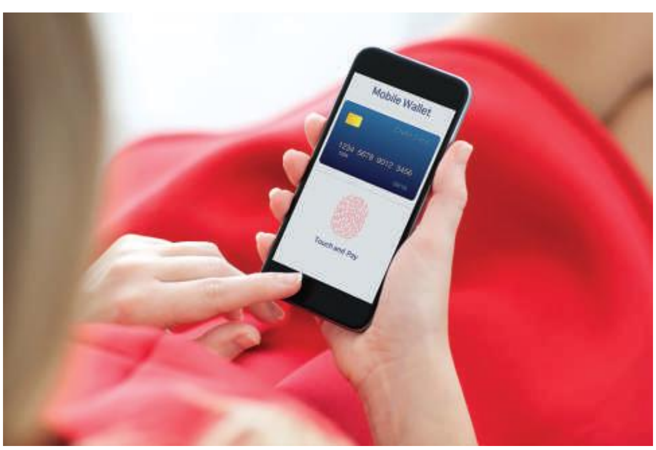


Figure 2A–20 The Touch ID electronic fingerprint recognition on your mobile phone is a valid measure of authentication because it accurately recognises your specific fingerprint before giving you access to the phone.

Figure 2A–21 Teen magazines often publish 'personality tests' that describe your personality by identifying your favourite things. These tests are not valid measures because they probably do not actually measure personality.

Check-in questions – Set 4

1 What is a true value?
2 What is the difference between accuracy and precision?
3 What is the difference between repeatability and reproducibility?
4 What is the difference between internal and external validity?

ISBN 978-1-009-25416-8 Gallagher et al

Error

Personal error

Personal error
a mistake, miscalculation or observer error made when conducting research

Personal errors include mistakes, miscalculations and observer errors made when conducting research. For example, a researcher observing a child and parent's responses during an immunisation incorrectly records when the child was crying (Figure 2A–22). This is a personal error because it was a mistake made by the observer. To remove personal errors, the investigation should be repeated correctly, and the errors should not be included in the reporting and analysis of the data.

Seconds	1									10										20										30
Child crying					✗	✗	✗	✗	✗	✗	✗	✗	✗	✗														✗	✗	✗

Figure 2A–22 A personal error can involve an observer making an incorrect record of the participant's behaviour. For example, a researcher could make an error when recording the times that a child cried during an immunisation procedure.

Figure 2A–23 This investigation needs to be repeated correctly as the researcher recorded the baby's responses incorrectly.

Measurement error
the difference between the measured value and the true value

Measurement error

Measurement error is the difference between the measured value and the true value of what is being measured. Two types of measurement error should be considered when evaluating the quality of data: systematic errors and random errors.

ISBN 978-1-009-25416-8 Gallagher et al

Systematic error

Systematic errors affect the accuracy of a measurement by causing readings to differ from the true value by a consistent amount or by the same proportion each time a measurement is made. All the readings are shifted in one direction from the true value. They may be produced by observational error, imperfect instrument calibration or environmental interference. For example, a thermometer might measure temperature one degree higher than the true value every time the thermometer is used. The accuracy of measurements subject to systematic errors cannot be improved by repeating the measurements because the error is present all the time. For example, continuing to use the thermometer will not improve the accuracy of the thermometer. Most systematic errors can be reduced by being familiar with the limitations of instruments and becoming experienced with their correct use.

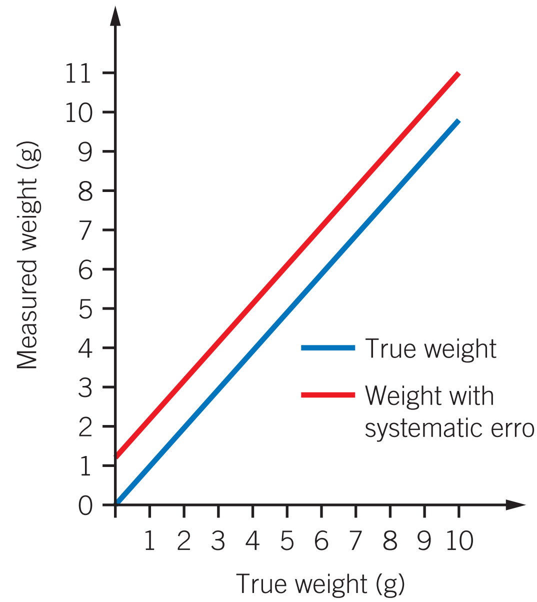


Figure 2A–24 Systematic errors affect accuracy: they cause a consistent shift in the measurements. For example, a weight scale that has not been zeroed will include the container weight each time it is used.

Systematic error an error that causes readings to differ from the true value by a consistent amount each time a measurement is made

Random error

Random errors affect the precision of a measurement by creating unpredictable variations in the measurement process; they result in a spread of readings. Random errors are present in all measurements except for those involving counting, and they do not follow a pattern because they cause one measurement to differ slightly from the next. They may be produced by a limitation in the instrument, an environmental factor or a slight variation in the procedure. For example, if a person stands in a slightly different spot on a set of scales each time the researcher measures their weight, it can produce slight variations in their measured weight. The effect of random errors can be reduced, and the precision of measurements improved, by making more or repeated measurements, calculating a new mean, increasing the sample size, or refining the measurement method or technique.

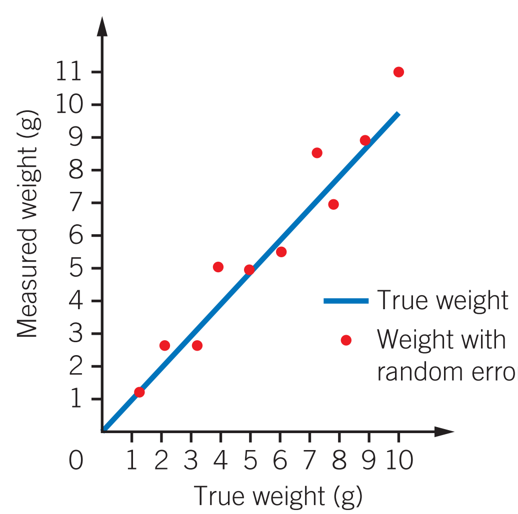


Figure 2A–25 Random errors affect precision: they affect how closely a set of measurements agree with each other. For example, standing on a different section of a weight scale each time may produce different results.

Random error an error that creates unpredictable variations in the measurement process and results in a spread of readings

ISBN 978-1-009-25416-8 Gallagher et al

Uncertainty

Uncertainty refers to a lack of exact knowledge of the value being measured. All scientific efforts are directed towards reducing the degree of uncertainty about observations, relationships and causes. All measurements are subject to uncertainty and may have many potential sources of variation, and this uncertainty extends to all inferences and conclusions that depend on uncertain measurements. The nature of human behaviour and mental processes measured within psychology often involves psychological constructs that, by their very nature, can increase the degree of uncertainty associated with such measurements.

Uncertainty of the result of a measurement is not the same as error, and in VCE Psychology it does not require calculations. A qualitative treatment of uncertainty involves evaluating the data to identify **contradictory data** (incorrect data) and **incomplete data** (missing data – questions without answers or variables without observations), including possible sources of bias. All measurements have some uncertainty, and it requires the observer to make a judgement.

Uncertainty
a lack of exact knowledge of the value being measured

Contradictory data
data that appears incorrect

Incomplete data
data that has elements missing

Outlier
a value that lies a long way from other results

Outliers

Outliers are values that lie a long way from other results. These readings may occur by chance in any given data set and can be real or true, or caused by measurement and recording errors, a skewed distribution or data points from a different underlying distribution. A small number of outliers are expected when there is a larger sample, and their presence alone does not suggest an anomaly. Repeating readings may be useful in further exploring an outlier. In VCE Psychology, data visualisation is used to recognise whether outliers are present in the data. Outliers must be analysed and accounted for, not automatically dismissed, to consider how these outliers would affect the testing efforts and validity of the research.

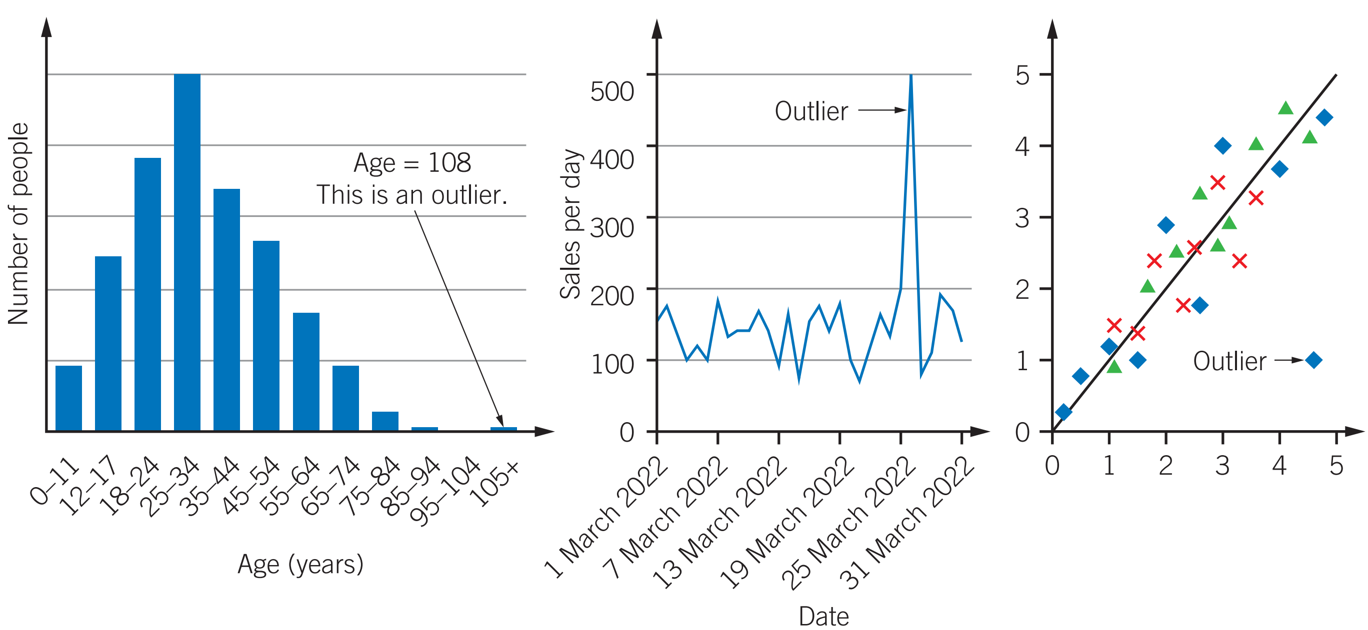


Figure 2A–26 An outlier is a value that lies far away from the rest of the data values.

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 5

WORKSHEET 2A–3 ANALYSING DATA

1 What is the difference between systematic errors and random errors?
2 What is uncertainty in measurement of data?
3 What are outliers in a set of data?

ACTIVITY 2A–1 INTERPRETING AND ANALYSING DATA

A food truck business is investigating what foods people prefer to buy from their food truck. They create a questionnaire with several questions. One of the questions involves the different pizza toppings offered at the food truck. Each pizza topping type is assigned a number (1 Hawaiian, 2 Margarita, 3 Meat Lovers, 4 Vegetarian, 5 Supreme). The results for the favourite pizza topping flavours of a group of people are as follows:

1, 1, 2, 2, 2, 2, 2, 2, 2, 2, 3, 4, 5, 5, 5, 5, 5, 5, 5, 5

To determine the favourite pizza topping from the data collected, the researcher calculates the mean to be 3.25. After they analyse their data, the business changes their menu to reflect the preferences determined by the data. Now their only pizza option is Meat Lovers. At their first event, the food truck business is surprised that they only sell a couple of Meat Lovers pizzas, and have many people asking for other toppings that are not available.

1 Explain why the use of a mean to determine the favourite pizza topping was an inappropriate choice.
2 Identify a measure of central tendency that would better summarise the results of the pizza topping preferences. Determine the favourite topping using this measure.
3 Use an appropriate type of graph to display this data, following all graphing conventions.
4 The food truck business gives their questionnaire to people who attended an Italian food festival in Melbourne CBD, and at a primary school Christmas celebration. They obtained different results for each event. Discuss why this may have happened with reference to reproducibility and validity of the investigation.

Section 2A questions

1 A restaurant wants to survey their customers to obtain some honest feedback about their service and food. Provide an example of three questions the restaurant could ask to obtain qualitative data and three questions they could ask to obtain quantitative data to gather feedback.
2 A sport psychologist is investigating their belief that having a dedicated team captain can increase the motivation level of a team. On game day, they survey each player on a team that has a captain and each player on a team that does not have a captain, to find each player's motivation level out of 10. They then collate the results and calculate some statistics, as shown in the table below.

	Team with a captain	Team without a captain
Percentage of players who rated their motivation as 8 or above (%)	100	72
Mean motivation level (out of 10)	9.2	7.8
Standard deviation	0.4	1.2

ISBN 978-1-009-25416-8 Gallagher et al

a Explain what the percentage results tell us about the data obtained for each group.
b Based on the results data alone, explain whether the sport psychologist's hypothesis is supported by the results.
c Explain what the standard deviations tell us about this data.
d If the team without a captain for this game appoints a captain for the next game, explain how calculating the percentage change could be useful in determining the effect of a team captain on motivation.
e If the psychologist uses local basketball teams for this study, comment on the external validity of their results to all sports.

3 A publisher wants to produce a gratitude journal and is testing out two formats (named Gold and Silver) to see which one helps increase happiness more. They select a sample of 50 participants with 25 people trialling each format. They give all participants a happiness questionnaire before and after using the gratitude journal to find their happiness rating, and the results are shown in the table below.

Journal format	Mean happiness rating (out of 10)	
	Before using journal	After using journal
Gold	6.8	8.9
Silver	7.1	9.5

a Explain the results shown in the table.
b One participant recording their results interprets the happiness rating scale as 1 being the highest happiness rating and 10 being the lowest happiness rating. Identify this type of error and describe what should be done to fix this error.
c If the researcher wants to obtain extra data for this study using the same participants, would they be considering the study's repeatability or reproducibility?

4 'Vines' is a new clothing shop that is monitoring their online customer purchase habits to see how they compare to their competitors. Vines tracks their overall sales for their first six months of trading, as shown in the table below.

Month	January	February	March	April	May	June
Number of sales	15	17	25	35	50	105

a Plot this data as a line graph to show the trend in sales over the six months. Select an appropriate scale for the y-axis and be sure to label the axes and give the graph a title.
b During which month is there the largest number of sales?
c Describe the overall trend that this data is showing.
d Describe what might have happened during the data collection and processing if the month of July had recorded only seven sales.

ISBN 978-1-009-25416-8 Gallagher et al

2B Drawing conclusions and communicating scientific ideas

Study Design:

Construct evidence-based arguments and draw conclusions

- Distinguish between opinion, anecdote and evidence, and scientific and non-scientific ideas
- Evaluate data to determine the degree to which the evidence supports the aim of the investigation, and make recommendations, as appropriate, for modifying or extending the investigation
- Evaluate data to determine the degree to which the evidence supports or refutes the initial prediction or hypothesis
- Use reasoning to construct scientific arguments, and to draw and justify conclusions consistent with the evidence and relevant to the question under investigation
- Identify, describe and explain the limitations of conclusions, including identification of further evidence required
- Discuss the implications of research findings and proposals, including appropriateness and application of data to different cultural groups and cultural biases in data and conclusions

Analyse, evaluate and communicate scientific ideas

- Use appropriate psychological terminology, representations and conventions, including standard abbreviations, graphing conventions and units of measurement
- Discuss relevant psychological information, ideas, concepts, theories and models and the connections between them
- Critically evaluate and interpret a range of scientific and media texts (including journal articles, mass media communications, opinions, policy documents and reports in the public domain), processes, claims and conclusions related to psychology by considering the quality of available evidence
- Use clear, coherent and concise expression to communicate to specific audiences and for specific purposes in appropriate scientific genres, including scientific reports and posters
- Acknowledge sources of information and assistance, and use standard scientific referencing conventions

Glossary:

Abstract
Anecdote
Conclusion
Discussion section
Evidence
Implications
Introduction section
Limitations of conclusions
Methodology section
Opinion
References and acknowledgements section
Results section
Scientific poster
Scientific report

ISBN 978-1-009-25416-8 Gallagher et al

ENGAGE

Should you trust every experiment you read?

Figure 2B–1 Some images from the Rorschach inkblot test

What do you see in the images in Figure 2B–1? These images are from the Rorschach inkblot test. The test was originally produced in 1921 by Hermann Rorschach, who aimed to use inkblot pictures such as these to help diagnose mental illness, particularly schizophrenia. However, after his death, the inkblots were widely used as a personality test.

The Rorschach inkblot test has been widely criticised for its lack of scientific merit, in particular the lack of consistency when interpreting responses, and the fact that the images are being used for purposes that they were not designed for.

EXPLAIN

Analysing and evaluating scientific ideas

Opinion
a judgement that is not necessarily based on proof

Anecdote
a short personal account of an event

Evidence
a verified fact

When you read information on a particular topic in scientific or media texts, such as journal articles, mass media communications, opinions, policy documents and reports in the public domain, it is important that you evaluate the source of the information. You should distinguish between information based on opinion, anecdote and evidence, and determine whether it is presenting scientific or non-scientific ideas. **Opinion** is a judgement that is not necessarily based on proof. An **anecdote** is a short personal account of an event. **Evidence** is verified fact. You should evaluate the processes used, and the claims and conclusions drawn according to the quality of evidence provided by the source.

1C SAFETY AND ETHICAL UNDERSTANDING LINK

When investigating issues relating to the application of scientific knowledge in society, you should apply your knowledge and skills of ethical understanding to reach an informed stance on the issue, as discussed in Section 1C.

ISBN 978-1-009-25416-8 Gallagher et al

Figure 2B–2 When reading and interpreting information on psychological issues and research, it is important to distinguish between scientific ideas and non-scientific ideas.

Drawing conclusions

Once the results collected in an investigation have been analysed for differences, trends and patterns, the final steps in research involve evaluating the data to determine whether the evidence supports the initial aims, hypotheses and predictions of the investigation. You can then determine an evidence-based conclusion for the sample, identify limitations to the conclusions and discuss the implications of the findings.

LINK 1A INVESTIGATION AIMS, QUESTIONS, HYPOTHESES AND VARIABLES

A **conclusion** is a statement about the findings of a study. A conclusion addresses the aim of the study and states whether the original hypothesis was found to be supported by the evidence. It is based on whether observed patterns in the results are consistent with the original hypothesis. For a controlled experiment, the major findings are summarised as justification for whether the IV caused a change in the DV. In this way, a conclusion ties the hypothesis and the results together.

Conclusion a statement about the findings of a study, which addresses the aim and hypothesis

For example, one of the conclusions based on the data displayed in Figure 2A–15 (How students spend their free time) is that older students prefer to spend more time on social media than on games or television.

A conclusion based on the analysis of summary statistics such as means may only be determined for the specific sample that was studied, not the wider population. Additionally, findings cannot determine that the hypothesis was proved to be true, only that it is supported or refuted (not supported). You cannot draw a conclusion if the study was found to have poor validity; for example, if the methods were not strongly measuring the research question or if confounding variables were present. To draw conclusions for the wider population, the study must have good external validity.

Figure 2B–3 A conclusion is a statement of the final findings that addresses the original aim and hypothesis.

ISBN 978-1-009-25416-8 Gallagher et al

VIDEO 2B–1 SKILLS: WRITING AN INVESTIGATION CONCLUSION

2B–1 SKILLS

Writing an investigation conclusion

A conclusion for a study should include:

- a reference that it applies to the specific research sample only, and not the wider population of interest
- the direction of the results, such as whether the IV influences the DV to increase, decrease, heighten, lower, etc.
- the relationship between the variables
- a consideration of the investigation design in a controlled experiment.

For example, 'On the basis of the evidence from this sample, the results are consistent with the hypothesis that the consumption of sugar results in a decrease in the attention levels of children, compared to when children did not consume any sugar.'

Limitations of conclusions the faults or flaws in the design of an investigation that may limit the conclusions of that investigation

Implications the impact a study might have on the population, relevant theory and future research

A conclusion should include a discussion of the limitations of the conclusions by highlighting any faults in the experimental procedures and how they specifically may have affected the results. **Limitations of conclusions** refer to design flaws in the study that may limit the conclusions of an investigation. These are not the same as extraneous and confounding variables but will include these. For example, the choice of investigation design may have resulted in confounding variables, or the measurement instrument may have produced errors. A researcher can determine whether further evidence is required, and they can suggest improvements and specific recommendations to direct future research.

Figure 2B–4 One part of concluding a study involves discussing how the research will affect the population of interest and how future research could extend the findings.

Another component of concluding research is the consideration of **implications**, which are the impact that the study might have on the population, relevant theory and future research in the chosen area. Implications refer to how the research will affect the population of interest and how the findings will be important for identifying specific areas that require new research. When you discuss the implications of an investigation, consider whether there is any cultural bias in the collected data and final conclusions. If a study is conducted with a sample of participants from a particular cultural group, then the findings may not apply to people from a different cultural group.

Check-in questions – Set 1

1 What is a conclusion in research?
2 What is the difference between a limitation and an implication?
3 What are some of the things that are considered when concluding research?

ISBN 978-1-009-25416-8 Gallagher et al

Communicating scientific ideas

Researchers can communicate the findings of their study in a variety of ways to inform scientists and other interested people about what they discovered during their research. Usually, they will publish their results as an article in a scientific journal or present a scientific poster or talk at a conference. This way, the researcher can share the benefit of their findings.

Scientific journals are periodic publications that report on new primary research. They can be published in physical form, as found in university libraries, or in electronic form, as found online. New issues of journals can be published weekly, monthly or every few months, and each issue contains tens of articles reporting on various research findings. There are hundreds of psychology journals, and thousands of journals across all sciences. Many psychology journals publish on specific topics; for example, the *Journal of Cognitive Neuroscience* or the *Journal of Happiness Studies*.

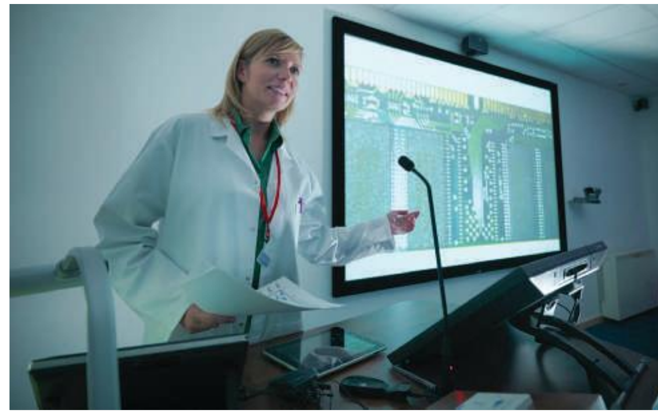


Figure 2B–5 Presenting at a conference is one way a researcher can communicate their ideas and findings.

2B–2 SKILLS

VIDEO 2B–2
SKILLS: SEARCHING FOR SCIENTIFIC RESEARCH ARTICLES

Searching for scientific research articles

Searching for an appropriate scientific research article online can be difficult and time consuming. You can often find lots of blogs, books or website articles dedicated to explaining the topic, but it can be harder to find an appropriate original scientific article that reports the primary data you are looking for.

Here are some tips for finding original scientific reports and journal articles in your chosen topic.

Know what you're looking for.

- Search for original articles written by the researcher(s) who actually completed the investigation.
- Articles outlining controlled experiments should have the main sections of a scientific report (introduction, methodology, results, discussion).

Use the right key words for your search.

- Use the term 'journal article' together with your IV and DV to refine your search.
- The term 'experiment' does not work as well to find scientific research articles.
- Clicking on 'scholarly articles for ...' or using scientific search engines such as Google Scholar, PubMed or PsycINFO refines the search to articles, but the articles will often include very complex research that can be difficult to understand.

Scan through the search listings, looking for:

- anything listed by a scientific journal
- a digital object identifier (doi), which is an identification number restricted to scientific articles
- a listed author shown as 'by (name) (date)'; for example, 'by NM Zuccon 2021'
- an acceptable year of publishing, that is as recent as possible
- 'cited by ...', which shows how many other researchers have mentioned this study in their own research. This can be a good indication of popular and relevant articles.

ISBN 978-1-009-25416-8 Gallagher et al

Once you have found an article, decide whether it is appropriate for your needs. Determine what information the site will let you see.

- 'Full text' is best because it will allow you to read the whole article. You may need to click on a link on the page to take you to the full text if it does not come up straight away.
- 'Limited access' is more common. This means you can only see parts of the article (typically just the abstract) unless you pay or subscribe.
- If there is not enough information provided in the abstract, you might need to keep searching. Sometimes you can find the full text on a different site, by conducting a new search in Google Scholar using the article's full title. You can also try searching for the researcher's personal website where they sometimes publish their own articles. You can even try emailing the researcher directly, and they might share their article with you!
- You can use the article's reference list to lead you to similar research by other people.
- Once you have found a full text article, read the abstract first. This is a summary of the whole investigation and can help you decide whether the article is appropriate and warrants further reading.

Scientific report a report outlining why and how some research was conducted, with an analysis of the findings

Abstract a section of a scientific report that is a concise summary of the whole investigation

Introduction section a section of a scientific report or poster that provides an overview of what the investigation is trying to achieve and why it is important

Research articles include complete explanations of original research and its findings. They can be very complex and vary in length, some being more than 20 pages. Research articles often follow a standard structure with several main sections in a particular order, depending on the investigation methodology they used. The researcher must follow the writing style determined by the publishing journal.

Scientific reports

In VCE Psychology, you may write a **scientific report** that explains your research and includes the following main sections: abstract, introduction, method, results and discussion.

An **abstract** is a concise summary of the whole report, including the aim, hypothesis, procedures or methods, major findings and conclusions.

The **introduction section** includes the information that is required for the reader to understand what the research is trying to achieve and why it is important. It begins broadly by describing the rationale of where the investigation question has come from, including previous research that has been done in the area of interest and other background information, such as psychological concepts, definitions of key terms and theories. As this section progresses, it then becomes more specific, by finishing with the investigation aim, hypothesis or predictions and variables of the study.

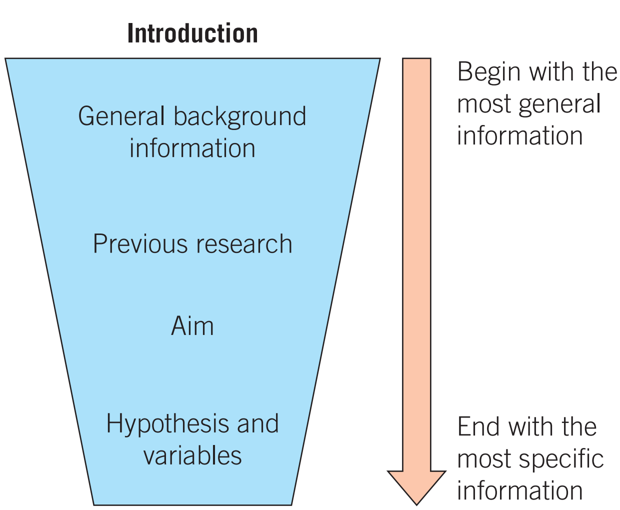


Figure 2B–6 The introduction section of a scientific report can be thought of as funnel shaped. It begins with the most general information about relevant theory at the wider part of the funnel, and ends at the narrowest part with the most specific information obtained from the completed study.

ISBN 978-1-009-25416-8 Gallagher et al

The **methodology section** of a scientific report describes how the study was undertaken. It often includes three subsections: participants, materials/equipment and procedures.

- *Participants:* This subsection describes the participants, including the number of participants, the population they were drawn from, the sampling technique, and relevant demographic characteristics, such as their gender, age range, and any other necessary characteristics for the research. If relevant, it also includes a statement about which research ethics committee reviewed and approved the study and which ethical frameworks the study was conducted within; for example, the National Health and Medical Research Council's 'National Statement on Ethical Conduct in Human Research'.
- *Materials/equipment:* This subsection lists all materials and equipment used in the study.
- *Procedures:* This subsection lists the steps taken to complete the research. It should be written in past tense as if the procedures have already been completed. The investigation design is included here, as well as the methods used to generate and analyse the data. The degree of detail should allow the reader to understand exactly how the study was done so that it could be easily repeated.

Methodology section a section of a scientific report or poster that describes the participants, materials and procedures used in the study

The **results section** displays all the relevant findings and evidence collected in the study. This includes tables, charts and graphs displaying the data and evidence. Generally, the same data should not be presented in a table as well as a graph. Findings may also be described in written text where it can be easily summarised. The results section should not include an explanation for the results. Raw data is not included within the results section but may be included as an appendix.

Results section a section of a scientific report or poster that outlines the evidence and findings of the study

The **discussion section** explains the findings and concludes the investigation. The section begins by reminding the reader of the objectives of the research and determines whether the hypothesis was supported, partly supported or refuted, in reference to the main findings. The background research that was discussed in the introduction can be referred to here and compared with the findings of the current research. In the discussion, any limitations of the design of the study are analysed, and any anomalous data that was not predicted and potentially a result of a flaw in the procedure are acknowledged. The discussion includes any suggestions for improvements to the study and future research. In the discussion, the researcher also includes any implications for the real-world application of the findings, as well as comments on the direction of future research. In a scientific report, this section finishes with a final detailed conclusion that links back to the original aim of the study. On a scientific poster, the conclusion is written in a separate section.

Discussion section a section of a scientific report or poster that analyses the findings and concludes the research

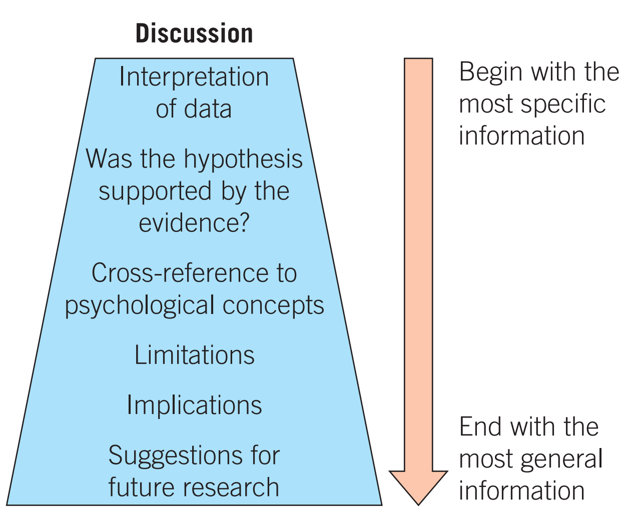


Figure 2B–7 The discussion section of a scientific report can be thought of as pyramid shaped. It begins with the most specific information about the study at the top of the pyramid, and ends with the most general information about the future direction of research in the topic at the bottom of the pyramid.

ISBN 978-1-009-25416-8 Gallagher et al

References and acknowledgements section
a list of all the sources used in a scientific report or poster

The **references and acknowledgements section** contains a complete list of all the sources referred to in the report, including the sources for the background research, theories, concepts, key term definitions or quotes. References in scientific reporting follow different style guides, with APA (American Psychological Association) style being most common in psychology. The style guide describes very specifically exactly what information is required when citing different sources, such as a journal article, book or website, as well as the specific formatting of the reference. You can use an online reference generator to create a reference that follows APA formatting guidelines. In VCE Psychology, you may choose to use another referencing format such as Harvard, and it is not required that you remember all the specific formatting rules as outlined in Skills 2B–3.

VIDEO 2B–3 SKILLS: REFERENCING SOURCES

2B–3 SKILLS

Referencing sources using the APA format

When writing a psychology report or poster, the correct referencing of a source involves two parts: an in-text citation and a reference list entry.

In-text citations

Include an in-text citation when your work has been influenced by someone else's work, either when using a direct quote or when paraphrasing. An in-text citation is a shortened form of the reference that you cite in the body of your report. The citation can be at the start, middle or end of the sentence, and always includes the first author's surname and year of publication.

This citation format can be used for all types of sources, including books, journal articles and web documents. The in-text citation briefly identifies the work so that the reader can locate the corresponding entry in the reference list.

Table 2B–1 Citation formats

Number of authors	Information to include	Examples
One author or one organisation	• Author's surname and publication year	• Zuccon (2021) has proposed that ... • … effect was shown in a recent study (Robinson, 2021).
	• Organisation name and publication year • Organisation's full name used in first citation, an abbreviation used thereafter.	• In 2018, the National Health and Medical Research Council (NHMRC) produced a document ...
Two authors	• Both surnames every time, and the publication year • Use '&' only within brackets.	• (Beddoes & Harrington, 2020) • Clark and Dickinson (2020) found that …
Three or more authors	• First author's surname followed by 'et al.' (a Latin abbreviation meaning 'and others') and publication year	• (Checkley et al., 2019). • Green et al. (2003) found that …

ISBN 978-1-009-25416-8 Gallagher et al

Reference lists

All sources cited in text, such as in the introduction section of a scientific poster, must be included in the reference list. References should be listed in alphabetical order by author surname or organisation name. There are very specific formatting rules for references lists, and different sources require different details. In general, four elements are included in a reference: author, date, title and source. The examples below show a reference entry for a journal article, a book and a website. For more examples and explanations of how to reference other sources such as Wikipedia, organisational reports, films, YouTube clips, TED Talks, and podcasts, a referencing quick guide is provided in the Interactive Textbook.

DOCUMENT 2B–1 QUICK REFERENCING GUIDE

Periodical (journal, magazine or newspaper article; print or online)

Author(s) surname and first initials

Date of publication
- in round brackets
- year only for journal article
- full date for magazine article

Article title
- in sentence case

Peter, M.S., Durrant, S., Jessop, A., Bidgood, A., Pine, J. M., & Rowland, C. F. (2019). Does speed of processing or vocabulary size predict later language growth in toddlers? *Cognitive Psychology, 115,* Article 101238. https://doi.org/10.1016/j.cogpsych.2019.101238

Page range or article number
- page range written as x–x
- article number written as Article xxxx

DOI or URL
- doi written as https://doi.org/xxxxx
- URL written as https://xxxxx

Periodical title
- in *italics*
- every major word starting with a capital letter

Volume number
- in *italics*

Issue number
- in round brackets, no italics

Book

Author(s) surname and first initials

Year of publication
- in round brackets

Book title
- in sentence case

Edition number if other than first edition
- in round brackets
- written as (2nd ed.).

Jeffs, S., & Leggatt, M. S. (2020). *Out of the madhouse: From asylums to caring community?* Australian Scholarly Publishing Pty Ltd.

Publisher:
- every major word starting with a capital letter

Website

Author surname and first initials or name of group

Date of publication
- in round brackets

Title of work
- in *italics*
- in sentence case

Australian Psychological Society (2020). *How to access a psychologist.* https://www.psychology.org.au/for-the-public/about-psychology/how-to-access-A–psychologist

Website name goes before URL if different from author – here website and author are same, so omitted

URL
- written as https://xxxxx

ISBN 978-1-009-25416-8 Gallagher et al

VIDEO 2B–4 SCIENTIFIC POSTERS

Scientific posters

Conventions and conferences are formal meetings where scientists present their research. It is a chance for researchers to come together and share their latest developments with like-minded people. It is also a chance to collaborate and network. The research topics may cover a broad range or be very specific. A researcher will create a large **scientific poster** of their work, often measuring more than a metre wide, which they stand next to during the convention and discuss with the attendees (Figure 2B–8).

Scientific poster a way to present the main sections of a scientific report in a brief and visual way

A scientific poster includes all the main components of a scientific report summarised to be much more concise and more visually appealing. A scientific poster should not look like a research report condensed onto one page. It can be thought of as an illustrated abstract because it succinctly describes all the main features without the tiny details, in an eye-catching way. Because the researcher will be present at the poster session, they can discuss additional details with the reader.

Figure 2B–8 A researcher can present their findings on a scientific poster at conferences. A scientific poster should include a very brief summary of the research, and it should be visually appealing and easy to read from a distance. A researcher may discuss their research in more detail with anyone attending the poster session.

A good scientific poster contains small blocks of text in a large and simple font, with headings, graphs, tables and images that can be read from a distance. You can reduce the amount of text by using diagrams, bullet points, flow charts and images. All images should be clearly labelled. Use soft colours that do not strain the eyes. Scientific posters in the real world can follow many different templates. The poster may be either in portrait or in landscape orientation, and it can be divided into two, three or four columns, appropriately spaced apart. The sections of a poster should follow a logical order to allow for easy interpretation.

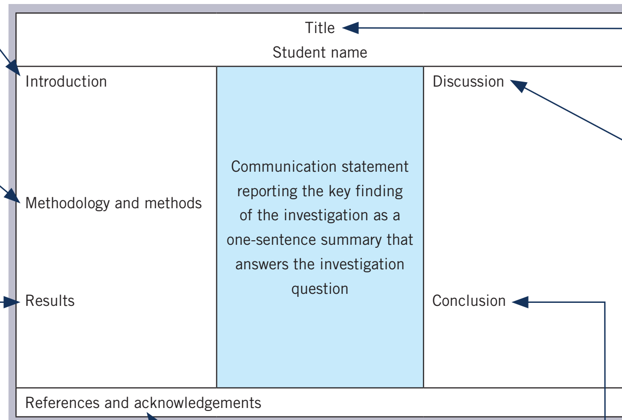
VCE Psychology mandates a specific format for a scientific poster. The sections must include a title, introduction, methodology and methods, results, discussion, conclusion, references and acknowledgements. You do not need to include an abstract on a scientific poster in VCE Psychology, and the information on the poster should not exceed 600 words in total (excluding text in tables, graphs, image captions, references, which are all not included in the word count).

Figure 2B–9 outlines the template required for a scientific poster in VCE Psychology. You can include photos, illustrations, diagrams, bullet points, flow charts, tables and graphs to make the poster visually appealing and reduce the number of words.

ISBN 978-1-009-25416-8 Gallagher et al

Introduction
- A brief explanation or reason for undertaking the investigation, including a clear aim, a hypothesis and/or prediction and relevant background psychological concepts. Photos and illustrations can be included where relevant.

Methodology and methods
- Brief outline of methodology used to address investigation question
- Summary of methods of data generation and data analysis
- Often includes subsections for participants, materials and procedures
- Materials can be in a bulleted list
- Only include key parts of procedure, in enough detail that study could be repeated
- Figures and flow charts can be used to describe procedures
- A diagram can be used to describe set-up of equipment



Title
- Question under investigation

Discussion
- Interpretation and evaluation of analysed primary data
- Identification of limitations in data and methods, and suggested improvements
- Cross-referencing of results to relevant psychological concepts and previous research
- Linking of results to the investigation question and aim, to explain whether investigation data and findings support the hypothesis
- Implications of investigation and/or suggestions for further investigations

References and acknowledgements
- Acknowledges any information that has been sourced elsewhere, including quotes, definitions and background research
- Sources should be referred to in the body of poster, and a full detailed reference included in the reference list
- Reference list should follow APA formatting guidelines

Centre of the poster will feature a simple and engaging communication statement: a one-sentence summary of the major finding of the investigation that answers the investigation question. This section must occupy 20–25% of the poster space.

Results
- Presentation of generated data/evidence in appropriate format to illustrate trends, patterns and/or relationships
- Data presented in a table or graph, clearly labelled and titled, and appropriate to data
- A small amount of text may be included to note key points featured in tables and graphs

Conclusion
- Conclusion that provides a response to investigation question
- Identification of the extent to which the analysis has answered investigation question, with no new information being introduced

Figure 2B–9 The scientific poster template required in VCE Psychology, with the main information required for each mandated section

WORKSHEET 2B–1 EVALUATING SCIENTIFIC POSTERS

Check-in questions – Set 2

1. List the main sections of a scientific report.
2. What is included in the centre column of a scientific poster?
3. Which section includes the final statements of the overall findings and a closing response to the investigation question?

ISBN 978-1-009-25416-8 Gallagher et al

VIDEO 2B–5 SKILLS: LANGUAGE IN SCIENTIFIC REPORTS AND POSTERS

2B–4 SKILLS

Language in scientific reports and posters

A scientific report is a formal piece of writing that should use scientific language and a formal tone.

A scientific report or poster can be written in the first person (e.g. 'I discovered that …', 'Our experiment showed …') or the third person (e.g. 'The researcher found …', 'The participants were instructed to …') because the scientific community has not reached a consensus, and different scientific journals have different requirements for language use. However, third-person voice helps to maintain an objective tone to your writing and will more likely be recommended by your teachers.

A scientific report or poster may use different tenses in different sections. In general, anything that has already been done (such as the procedure of an experiment) should be written in past tense; for example, 'The participants were divided equally into two groups.' When describing something that still exists (such as a psychological theory), then use present tense; for example, 'The Atkinson-Shiffrin model of memory states that there are three major memory stores.'

ACTIVITY 2B–1 COMPARING SCIENTIFIC REPORTS AND SCIENTIFIC POSTERS

Create a summary table that describes the similarities and differences in presenting a scientific investigation in a report format and a poster format.

	Scientific report	Scientific poster
Similarities		
Differences		

Figure 2B–10 Whether you convey your information in a scientific report or a poster, remember to use formal language and a formal tone.

ISBN 978-1-009-25416-8 Gallagher et al

Section 2B questions

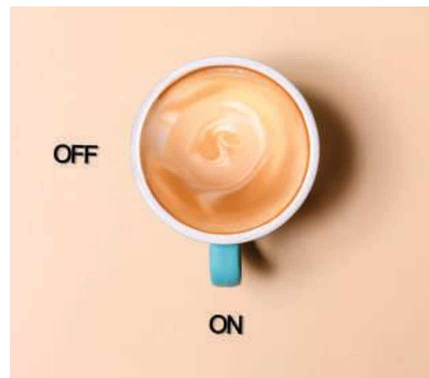
1 A researcher studying driving safety and sleep deprivation wants to use a driving simulator in their controlled experiment to measure driving performance. They are concerned about whether the driving simulator actually measures participants' driving performance or whether it measures participants' performance on arcade games. The researcher selects the first five people who come into the vehicle registration building.

a Identify and explain the evaluation that the researcher is concerned about and suggest a way that they could resolve their concern.

b Identify two limitations of this investigation.

c Discuss the implications of this study.

2 A health psychologist is investigating the effect of caffeine on sleep latency (the time it takes to fall asleep) in Australian university students. They think that caffeine will increase sleep latency, with energy drinks increasing sleep latency more than coffee. The psychologist samples 100 students from their university in Melbourne. Before going to bed, one group of the sample drinks coffee, one group drinks an energy drink and one group drinks a placebo. The groups follow a within subjects investigation design and complete all three conditions over three nights. Participants are given a smart watch to record their sleep, including the time they fall asleep. Several of the participants report that the smart watches are very old and that the watches are recording sleep latency as earlier than what actually occurs. The results for the three groups' sleep latency following drinking a caffeinated drink are shown in the table. The psychologist decides to communicate the findings as a scientific report, and it is published in a scientific journal.



Group	Average sleep latency (min) after energy drink	Average sleep latency (min) after coffee	Average sleep latency (min) after placebo
A	40	35	20
B	21	40	38
C	58	21	29

a Suggest a conclusion the psychologist will come to for their investigation.

b Identify the limitations to this study and make some recommendations for future research.

c A university student reads the journal article and shares the main findings to the university's social media page, asking for students to comment on their own experiences of caffeine and sleep. Identify one example of an opinion, anecdote and evidence that might be read on the social media post.

d List the main information the psychologist would have included in the introduction section of their scientific report.

ISBN 978-1-009-25416-8 Gallagher et al

Chapter 2 review

Summary

Create your own set of summary notes for this chapter on paper or in a digital document. A model summary is provided in the Teacher Resources, which can be used to compare with yours.

Checklist

In the Interactive Textbook, the success criteria are linked from the review questions and will be automatically ticked when answers are correct. Alternatively, print or photocopy this page and tick the boxes when you have answered the corresponding questions correctly.

	Success criteria – I am now able to:	Linked questions
2A.1	Distinguish between primary and secondary data	2☐
2A.2	Systematically generate and record primary data, and collate secondary data for an investigation	13a☐
2A.3	Determine the type and amount of qualitative and quantitative data to be generated or collected in an investigation	13b☐
2A.4	Identify potential sources of error and uncertainty when designing and conducting investigations	12c☐
2A.5	Distinguish between the features of qualitative and quantitative data	11b☐
2A.6	Identify examples of qualitative and quantitative data and evaluate the appropriateness of their use in an investigation	11a☐
2A.7	Accurately and systematically record and summarise qualitative and quantitative data, including using a logbook	13a☐
2A.8	Describe the features and uses of tables, bar charts and line graphs to organise and present data	10a☐
2A.9	Select a meaningful and relevant presentation format, and then organise and present data using tables, bar charts and line graphs	13c☐
2A.10	Interpret data presented in tables, bar charts and line graphs	10b☐
2A.11	Describe the features and purposes of using percentages, percentage change, measures of central tendency (mean, median, mode), and measures of variability (standard deviation)	9☐
2A.12	Select the appropriate mathematical relationships for a set of quantitative data and calculate the percentage, percentage change, mean, median, mode and standard deviation using the correct units of measurement	13d☐
2A.13	Interpret quantitative data presented as percentages, percentage change, measures of central tendency (mean, median, mode), and measures of variability (standard deviation)	6☐
2A.14	Describe the concepts of accuracy, precision, repeatability, reproducibility, true values, internal and external validity, errors and certainty in relation to a qualitative analysis of data	3☐
2A.15	Describe and analyse the effect of sample size on the quality of data obtained	13e☐
2A.16	Analyse data qualitatively for accuracy, precision, repeatability, reproducibility, true values, internal and external validity, errors and certainty	7☐, 8☐

ISBN 978-1-009-25416-8 Gallagher et al

Success criteria – I am now able to:		Linked questions
2A.17	Identify outliers, contradictory data and incomplete data in a data set	13f ☐
2A.18	Analyse the effect of outliers, contradictory and incomplete data	13f ☐
2A.19	Explain the benefit of repeating experiments to ensure findings are robust	12a ☐
2A.20	Evaluate investigation methods and the effect of possible sources of error or uncertainty in an investigation	12c ☐
2A.21	Suggest improvements regarding sources of error or uncertainty in investigation methods to increase validity and to reduce uncertainty	12c ☐
2B.1	Distinguish between opinion, anecdote and evidence, and scientific and non-scientific ideas	1 ☐
2B.2	Evaluate sources of information for the use of opinion, anecdote, evidence, scientific and non-scientific ideas	13h ☐
2B.3	Evaluate data to determine the degree to which the evidence supports the aim of an investigation	5 ☐
2B.4	Provide appropriate recommendations for modifications or extensions to an investigation	10d ☐
2B.5	Evaluate data to determine the degree to which the evidence supports or refutes the initial prediction or hypothesis of an investigation	5 ☐
2B.6	Construct scientific arguments using reasoning	10c ☐
2B.7	Use reasoning and evidence to draw and justify conclusions for a question under investigation	12b ☐
2B.8	Identify, describe and explain the limitations of conclusions	10d ☐
2B.9	Identify when further evidence is required, and suggest what further evidence would improve the limitations of an investigation's conclusions	10d ☐
2B.10	Discuss relevant implications of research findings and proposals	10c ☐
2B.11	Evaluate cultural bias in data and conclusions to determine the appropriateness of application to different cultural groups	10d ☐
2B.12	Use appropriate psychological terminology, representations and conventions, including standard abbreviations	12c ☐
2B.13	Use appropriate graphing conventions and units of measurement when presenting data from investigations	13c ☐
2B.14	Access and interpret the information provided in a range of scientific and media texts including journal articles, mass media communications, opinions, policy documents and reports in the public domain	13a ☐
2B.15	Critically evaluate the quality of evidence provided by a range of scientific and media texts, processes, claims and conclusions	13h ☐
2B.16	Identify relevant audiences for specific scientific communications and use clear, coherent and concise expression to communicate for specific purposes in appropriate scientific genres	12d ☐
2B.17	Describe and apply the requirements for writing a scientific report and a scientific poster to an investigation	4 ☐
2B.18	Locate the required referencing details within scientific and media texts and use standard scientific referencing conventions to acknowledge sources of information and assistance used in research	13g ☐

ISBN 978-1-009-25416-8 Gallagher et al

Multiple-choice questions

1 Which of the following sources is most likely to accurately report evidence of scientific ideas?

A A psychology wiki
B The *Journal of Psychoeducational Assessment*
C A website with daily horoscopes
D A psychology blog

2 Which of the following identifies the difference between the collection of primary data and secondary data?

	Primary data	Secondary data
A	data collected through first-hand methods	data collected through research conducted by another person
B	data collected through research conducted by another person	data collected through second-hand experiments
C	data collected through experiments	data collected through first-hand methods
D	data collected through observational methods	data collected through research conducted by another person

3 What is the difference between systematic errors and random errors?

A Systematic errors create unpredictable variations in readings, whereas random errors can be improved by repeating the measurement.
B Systematic errors cause readings to differ by a consistent amount each time, whereas random errors create unpredictable variations in readings.
C Systematic errors involve all readings being shifted in one direction from the true value, whereas random errors follow a pattern.
D Systematic errors do not follow a pattern, whereas random errors involve a consistent change to readings.

4 Which of the following identifies the order of the sections of a scientific report?

A introduction, results, method, conclusion
B introduction, method, results, discussion
C abstract, discussion, method, conclusion
D abstract, results, method, discussion

The following information relates to Questions 5–7.

A restaurant is collecting data on their takeaway service in the 10 weeks before and the 10 weeks after signing up with a popular online order and delivery service called Cuisine Runners. The mean number of weekly orders and the standard deviation of orders is recorded in the table, as well as the percentage of satisfied customers at each stage. The restaurant had predicted an increase in weekly orders with the use of the new delivery service.

	Before Cuisine Runners	After 10 weeks of Cuisine Runners
Mean number of weekly orders	165	192
Standard deviation	7	8
Percentage of satisfied customers (%)	90	95

ISBN 978-1-009-25416-8 Gallagher et al

5 What does the results table indicate about the findings of this study?
  A The number of weekly orders and customer satisfaction increased with the use of Cuisine Runners, with a similar weekly spread of the number of orders before and after its use.
  B With the use of Cuisine Runners, the number of weekly orders and customer satisfaction decreased and there was a larger spread of the number of orders.
  C The spread of the number of orders was larger before the use of Cuisine Runners.
  D After the use of Cuisine Runners, the number of weekly orders increased, there was a smaller spread of the number of orders, and a larger percentage of satisfied customers.

6 The percentage change for the mean number of weekly orders is calculated to be 16.4%. This indicates there was
  A an increase of 16.4% in the mean orders since using Cuisine Runners.
  B a decrease of 83.6% in the mean orders since using Cuisine Runners.
  C a decrease of 16.4% in the percentage of orders since using Cuisine Runners.
  D an increase of 83.6% in the percentage of orders since using Cuisine Runners.

7 A café nearby heard about the increase in orders after the restaurant started using Cuisine Runners and is interested in using the delivery service themselves. Which of the following qualitative measures would best determine whether the delivery service would also improve orders for the café?
  A repeatability
  B precision
  C true value
  D external validity

8 Elizabeth Loftus is a researcher who conducted many studies on how eyewitness testimonies can be influenced by leading questions – questions that prompt a person to give a desired answer. Leading questions can propose incorrect information that is then incorporated into the original memory.

  Loftus obtained similar results when she repeated the investigation on another group of participants using the same procedures.

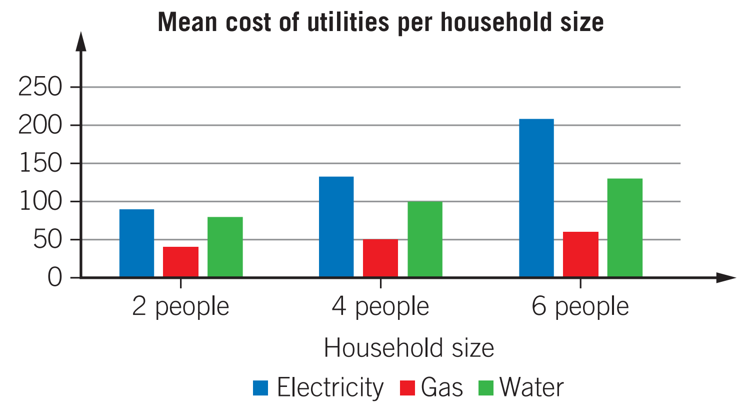
  What does this suggest about Loftus's studies?
  A Extraneous variables were well controlled for.
  B The studies had high validity.
  C The studies had low repeatability.
  D The studies had high reproducibility.

9 Which of the following is correct for quantitative data measures?
  A A mean would be used to find the average value of a set of data, whereas a median would be used to find the value that occurs most often.
  B The median, mean and mode can all be used to summarise qualitative data.
  C The standard deviation would be used to determine the spread of data around the mean, whereas the median would be used to find the value in the middle of a data set.
  D The mean is less influenced by outliers than the median is.

ISBN 978-1-009-25416-8 Gallagher et al

Short-answer questions

10 A researcher for a local council is collecting data on how the size of household utility bills changes according to the size of the household. They conduct surveys to find the cost of electricity, gas and water from a variety of households in a Melbourne neighbourhood. Their results are shown in the bar graph below.



- **a** What is an appropriate label for the vertical axis of this graph? (1 mark)
- **b** Describe the trend in electricity results shown in the graph. (1 mark)
- **c** Describe the implications of the findings from this investigation. (1 mark)
- **d** The data for this study was collected in Melbourne, Australia. Describe why the findings and conclusions from this investigation are not likely to be applicable to households in Alaska, USA. What further evidence and extensions to the investigation are required to make these finding applicable to people in Alaska? (2 marks)

11 A plant nursery wants to start selling their plants online through their website. Before they invest in this process, they wish to find out whether their customers would like this option.

- **a** Suggest one example of quantitative data and one example of qualitative data that the nursery could collect in this investigation. (2 marks)
- **b** For each example you gave in the previous question, explain why it is classified as qualitative or quantitative. (2 marks)

ISBN 978-1-009-25416-8

12 An educational researcher is conducting an investigation into the amount of sleep secondary students have received when they are absent for the first period of school the next day. Research states that adolescents should be sleeping about nine hours per night, and the researcher believes that if students sleep less than that, it may affect their school attendance for the first period of the day. The researcher samples 50 students from a local secondary school and finds that students who are absent for the first period of school are sleeping less than nine hours 79% of the time.

- **a** What should the researcher do to help verify their findings? (1 mark)
- **b** Suggest a conclusion for this study. (3 marks)
- **c** The researcher asks the students to record their own estimation of the number of hours they sleep each night. After the study has concluded, they notice that several nights' worth of data is missing for one student. Comment on the certainty of this data and suggest an improvement to the investigation methods to help increase the validity of the data. (2 marks)
- **d** The researcher wants to communicate their findings in a monthly publication on social media. Identify the relevant audience the researcher might be trying to reach by publishing their findings in this manner. (1 mark)

13 Using an appropriate source for weather recordings, collect data on the temperature in your city compared to another city in the world, over the past two weeks.

- **a** Record your data in an appropriate table. (2 marks)
- **b** When comparing the weather of two cities, what other qualitative and quantitative data might be useful in this investigation? (2 marks)
- **c** Select an appropriate presentation format for the data and plot the collected data using correct graphing conventions. (4 marks)
- **d** Calculate the mean, median and mode temperature for each city. (3 marks)
- **e** Search online for last year's mean monthly temperature of each city (for the current month). Record this result and compare your calculated mean temperatures to the mean monthly temperatures you sourced online. Describe how collecting one month's worth of data may affect the mean temperature of each city. (2 marks)
- **f** Comment on whether there appear to be any outliers in your data and analyse their effect on the statistics you calculated earlier. (2 marks)
- **g** Write down the reference for your data source using standard scientific referencing conventions. (1 mark)
- **h** Critically evaluate the quality of the evidence provided by the source of your weather data. (2 marks)

ISBN 978-1-009-25416-8 Gallagher et al

UNIT 3 HOW DOES EXPERIENCE AFFECT BEHAVIOUR AND MENTAL PROCESSES?

CHAPTER 3 NERVOUS SYSTEM FUNCTIONING

Introduction

Think about the things you do daily. Sleeping, walking, learning, remembering, talking, eating – the list goes on. Everything on this list requires the use of your nervous system. This is because when you engage in any of these activities, the network of neurons within your body receives information from the environment, processes it, and responds to it in a coordinated manner. Often, we take for granted the ability of our nervous system to perform most of its functions unconsciously without our awareness. In fact, our nervous system is so good at adapting that its neural pathways can change in response to experiences when learning and forming new memories. In addition, it performs many adaptive responses that increase our chances of survival in our environment, such as the flight-or-fight-or-freeze response, spinal reflex, and behaviours required to meet our basic needs such as eating and drinking. However, it can also play a role in unhelpful behaviours such as addiction.

Curriculum

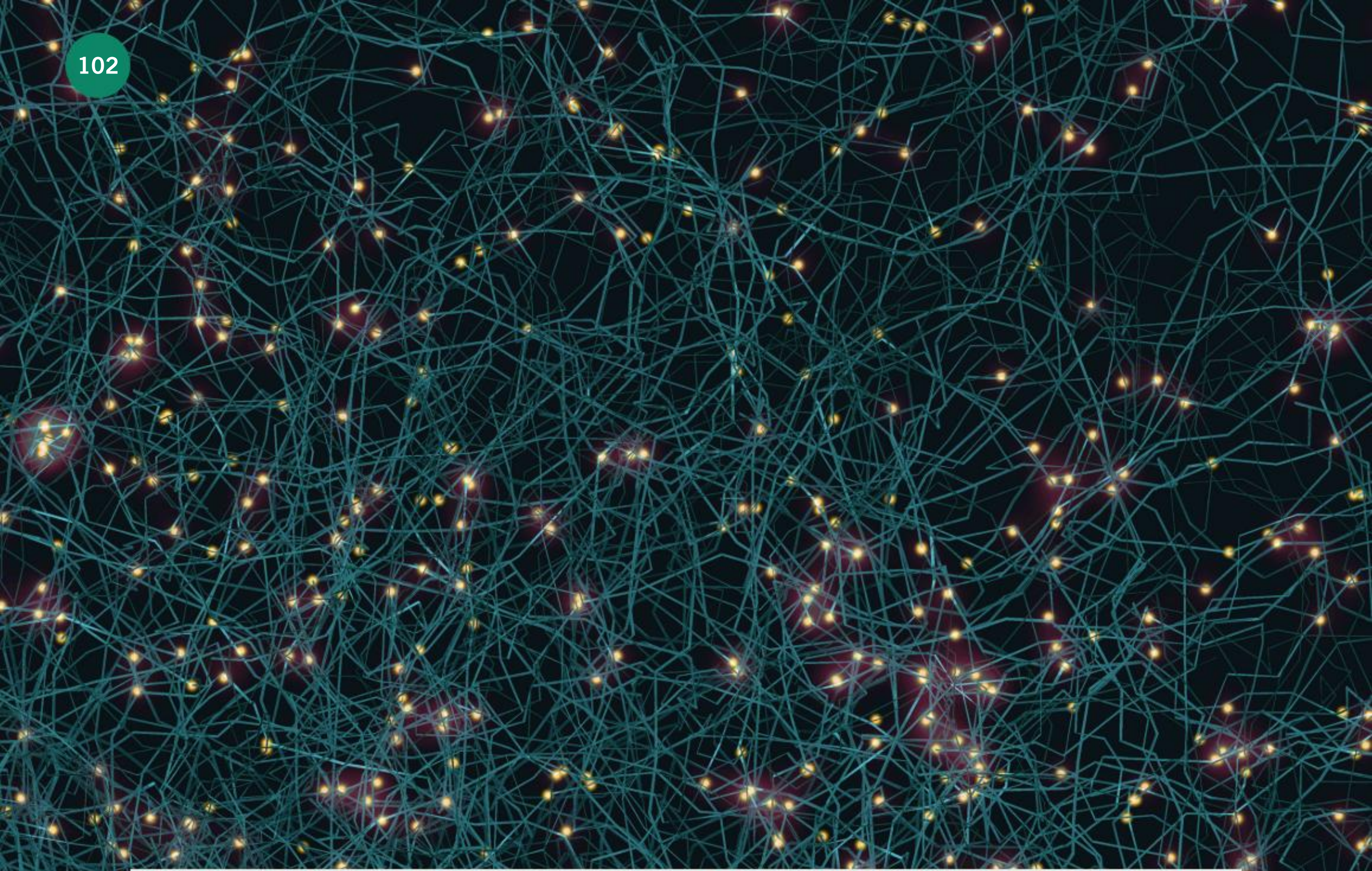
Area of Study 1 Outcome 1

How does the nervous system enable psychological functioning?

Study Design	Learning objectives – at the end of this chapter I will be able to:
• The roles of different subdivisions of the central and peripheral nervous systems in responding to, and processing and coordinating with, sensory stimuli received by the body to enable conscious and unconscious responses, including spinal reflexes	**3A The central and peripheral nervous systems** **3A.1** Identify the different divisions of the nervous system **3A.2** Explain the role of the central nervous system, including the brain and spinal cord **3A.3** Explain the role of the peripheral nervous system, including the somatic and autonomic subdivisions and the further subdivisions of the sympathetic and parasympathetic nervous systems **3A.4** Compare and contrast the roles of the different divisions and subdivisions of the nervous system **3A.5** Apply my understanding of the role of each division and subdivision of the nervous system to real-life examples of sensory stimuli received by the body

ISBN 978-1-009-25416-8 Gallagher et al

Study Design	Learning objectives – at the end of this chapter I will be able to:
	3A.6 Describe the key features of both a conscious and unconscious response and provide examples of each **3A.7** Distinguish between the key features of conscious and unconscious responses **3A.8** Correctly identify a conscious or an unconscious response from a real-life example **3A.9** Explain the role of the spinal reflex as an example of an adaptive, unconscious response **3A.10** Explain how a spinal reflex occurs when responding to sensory stimuli **3A.11** Apply my understanding of the spinal reflex to a real-life example of sensory stimuli received by the body
• The role of neurotransmitters in the transmission of neural information across a neural synapse to produce excitatory effects (as with glutamate) or inhibitory effects (as with gamma-aminobutyric acid (GABA)) as compared with neuromodulators (such as dopamine and serotonin) that have a range of effects on brain activity	**3B Neurotransmitters and neuromodulators** **3B.1** Explain the role of neurotransmitters in the transmission of information across a neural synapse **3B.2** Distinguish between the excitatory and inhibitory effects of neurotransmitters on the post-synaptic neuron **3B.3** Explain the role of glutamate in the production of excitatory effects **3B.4** Explain the role of GABA in the production of inhibitory effects **3B.5** Explain the role of neuromodulators and their effects on brain activity **3B.6** Explain how dopamine and serotonin both work as neuromodulators in the brain **3B.7** Compare the effects of dopamine and serotonin on brain activity **3B.8** Distinguish between neurotransmitters and neuromodulators
• Synaptic plasticity – resulting from long-term potentiation and long-term depression, which together act to modify connections between neurons (sprouting, rerouting and pruning) – as the fundamental mechanism of memory formation that leads to learning	**3C Synaptic plasticity** **3C.1** Explain what is meant by synaptic plasticity **3C.2** Describe the modifications that occur to connections between neurons as a result of sprouting, rerouting and pruning. **3C.3** Explain how both long-term depression and long-term potentiation modify the connections between neurons **3C.4** Explain the relationship between synaptic/neural plasticity and the formation of memories that leads to learning



Key Science Skills

- Identify, research and construct aims and questions for investigation
- Identify independent, dependent and controlled variables in controlled experiments
- Formulate hypotheses to focus investigations
- Predict possible outcomes of investigations
- Design and conduct investigations; select and use methods appropriate to the investigation, including consideration of sampling technique (random and stratified) and size, equipment and procedures, taking into account potential sources of error and uncertainty; determine the type and amount of qualitative and/or quantitative data to be generated or collated

Glossary

Autonomic nervous system
Brain
Central nervous system (CNS)
Conscious response
Dendritic spine
Dopamine
Excitatory effect
Filigree appendage
Gamma-aminobutyric acid (GABA)
Glutamate
Inhibitory effect
Interneuron
Long-term depression (LTD)
Long-term potentiation (LTP)
Motor neuron
Neural transmission
Neuromodulator
Neuron
Neurotransmitter
Parasympathetic nervous system
Peripheral nervous system
Pruning
Receptor site
Rerouting
Reward pathway
Sensory neuron
Sensory receptor
Serotonin
Serotonin pathway
Somatic nervous system
Spinal cord
Spinal reflex
Sprouting
Sympathetic nervous system
Synapse
Synaptic gap
Synaptic plasticity
Synaptic vesicle
Synaptogenesis
Unconscious response

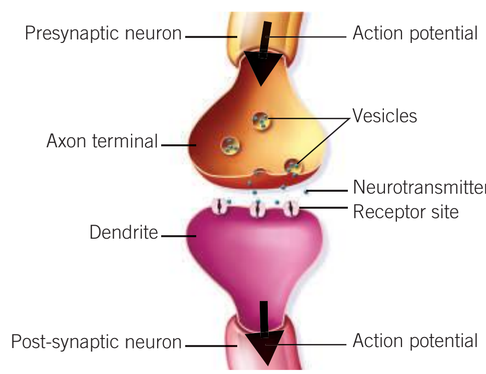
ISBN 978-1-009-25416-8 Gallagher et al

Concept map

3A The central and peripheral nervous systems

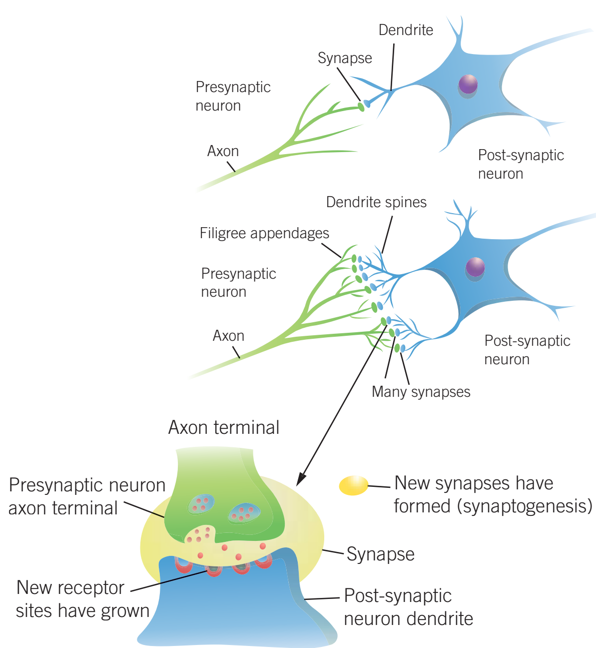
Communication of information throughout the nervous system

3B Neurotransmitters and neuromodulators



Changes to connections between neurons

3C Synaptic plasticity



See the Interactive Textbook for an interactive version of this concept map interlinked with all concept maps for the course.

ISBN 978-1-009-25416-8 Gallagher et al

3A The central and peripheral nervous systems

Study Design:
The roles of different subdivisions of the central and peripheral nervous systems in responding to, and processing and coordinating with, sensory stimuli received by the body to enable conscious and unconscious responses, including spinal reflexes

Glossary:
Autonomic nervous system
Brain
Central nervous system (CNS)
Conscious response
Interneuron
Motor neuron
Parasympathetic nervous system
Peripheral nervous system
Sensory neuron
Sensory receptor
Somatic nervous system
Spinal cord
Spinal reflex
Sympathetic nervous system
Unconscious response

ENGAGE

Artificial intelligence for treatment of nervous system damage

People who are paralysed because of a stroke or neurological disease can have trouble communicating with the outside world. Even a simple sentence can seem impossible to communicate. In recent research, a volunteer paralysed from the neck down was asked to imagine moving his arm to write each letter of the alphabet. The volunteer's brain activity during this task was used to train a computer model known as a neural network to interpret these commands. The computer model could trace the intended trajectory of his imagined pen tip to create the letters of the alphabet. Eventually, the computer could read out the volunteer's imagined sentences with roughly 95% accuracy at a speed of about 66 characters per minute. With more practice, the researchers expect this speed to increase. As the technology is refined, the neural recordings will be used to better understand how the brain plans and orchestrates fine motor movements.

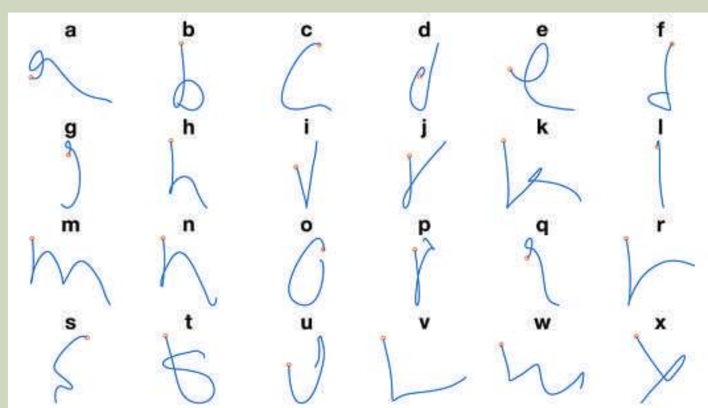


Figure 3A–1 These letters of the alphabet were written by a paralysed volunteer, using technology that included electrodes implanted in their brain.

ISBN 978-1-009-25416-8 Gallagher et al

EXPLAIN

Organisation of the human nervous system

The human nervous system consists of two main divisions: the central nervous system (CNS) and the peripheral nervous system. It is further divided into subdivisions as shown in Figure 3A–2.

VIDEO 3A–1 THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS

WORKSHEET 3A–1 SUMMARY OF THE NERVOUS SYSTEM ORGANISATION

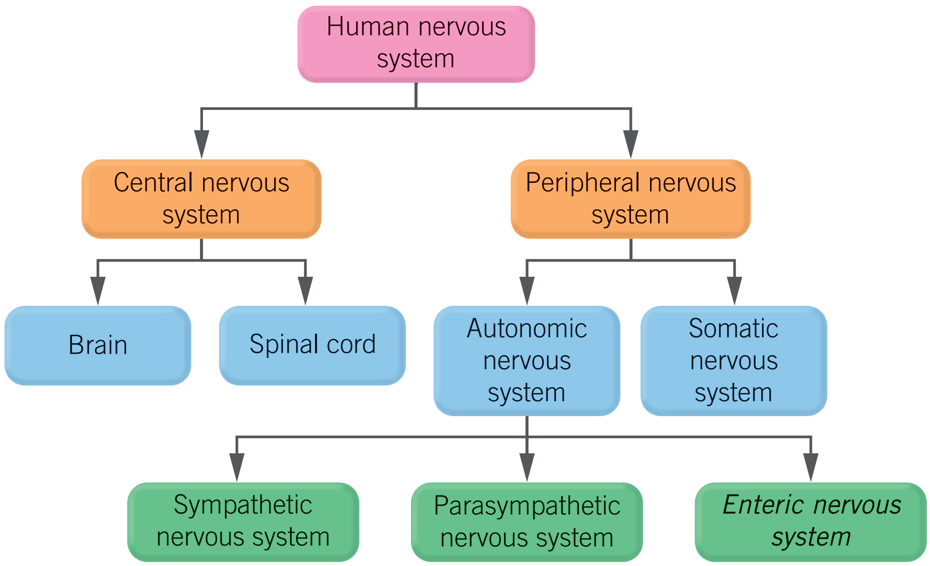


Figure 3A–2 The subdivisions of the central and peripheral nervous systems

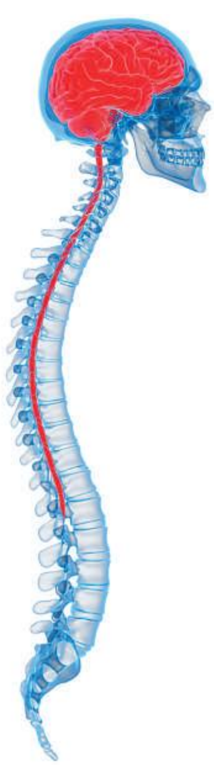


Figure 3A–3 The central nervous system consists of the brain and the spinal cord (shown in red).

Central nervous system

The **central nervous system (CNS)** is made up of the brain and spinal cord. It is referred to as 'central' because it occupies a central position in the body and is the most important part of the nervous system for processing and coordinating responses to sensory stimuli received by the body. The CNS integrates and coordinates all incoming (sensory) information and initiates outgoing (motor) messages to be sent to the body. These can be conscious commands, such as those controlling voluntary movements, and automatic or unconscious commands (such as changing heart rate) or involuntary responses, such as reflexes.

Central nervous system (CNS) the brain and the spinal cord; processes and coordinates responses to sensory stimuli

Brain

The **brain** is an amazingly complex structure consisting of approximately 86 billion neurons. It receives and processes sensory stimuli from the body, coordinates responses, including voluntary movements, emotions and conscious thought, and regulates a variety of functions without our conscious awareness, such as breathing, temperature regulation and hunger.

Brain a complex structure that receives and processes sensory stimuli from the body and coordinates responses, including voluntary movements, emotions and conscious thought

ISBN 978-1-009-25416-8 Gallagher et al

The brain communicates with the body via the spinal cord and its nerves, as well as cranial nerves that connect the brain directly to various organs and muscles of the body, such as the eyes, facial muscles, tongue, heart and stomach. One of these cranial nerves is the vagus nerve, which connects the brain directly to the stomach and intestinal tract, controlling digestion. These cranial nerves are considered to be part of the peripheral nervous system.

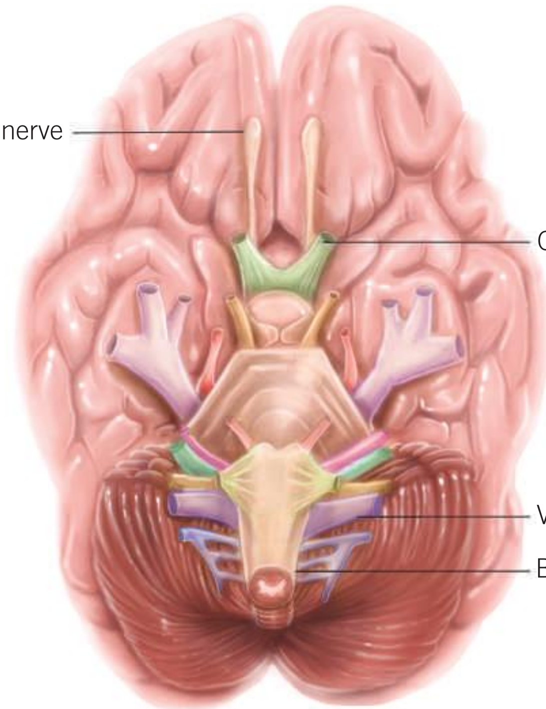


Figure 3A–4 The brain (seen from below) is connected to the rest of the body via the spinal cord and 12 pairs of cranial nerves, including the olfactory, optic and vagus nerves.

Spinal cord

Spinal cord a dense bundle of nerves that carries sensory information from the body to the brain and motor information from the brain to the body

The **spinal cord** is a 45-centimetre-long extension of the brain stem. It is composed of a dense bundle of nerve fibres and is directly linked to the peripheral nervous system by 31 pairs of spinal nerves. These spinal nerves consist of bundles of fibres, which connect them to various parts of the body such as skin, muscles and internal organs. Some of these bundles are connected to sensory receptors in the body and therefore carry sensory or afferent information towards the spinal cord. Some are connected to motor or efferent pathways, which carry motor commands initiated by the brain to the muscles in the extremities required to perform motor movements.

Figure 3A–5 A cross-section of the spinal cord, which is an extension of the brain stem and is connected to the peripheral nervous system by 31 pairs of spinal nerves

ISBN 978-1-009-25416-8 Gallagher et al

The spinal cord has two main roles:

- To carry incoming sensory information from the body (peripheral nervous system) towards the brain for processing; for example, sensations such as touch or pressure from the skin on your hands when holding a ball
- To carry motor information initiated by the brain towards the body (peripheral nervous system); for example, instructions about how to move your hands and legs to kick a drop punt when playing football.

The only exception to these two main functions is when the spinal cord is involved in involuntary responses, such as the spinal reflex, which occur without conscious awareness or input from the brain.

Figure 3A–6 Tayla Harris of the Melbourne Football Club kicking the ball during a 2022 Australian Football League Women's match. Instructions about how to move your legs to kick a ball are initiated by your brain and communicated to your peripheral nervous system by the spinal cord.

Check-in questions – Set 1

1. Identify the two components of the CNS.
2. Use an example to explain the two main functions of the CNS.
3. How does the brain communicate with the body?
4. Describe the structure of the spinal cord.
5. Explain the difference between the afferent and efferent pathways that the spinal nerves are connected to.
6. Use an example other than the one discussed in the text to describe the two roles of the spinal cord.

Spinal reflexes

Have you ever held your finger too close to the flame of a candle and noticed that it moved away from the flame before you had even realised that your hand was scorched? This is an example of a **spinal reflex**. Spinal reflexes occur when a quick response is important for your survival. A spinal reflex is an involuntary and unconscious response to a stimulus involving the spinal cord and occurs without input from the brain. Therefore, spinal reflexes occur without our conscious awareness.

Spinal reflex an involuntary and unconscious response to a stimulus involving the spinal cord, which occurs without input from the brain

ACTIVITY 3A–1 TESTING THE KNEE-JERK SPINAL REFLEX

Do this activity with a partner. Your partner sits on a table with their legs hanging over the edge and their knees bent. They cross one leg over the other so that their upper foot hangs clear of the floor. Gently touching their knee, locate the small space below the kneecap, or patella, between it and the shin bone. This is where the patella tendon is located. Using the edge of a ruler or the side of your palm, tap this space firmly. The sharp tap on the tendon will slightly stretch the quadricep (muscle group at the front of the upper leg). Your partner's lower leg should jerk towards you in a sudden kicking movement of the lower leg. It may take several attempts to find the right spot. Once you have done so, swap roles with your partner.

1 What is the adaptive value of this spinal reflex? Discuss.

Figure 3A–7 Testing the patella reflex

Spinal reflex processes

Sensory receptor a sensory nerve ending that produces an afferent or sensory impulse when stimulated

Sensory neuron a nerve cell that carries sensory signals throughout the nervous system

A spinal reflex occurs through a series of steps involving sensory neurons. The following steps outline what happens when a person's fingers are brought too close to a candle flame (Figure 3A–8).

1 A sensory stimulus is detected by **sensory receptors**, sensory nerve endings that when stimulated, produce an afferent or sensory impulse.
Sensory receptors in the fingertips detect the heat from the candle flame.

2 **Sensory neurons**, nerve cells that carry sensory signals throughout the nervous system, transmit sensory information about the stimulus towards the spinal cord.
Sensory neurons in the arm transmit information about the heat of the candle flame and carry it to the spinal cord.

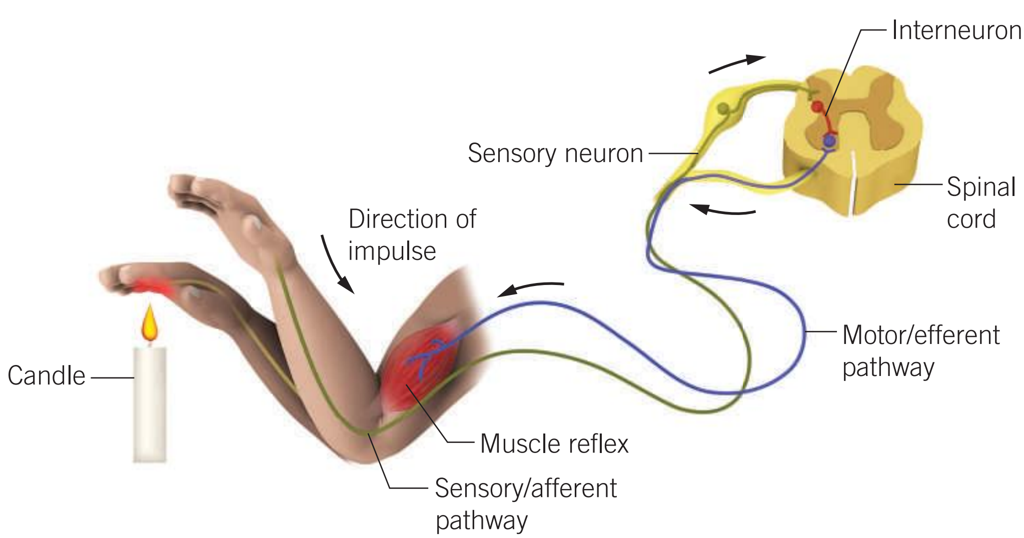


Figure 3A–8 In this spinal reflex, the hand moves away from the flame of the candle without input from the brain, and the person avoids getting burned.

ISBN 978-1-009-25416-8 Gallagher et al

3 The sensory information is relayed to **interneurons** in the spinal cord that connect motor and sensory neurons by relaying information between the two. In the case of a spinal reflex, an adaptive motor response is initiated by the interneurons without input from the brain to respond more quickly to the threat detected by the sensory receptors.
The interneurons in the spinal cord initiate a motor movement, to remove the hand from the flame to avoid getting burned.

4 Information about this motor movement is then relayed to **motor neurons**, which transmit the motor impulses from the spinal cord to the skeletal and/or smooth or visceral muscles (such as in the stomach).
A motor impulse is communicated by motor neurons to the muscles in the arm.

5 These muscles are then activated to perform the movements required.
The hand is withdrawn from the flame of the candle in an upwards motion.

Interneuron
a nerve cell in the spinal cord that connects motor and sensory neurons by relaying information between the two

Motor neuron
a nerve cell that transmits motor impulses from the spinal cord to the skeletal and smooth muscles

WORKSHEET 3A–2 SPINAL REFLEX

1 Sensory stimulus detected by **sensory receptors**. → 2 **Sensory neurons** carry information via a sensory (afferent) pathway to spinal cord. → 3 **Interneurons** in spinal cord initiate an involuntary motor movement. → 4 This is relayed to **motor neurons** and carried via a motor (efferent) pathway to **muscles**. → 5 **Muscles** perform reflex response without input from the brain.

Figure 3A–9 The steps involved in a spinal reflex

Check-in questions – Set 2

1 Why is a spinal reflex considered to be an unconscious response?
2 Explain the role of sensory receptors in a spinal reflex.
3 Explain the role of sensory neurons in a spinal reflex.
4 Explain the role of interneurons in a spinal reflex.
5 Explain the role of motor neurons in a spinal reflex.
6 Use a flow chart or diagram to represent the processes involved in the spinal reflex when you step on a sharp object such as a piece of glass.

Peripheral nervous system and its subdivisions

The **peripheral nervous system** consists of all the nerves outside of the CNS, including the cranial nerves that extend from the spinal cord and brain. Its main role is to carry messages between the CNS and muscles, organs and glands throughout the body. The peripheral nervous system has two subdivisions with quite different functions: the somatic nervous system and the autonomic nervous system.

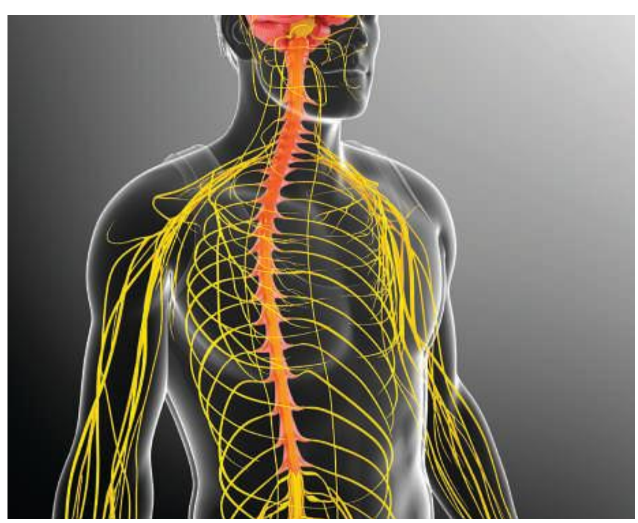


Figure 3A–10 The peripheral nervous system comprises all the nerves and neurons in the body, outside of the brain and the spinal cord, that connect the central nervous system to the body's muscles, organs and glands.

Peripheral nervous system
all the nerves outside of the central nervous system that carry messages between the central nervous system and muscles, organs and glands throughout the body

ISBN 978-1-009-25416-8 Gallagher et al

Somatic nervous system

This subdivision of the peripheral nervous system contains sensory (afferent) neurons and motor (efferent) neurons. It enables communication between the body and the CNS in two main ways.

Somatic nervous system
a subdivision of the peripheral nervous system that carries sensory information to the central nervous system and motor information to the body

1 The **somatic nervous system** carries sensory (or afferent) information to the CNS (brain and spinal cord). Sensory receptors and sensory neurons in the somatic nervous system gather information collected by our five senses (sight, smell, hearing, taste, touch) and communicate this to the CNS (Figure 3A–11); for example, the visual information as you read this page, or the feeling of the paper, mouse or touch pad as you scroll through this text.

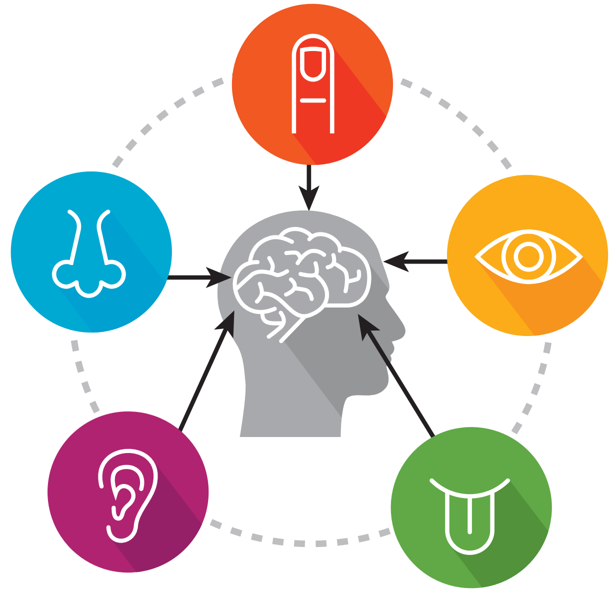


Figure 3A–11 The somatic nervous system is directly connected to our five senses, gathering sensory information and communicating this to the central nervous system.

2 The somatic nervous system carries motor (efferent) information from the CNS to the body. This involves motor (efferent) neurons in the somatic nervous system that are responsible for voluntary movements, communicating movement information back to the body's muscles, organs and glands from the CNS. These motor neurons direct the action of skeletal muscles, which are attached to the skeleton, enabling voluntary movement; for example, picking up an object, kicking a ball or running.

Figure 3A–12 The somatic nervous system, sometimes referred to as the 'voluntary nervous system', controls our skeletal muscles, which are attached to our skeleton, enabling us to perform voluntary motor movements such as running.

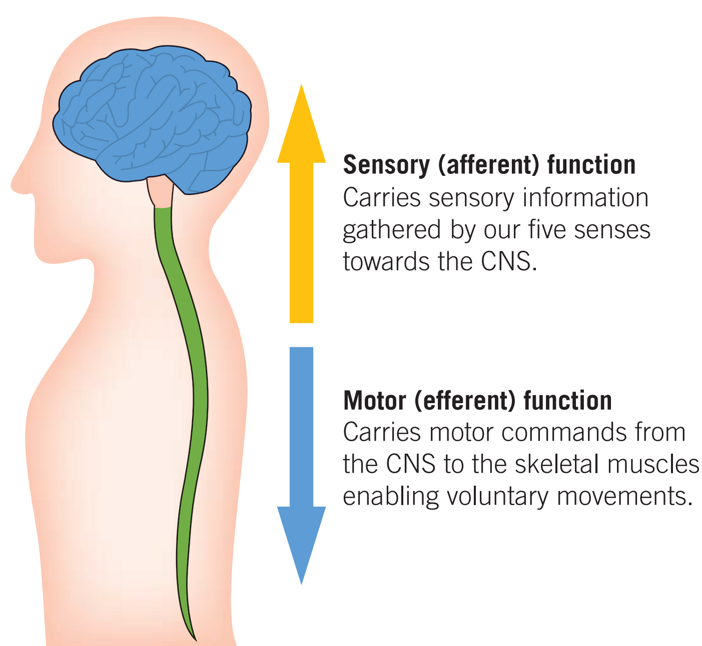


Figure 3A–13 The two main roles of the somatic nervous system

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 3

1 What is the peripheral nervous system made up of, in terms of cells and structures?
2 What is the main role of the peripheral nervous system?
3 Name the two subdivisions of the peripheral nervous system.
4 Describe the two ways that the somatic nervous system enables communication between the CNS and the body.

Autonomic nervous system

The **autonomic nervous system** controls the body's internal environment in an autonomous or self-regulated manner. This means that it performs most of its functions without our conscious awareness. It is directly connected to our organs, glands and visceral muscles (smooth, involuntary muscles in blood vessels), the stomach, digestive tract and other internal organs. The autonomic nervous system is responsible for basic life processes such as digestion, respiration, heart rate and blood pressure, which remain active without our conscious thought or awareness. It is constantly providing feedback to the CNS about these processes.

The autonomic nervous system has a major role in our experience of stress, fear and anger. In these cases, the different roles of the two subdivisions of the autonomic nervous system become evident.

- The **sympathetic nervous system** dominates when we are under threat, increasing our arousal and preparing us to deal with the situation; for example, dilating pupils or increasing heart rate.
- The **parasympathetic nervous system** dominates during normal day-to-day activities when we are relatively calm; for example, regulating body temperature to around 37.5°C. It also returns the body to a calm state after a threatening or stressful situation; for example, constricting our pupils or decreasing heart rate to normal once a threat has passed.

Autonomic nervous system a subdivision of the peripheral nervous system that controls the body's internal environment in an autonomous or self-regulated manner

Sympathetic nervous system a subdivision of the autonomic nervous system that increases our arousal, readying the body for a quick response

Parasympathetic nervous system a subdivision of the autonomic nervous system that controls the body's internal environment in an autonomous or self-regulated manner

Figure 3A–14 The autonomic nervous system is directly connected to our body's organs (e.g. liver, heart and lungs), glands and smooth muscles.

ISBN 978-1-009-25416-8 Gallagher et al

Sympathetic nervous system

The sympathetic nervous system is dominant in response to perceived threats and stressful psychological or physiological stimuli. Its main function is to increase arousal, readying the body for a quick response, otherwise known as the flight-or-fight-or-freeze response, which is discussed in detail in Section 4A.

4A INTERNAL AND EXTERNAL STRESSORS LINK

Examples of responses by the sympathetic nervous system to a threat are:

- pupils dilating to allow more light into the eye to see better
- heart rate, blood pressure and breathing rates increasing to accelerate oxygenated blood flow to the muscles in order to respond to the threat
- energy being diverted to the muscles from functions such as digestion to conserve energy for responding to the threat
- increased sugar and fat being released into the blood to provide energy for quick action.

Parasympathetic nervous system

The parasympathetic nervous system has two main functions.

1 Maintaining a balanced internal state, otherwise known as homeostasis, including regulation of blood sugar or energy levels, saliva secretion and waste elimination.

2 Counterbalancing the energising function of the sympathetic nervous system by lowering arousal and restoring the body to a calm state after a threat has passed. For example, the parasympathetic nervous system decreases heart rate, constricts the bronchi of the lungs, and constricts the pupils of the eyes, which are all opposite functions to those of the sympathetic nervous system in a threat situation, such as jumping out of an aeroplane (Figure 3A–15).

As the plane reaches altitude, the woman's sympathetic nervous system prepares her body, releasing adrenaline, dilating her pupils, increasing her heart rate and diverting energy from non-essential functions such as digestion to her muscles.

Her *para*sympathetic (which sounds like *para*chute) nervous system is now decreasing her arousal and returning her body back to a state of calm. Her pupils constrict, her heart rate decreases, and energy may be diverted back to non-essential functions such as digestion.

Figure 3A–15 Top: This woman is anxiously waiting her turn to jump out of the plane. Bottom: Once she has jumped and the parachute has released, the woman can relax and enjoy the view.

ISBN 978-1-009-25416-8 Gallagher et al

WORKSHEET
3A–3 SYMPATHETIC AND PARASYMPATHETIC NERVOUS SYSTEMS

The main functions of the parasympathetic nervous system are summarised in Figure 3A–16.

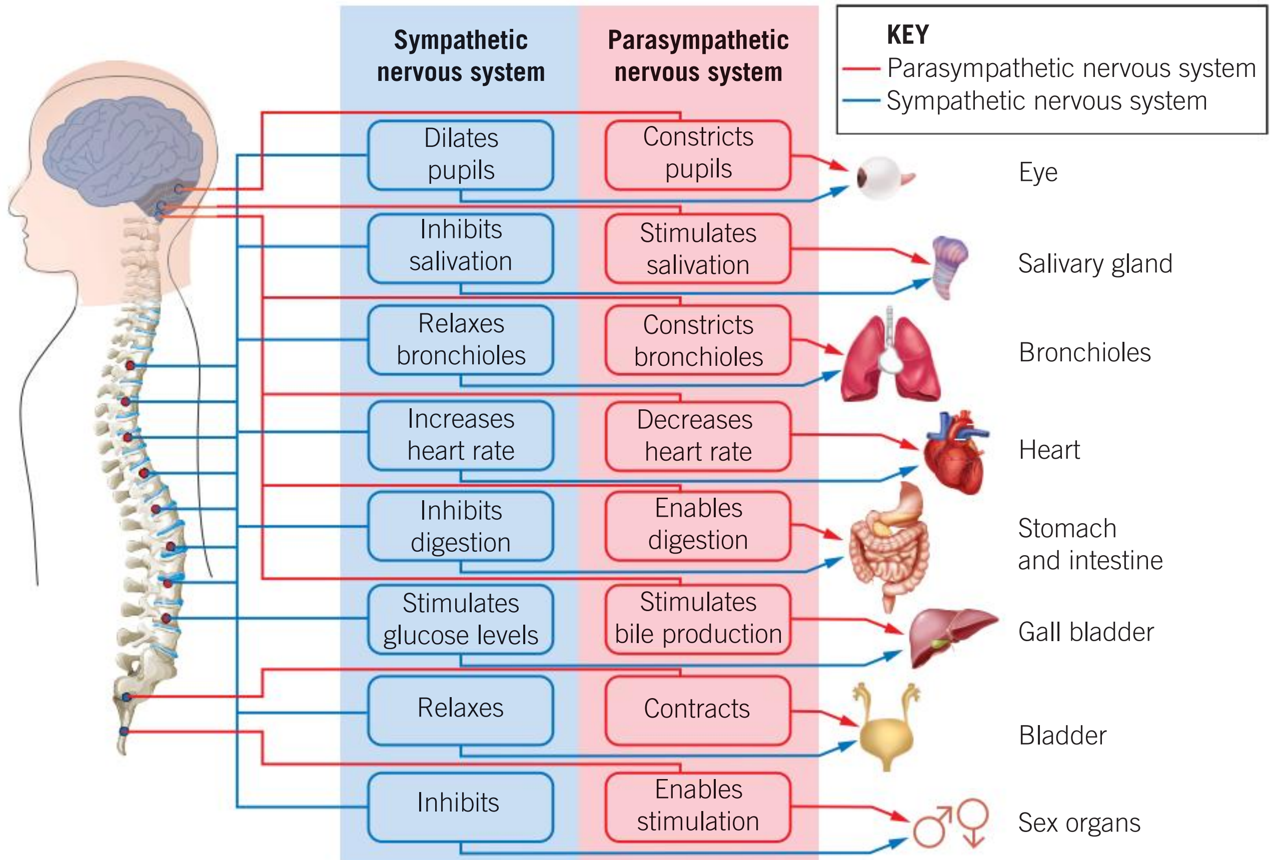


Figure 3A–16 The main functions of the subdivisions of the autonomic nervous system

It is important to note that the parasympathetic nervous system can be much slower in returning the body back to a calm state because hormones such as adrenaline that are initially released by the sympathetic nervous system can take longer to be removed, thus having a lingering effect.

Check-in questions – Set 4

1. What is the role of the autonomic nervous system?
2. What is meant by the autonomic nervous system being self-regulating?
3. Provide two examples of bodily functions the autonomic nervous system regulates.
4. Name the two subdivisions of the autonomic nervous system.
5. Why is the sympathetic nervous system dominant when we respond to perceived threats and stressful situations?
6. Provide two examples of responses the sympathetic nervous system may perform to increase our arousal in response to a threat.
7. Using examples, outline the two main functions of the parasympathetic nervous system.
8. Explain why the parasympathetic nervous system can be slower at returning the body to homeostasis.

ISBN 978-1-009-25416-8 Gallagher et al

Conscious and unconscious responses of the nervous system

We have discussed the main functions of the different divisions and subdivisions of the nervous system, and conscious and unconscious responses. For example, spinal reflexes occur without conscious awareness or input from the brain that involves awareness. Hence, they are categorised as an **unconscious response**. Any response of our nervous system that does not require awareness is deemed to be an unconscious one. Unconscious responses also tend to be quite simple compared with conscious responses. For example, blinking generally involves simply closing the eyelid. In addition, unconscious responses tend to be unlearned; for example, we are born with the ability to blink because it is innate.

Unconscious response any response of our nervous system that does not require awareness

Other examples of unconscious responses of the nervous system shown in the figure below are:

- reflexes such as sneezing or coughing
- spinal reflexes such as withdrawing your hand from a hot object
- shivering when cold and sweating when hot
- blushing when embarrassed
- digestion of food in the gut.

Figure 3A–17 Some examples of unconscious responses

When you are thirsty and decide to pour yourself a drink, this response requires awareness and is therefore categorised as a **conscious response**. Conscious responses usually involve input from the CNS (brain) and can involve decision-making or choice. They also tend to be more complex responses that can involve a series of responses. When you want a drink, a series of movements need to take place to allow you to walk to the fridge, select your drink and pour it into the glass. Conscious responses can also be learned; for example, catching or bouncing a ball.

Conscious response any response of the nervous system that requires awareness

Other examples of conscious responses are:

- putting a jumper on if you feel cold
- scratching an itch
- throwing a ball
- recalling what you ate for breakfast
- calculating a maths problem
- writing an essay.

ISBN 978-1-009-25416-8 Gallagher et al

Table 3A–1 Some differences between conscious and unconscious responses

Conscious responses	Unconscious responses
Involve awareness	Do not involve awareness
Are more complex, involving a series of responses	Are simpler, usually involving a single response to a stimulus
Can involve learning	Generally do not involve learning
Tend to require conscious input from the brain, such as a decision or choice	Can occur without conscious input from the brain
Can include voluntary responses, such as a movement performed by the somatic nervous system	Can include involuntary functions, such as those regulated by the autonomic nervous system
Examples: walking or picking something up	Examples: breathing, digestion, blinking and spinal reflexes.

3A KEY SCIENCE SKILLS

VIDEO 3A–2 KEY SCIENCE SKILLS: AIMS AND HYPOTHESES

Formulating aims, variables and hypotheses

In VCE Psychology, you may be asked to design a piece of research or an experiment that looks at the relationships between concepts covered within the study design. You may also be asked to identify or design elements of another person's research. Basic elements that you may need to address include:

- determining a research question to investigate
- constructing an aim
- identifying the independent variable (IV), dependent variable (DV) and controlled variables (if it is a controlled experiment)
- formulating a hypothesis to focus an investigation.

Question

Layla is studying VCE Psychology and has just learned about the roles of the different divisions of the human nervous system, as well as the role of sensory, motor and interneurons in the communication of information between these different divisions. Layla and her friend Abby from her Psychology class were chatting about whether sensory messages received at certain points on the body would take more time to be processed and responded to by the brain if they are further away; for example, the foot. They decided to run a controlled experiment with their classmates to compare the shoulder, which is closer to the brain, to the foot, which is further from the brain.

a State Layla and Abby's research question.
b Construct an aim for their investigation.
c Identify the IV in Layla and Abby's experiment.
d Identify the DV in Layla and Abby's experiment.
e Using your understanding of the nervous system, predict the possible outcome of Layla and Abby's investigation.
f Based on your prediction in part **e**, state a hypothesis.
g Suggest a controlled variable that Layla and Abby would need to keep constant and explain why this would be important in their study.

ISBN 978-1-009-25416-8 Gallagher et al

Suggested answer for full marks

a Do sensory messages received at certain points on the body take longer to be processed and responded to by the brain if they are further away, such as the foot?

b To investigate whether sensory messages received at certain points on your body take longer to be processed and responded to by the brain if they are further away, such as the foot.

c Whether a sensory stimulus was received on the shoulder (closer to the brain) or foot (further from the brain)

d The time taken to respond to the sensory stimulus received on the shoulder or foot

e A sensory stimulus that is received on the foot will take longer to respond to than one on the shoulder. This is because the sensory message has further to travel via sensory neurons up the leg (in the somatic nervous system) to the spinal cord (in the CNS) and then up to the brain for processing and coordinating a response, compared with the shoulder, which is a much shorter distance from the CNS (spinal cord).

f It is predicted that Psychology students will respond to a sensory stimulus on their shoulder more quickly than when they respond to a sensory stimulus on their foot.

g Layla and Abby would need to keep the time of day that they were testing each part of the body (shoulder or foot) constant. Students may be more alert at certain times of the day, and this will affect their response times. For example, they may be more alert later in the morning, having been awake longer. If they tested the foot early in the morning and the shoulder later in the morning, they might record a lower response time for the shoulder because they are more alert and not because the shoulder is closer to the brain (IV).

ACTIVITY 3A–2 SPEED OF NEURAL MESSAGES FROM DIFFERENT BODY PARTS

As a class or with a group of friends, design an experimental method to test whether a sensory stimulus received on your shoulder would be responded to more quickly than a stimulus received on your foot. Clearly determine:

- the aim
- the IV
- the DV
- any potential sources of error and possible control variables to account for these
- the hypothesis
- the type of data you will collect and method of data collection you will use
- whether your hypothesis has been supported, by analysing your results.

Check-in questions – Set 5

1. Provide an example of an unconscious response of the nervous system and explain why it is considered to be unconscious.
2. Provide an example of a conscious response of the nervous system and explain why it is considered to be conscious.
3. Provide two key distinctions between conscious and unconscious responses of the nervous system.

ISBN 978-1-009-25416-8 Gallagher et al

3A SKILLS

VIDEO 3A–3
SKILLS: NERVOUS SYSTEM KNOWLEDGE

Applying your understanding of nervous system divisions and subdivisions
Assessment questions about the nervous system will usually be asked in the context of a scenario, where an individual responds to a specific, sensory stimulus. You may be asked to identify the division or subdivision of the nervous system that would have controlled or activated a response. In addition, a question may require you to explain a specific division or subdivision's role in the response or to describe the interaction between two or more divisions or subdivisions in coordinating a response.

Question:
The following question is from the 2019 VCAA examination.

Question 1 (5 marks)

Finn was standing near a campfire with his friends when he noticed the fire becoming hotter against the skin of his legs. To avoid getting burnt by the growing flames, he took a step away from the campfire.

The human nervous system has two major divisions.

Identify the subdivision of **one** of these major divisions that activates Finn's responses and outline how the subdivision is involved in Finn's responses.

Key points to remember:
This question has a high mark allocation (5 marks), so it may be useful to plan your answer to obtain full marks.

The first part of the question asks you to '*identify*' a subdivision of a major division of the nervous system. The command term 'identify' means to name something and would be worth 1 mark. You need to name a subdivision of a major division of the nervous system 'that activates Finn's responses'. Of course, this division needs to be relevant to these responses.

To obtain this first mark, you must be clear that the two major divisions of the nervous system are the central and the peripheral nervous systems. However, the CNS technically has no subdivisions because the brain and spinal cord do not qualify as such. Therefore, the only possible options are the somatic and autonomic subdivisions of the peripheral nervous system. Finn's responses, as highlighted, are noticing the fire becoming hotter against the skin of his legs and taking a step away from the campfire, both of which are conscious responses. Therefore, it is unlikely that the autonomic nervous system is the subdivision that activated his responses and therefore the correct division is the somatic nervous system.

The second part of the question asks you to '*outline* how the subdivision is involved in Finn's responses'. The command term 'outline' requires a brief account or a summary. So, you need to provide a brief account of how the somatic nervous system activated each of Finn's responses. Importantly, the question also uses the word 'responses' which implies that you should outline more than one response. Therefore, for the remaining four marks, you need to provide an explanation of two different functions of the somatic nervous system (2 marks), with each applied to Finn's responses (2 marks).

ISBN 978-1-009-25416-8 Gallagher et al

Suggested answer for full marks:
The somatic nervous system, a subdivision of the peripheral nervous system would have activated Finn's responses. (1 mark)

First, the somatic nervous system has a sensory function, carrying sensory information from the body to the CNS. Sensory receptors in Finn's leg would have detected the heat from the fire and this information would have been carried via sensory neurons in the somatic nervous system to his spinal cord in the CNS for processing. (2 marks)

Second, the somatic nervous system has a motor function, carrying motor commands from the CNS to the body. Motor neurons in Finn's legs would have communicated to his muscles to move away from the fire because it was hot. (2 marks)

Note from the examiner's report:

> Responses indicating that the spinal cord activated the response were incorrect as the scenario clearly described a conscious action. Also, a response identifying the autonomic nervous system was considered valid if it described accurately how an autonomic flight response might alert the conscious decision-making system to the need to move away from the fire, thus being the subdivision that 'activated' the conscious response. The range of responses accepted reflected the wording of the scenario, and valid understandings of the word 'activated' in the context of the nervous system.

Section 3A questions

1. In terms of CNS function, how are the brain and spinal cord different?
2. Explain how the brain and spinal cord in your CNS would enable you to type an essay on your laptop.
3. Explain the process involved in the spinal reflex of withdrawing your hand when touching a needle on a cactus plant. Refer to sensory receptors, sensory neurons, interneurons and motor neurons in your answer.
4. a Provide an example of a response that involves the central and peripheral nervous systems working together.
   b Explain the role of each system in this example.
5. Use a Venn diagram to compare the functions of the somatic and autonomic subdivisions of the peripheral nervous systems.
6. Use an example of a stressful situation to distinguish between the roles of the sympathetic and parasympathetic subdivisions of the autonomic nervous system.
7. Ali wanted to investigate whether the experience level of skydivers affects their stress responses when skydiving. He conducted an experiment that compared the level of arousal of professional skydivers who had completed more than 1000 jumps, to first-time skydivers. He used heart rate monitors to determine their heart rate in beats per minute (bpm), filmed their faces while jumping to establish the dilation of their pupils in millimetres (mm) and conducted a blood test to determine the level of adrenaline in their bloodstreams in picograms per millilitre (pg/mL). A picogram is one-trillionth of a gram. Ali measured these indicators before, during and after the jump and the measurements are shown in the following table.

ISBN 978-1-009-25416-8 Gallagher et al

	Professional skydivers			First-time skydivers		
	Average heart rate (bpm)	Average pupil size (mm)	Average adrenaline level (pg/mL)	Average heart rate (bpm)	Average pupil size (mm)	Average adrenaline level (pg/mL)
Before jump	72	8	15	85	10	23
During jump	86	10	21	102	19	35
After jump	81	9	22	100	17	40

a State Ali's research question.
b State a possible aim of Ali's research.
c Determine the IV of his research.
d Determine the DV of his research.
e Identify one possible source of error for Ali and suggest a way he could have accounted for this.
f Formulate a research hypothesis.
g Interpret the results and determine whether the hypothesis has been supported or not.

8 In the table below, identify which division or subdivisions of the nervous system is responsible for performing each response and determine whether it is a conscious or unconscious response.

	Example of a response	Division(s) of the nervous system	Conscious or unconscious?
a	Deciding to have a shot for goal in a soccer match		
b	Your stomach grumbling because you are hungry		
c	Kicking the ball in a soccer match		
d	Developing goose bumps on your arms because you are cold		
e	Moving your arm to wave to your friend across the street		
f	Planning how you are going to answer a question		
g	Initiating the quick withdrawal of your hand from a hot object without your awareness		
h	Your pupils dilating to see your attacker more clearly		
i	Becoming hungry after your attacker has run away and the threat has passed		

ISBN 978-1-009-25416-8

3B Neurotransmitters and neuromodulators

Study Design:
The role of neurotransmitters in the transmission of neural information across a neural synapse to produce excitatory effects (as with glutamate) or inhibitory effects (as with gamma-aminobutyric acid (GABA)) as compared with neuromodulators (such as dopamine and serotonin) that have a range of effects on brain activity

Glossary:
Dopamine
Excitatory effect
Gamma-aminobutyric acid (GABA)
Glutamate
Inhibitory effect
Neural transmission
Neuromodulator
Neuron
Neurotransmitter
Receptor site
Reward pathway
Serotonin
Serotonin pathway
Synapse
Synaptic gap
Synaptic vesicle

ENGAGE

Targeting neurotransmitter dysfunction in depression treatment

According to the World Health Organization, 35 million people worldwide live with depression. Symptoms include low mood and/or loss of interest and pleasure in usual activities. Symptoms are experienced most days and last for at least two weeks and interfere with all areas of a person's life, including work and social relationships. Although there has been a lot of research attempting to link depression to brain chemistry, there is still much we do not know. Depression is not simply the result of a chemical imbalance such as too much or not enough of a particular brain chemical. It is complicated, and there are multiple causes, such as genetic vulnerability, severe life stressors, substance use and medical conditions that can affect the way the brain regulates your moods.

Figure 3B–1 A person with depression experiences persistent low moods and loses interest and pleasure in their usual activities.

Most modern antidepressants (selective serotonin reuptake inhibitors, or SSRIs) influence the levels of the neurotransmitter serotonin in the brain. Effective treatment with SSRIs can stimulate the growth of new nerve cells in circuits that regulate mood, and this is thought to play a critical role in recovering from severe depression. So how do these medications work?

ISBN 978-1-009-25416-8 Gallagher et al

SSRIs work by preventing serotonin from being reabsorbed by the body. This means that serotonin levels stay high in the brain, which is believed to improve mood and treat depression. Usually after a neural impulse is passed between neurons, and neurotransmitters are released into the synapse, any unused neurotransmitters are recycled in a process called reuptake. A channel in the membrane of the presynaptic neuron carries the unused neurotransmitter back into the axon terminal for storage until it is needed again. In the case of serotonin, SSRIs bind to specific serotonin channels on the presynaptic neuron and block or inhibit its activity, stopping it from reabsorbing serotonin. This allows more serotonin to remain in the synapse, increasing the levels of serotonin available within the brain, therefore improving mood and alleviating the symptoms of depression.

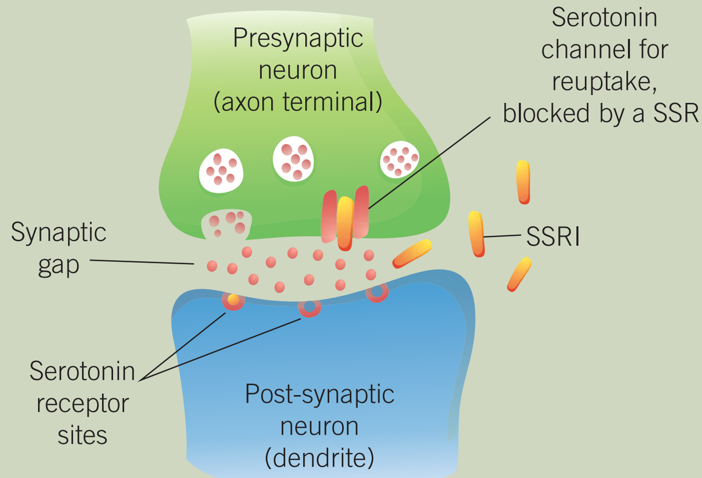


Figure 3B–2 A close-up of a synapse in which an SSRI has blocked a serotonin channel, inhibiting the process of reuptake and enabling higher levels of serotonin to remain within the synapse

EXPLAIN

The role of neurotransmitters in neural transmission

When you are cold, you can respond consciously by putting on a jumper or unconsciously by shivering and getting goose bumps on your skin. Both responses involve information being transmitted throughout your nervous system by **neurons**. These are individual nerve cells, specialised to receive, process and transmit information within the nervous system. When neurons communicate with each other, this is referred to as **neural transmission**, which occurs when a neuron is activated, or fires, sending out an electrical impulse or action potential.

VIDEO 3B–1 NEUROTRANSMITTERS AND NEUROMODULATORS

Neuron an individual nerve cell that is specialised to receive, process and/or transmit information within the nervous system

Neural transmission an electrical impulse that occurs when a neuron is activated or fires

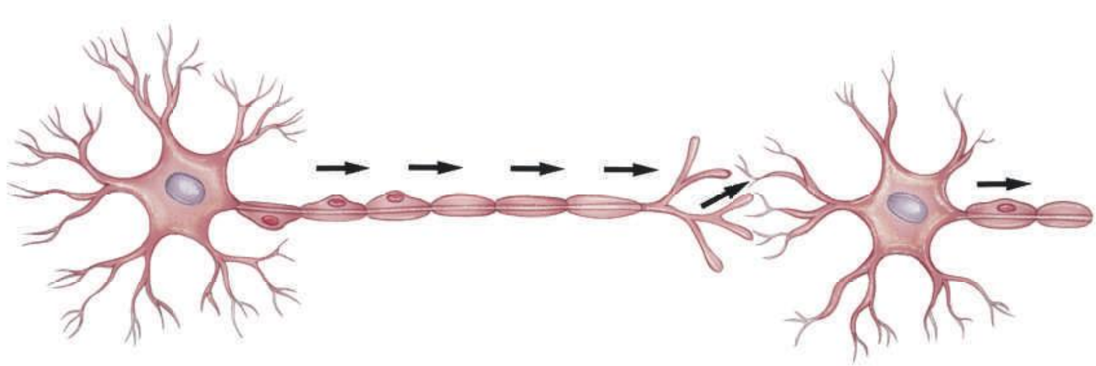


Figure 3B–3 Neural transmission between two neurons: the arrows indicate the direction of the electrical impulse or action potential.

ISBN 978-1-009-25416-8 Gallagher et al

WORKSHEET 3B–1 NEURAL TRANSMISSION

Neurotransmitter a chemical produced by neurons that carries messages to other neurons or cells within the nervous system, including muscles, organs and glands

Synapse the point of communication between two neurons or between a neuron and a target cell such as a muscle or gland

Synaptic vesicle a membrane-bound sphere filled with neurotransmitter molecules

Synaptic gap the space between the axon terminal of the presynaptic neuron and the membrane of the post-synaptic neuron

Receptor site a membrane protein on the dendrites of neurons that receive and detect specific neurotransmitters

Activation or firing of a neuron takes place when the neuron is stimulated by a sensory stimulus such as pressure, heat or light, or by chemical information from other cells in the form of **neurotransmitters**. Neurotransmitters are chemicals produced by neurons that carry messages to other neurons or cells within the nervous system, including muscles, organs and glands. The point of communication between two neurons or between a neuron and a target cell, such as a muscle or a gland, is called a **synapse**. The synapse comprises an axon terminal of the presynaptic neuron, the synaptic gap and a dendrite of the post-synaptic neuron (Figure 3B–4).

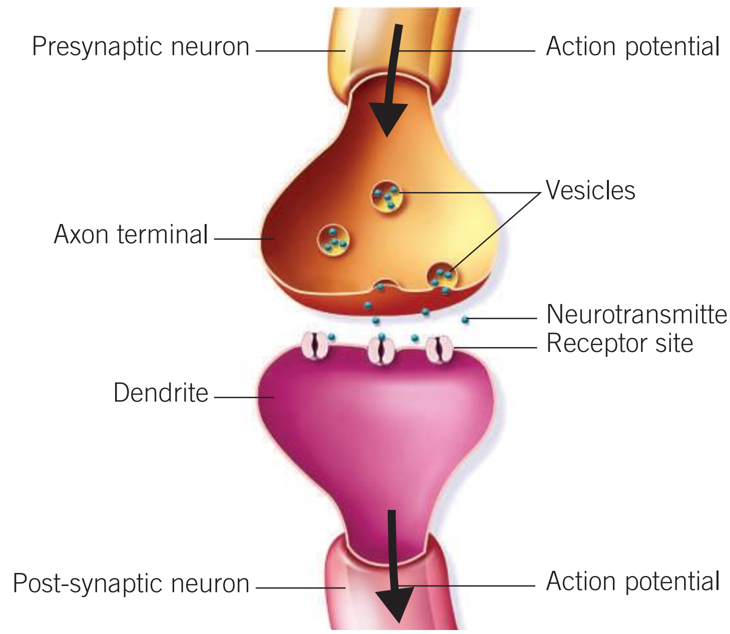


Figure 3B–4 A close-up of a synapse showing neurotransmitters released from vesicles and attaching to receptors

The firing of a neural impulse or action potential in one neuron (referred to as the presynaptic neuron) causes the transmission of a signal to another neuron (referred to as the post-synaptic neuron). Inside the axon terminal of a presynaptic neuron are many **synaptic vesicles**, which are membrane-bound spheres filled with neurotransmitter molecules. The small space between the axon terminal of the presynaptic neuron and the membrane of the post-synaptic neuron is the **synaptic gap**. When an action potential travels down an axon and into an axon terminal, it triggers chemical changes within the terminal.

This causes the synaptic vesicles to merge with the membrane at the presynaptic terminal and release neurotransmitters into the synaptic gap. Neurotransmitters travel across this gap towards the **receptor sites** on the dendrites of the post-synaptic neuron. They then attach or bind to the receptor sites, which are specialised to receive specific neurotransmitters, and make it either more or less likely to fire a further neural impulse or action potential. This depends on the type of neurotransmitter and its effect.

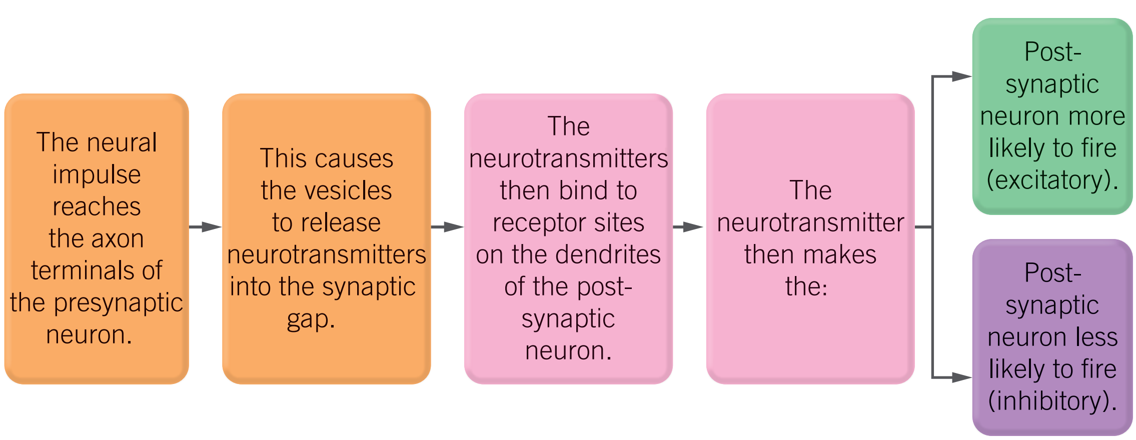


Figure 3B–5 A summary of the transmission of neural information across the synapse

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 1

1 What is the role of neurons in the nervous system?
2 What are neurotransmitters and what do they do?
3 Using the terms listed, draw and label a diagram of a synapse. Indicate the direction of the neural impulse, presynaptic neuron, post-synaptic neuron, axon terminal, dendrite, synaptic vesicle, neurotransmitter, receptor site, synaptic gap.
4 Using your own diagram or flow chart, describe how information is transmitted across a synapse.

Excitatory and inhibitory effects of neurotransmitters

Excitatory neurotransmitters

Generally, a neurotransmitter can be categorised according to the effect it has on the post-synaptic neuron. These effects can be excitatory or inhibitory. Excitatory neurotransmitters increase the likelihood that the post-synaptic neuron will fire an action potential or neural impulse, thus having an **excitatory effect** on the post-synaptic neuron. The main excitatory neurotransmitter in the nervous system is **glutamate** (Figure 3B–6).

LINK CHAPTER 5
LINK CHAPTER 6
LINK 3C SYNAPTIC PLASTICITY

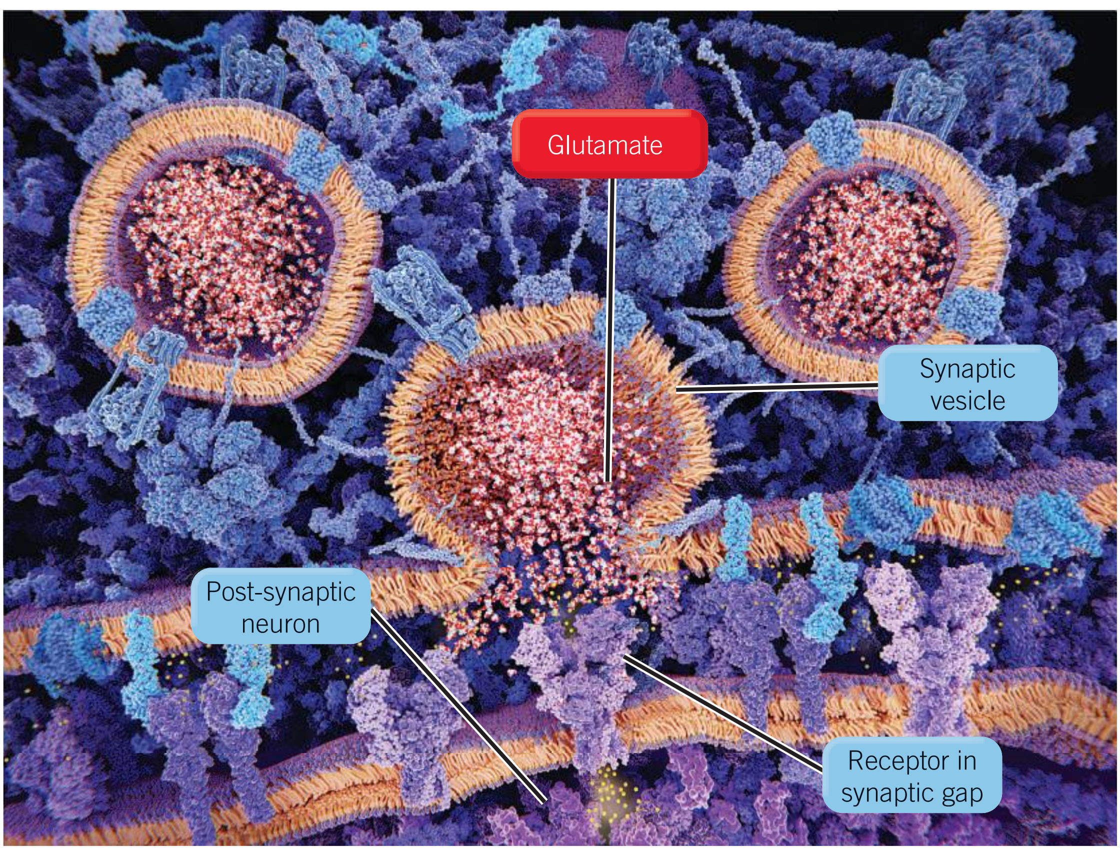


Figure 3B–6 A representation of glutamate (red and white molecules), the main excitatory neurotransmitter in the nervous system, being released from synaptic vesicles (the round orange structures) into the synaptic gap across the presynaptic membrane towards receptor sites on the post-synaptic neuron

Excitatory effect the increased likelihood that the post-synaptic neuron will fire an action potential or neural impulse

Glutamate the main excitatory neurotransmitter in the nervous system, which is involved with learning and memory

ISBN 978-1-009-25416-8 Gallagher et al

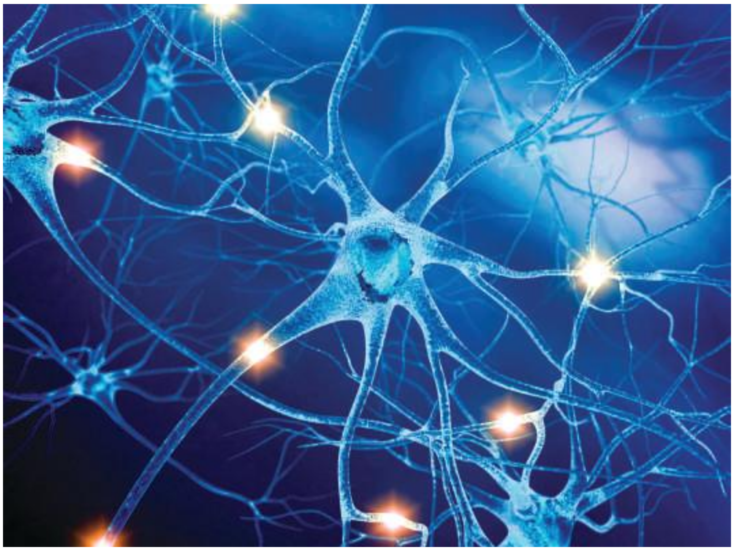


Figure 3B–7 A neural pathway of connected neurons

Glutamate plays an important role in learning and the formation of memories in the brain, by stimulating essential structural and functional changes to the connections between neurons. Glutamate is released when a neural pathway associated with an experience is activated or stimulated. For example, as you read this text and form a memory about the excitatory effects of neurotransmitters, glutamate will be released in the neural pathway associated with this concept in your brain. Each time you retrieve this memory, when you revise, complete homework, and discuss the concept in class or with your friends, this pathway will probably be strengthened. However, if you do not revise regularly, or complete your homework, this neural pathway will probably become weaker over time. These changes to the strength of your neural connections are referred to as synaptic plasticity, discussed in detail in Section 3C.

3C SYNAPTIC PLASTICITY LINK

Check-in questions – Set 2

1 Name an excitatory neurotransmitter.
2 What is meant by an excitatory effect in relation to neurotransmitters?
3 Describe the role of glutamate when learning something new and storing a memory of it.

Inhibitory effect the decreased likelihood that the post-synaptic neuron will fire an action potential or neural impulse

Gamma-aminobutyric acid (GABA) the main inhibitory neurotransmitter in the nervous system, associated with anxiety, specific phobias and Parkinson's disease

Inhibitory neurotransmitters

Inhibitory neurotransmitters decrease the likelihood that the post-synaptic neuron will fire an action potential or neural impulse, thus having an **inhibitory effect** on the post-synaptic neuron. The main inhibitory neurotransmitter in the nervous system is **gamma-aminobutyric acid (GABA)**.

The brain (CNS) requires that the different neurotransmitters are in balance, as too much or too little of certain neurotransmitters can be harmful to the functioning of neurons. For example, without sufficient levels of the inhibitory neurotransmitter GABA, activation of post-synaptic neurons may get out of control because the excitatory effects of glutamate take over, leading to mental disorders such as anxiety. This is often associated with hyperactivity in various regions of the brain, as well as increased arousal because of sympathetic nervous system activation, as discussed in Section 3A, resulting in physiological responses such as increased heart and breathing rates. When the brain's neurochemistry is in balance, the inhibitory action of GABA counterbalances the excitatory activity of glutamate and vice versa.

CHAPTER 10 LINK

3A THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS LINK

Figure 3B–8 Within our brain there is a balancing act of excitatory neurotransmitters such as glutamate and inhibitory neurotransmitters such as GABA.

ISBN 978-1-009-25416-8 Gallagher et al

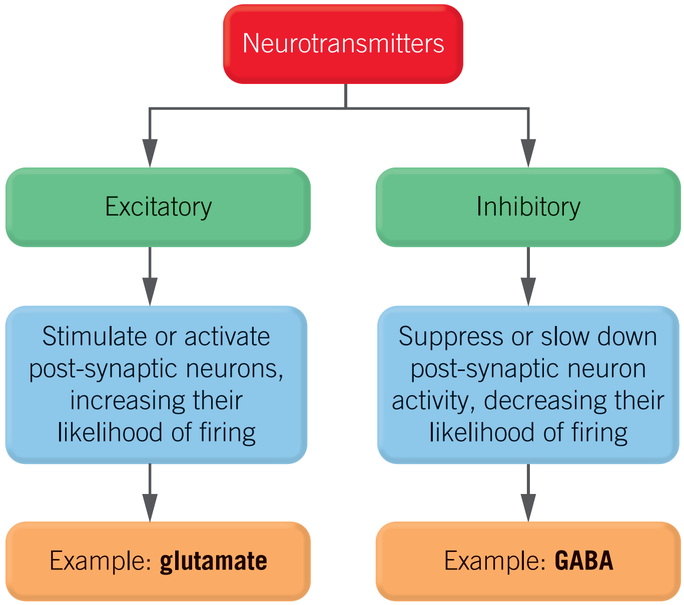


Figure 3B–9 A summary of the inhibitory and excitatory effects of neurotransmitters

ACTIVITY 3B–1 STOP MOTION VIDEO OF NEURAL TRANSMISSION

Using playdough, craft materials, lollies or random objects from around your house, create a stop motion video to demonstrate the differences between the inhibitory and excitatory effects of neurotransmitters at the synapse. Think about how you might distinguish between these two very different effects on the post-synaptic neuron using your materials. You could use an app such as Stop Motion Studio to create your video.

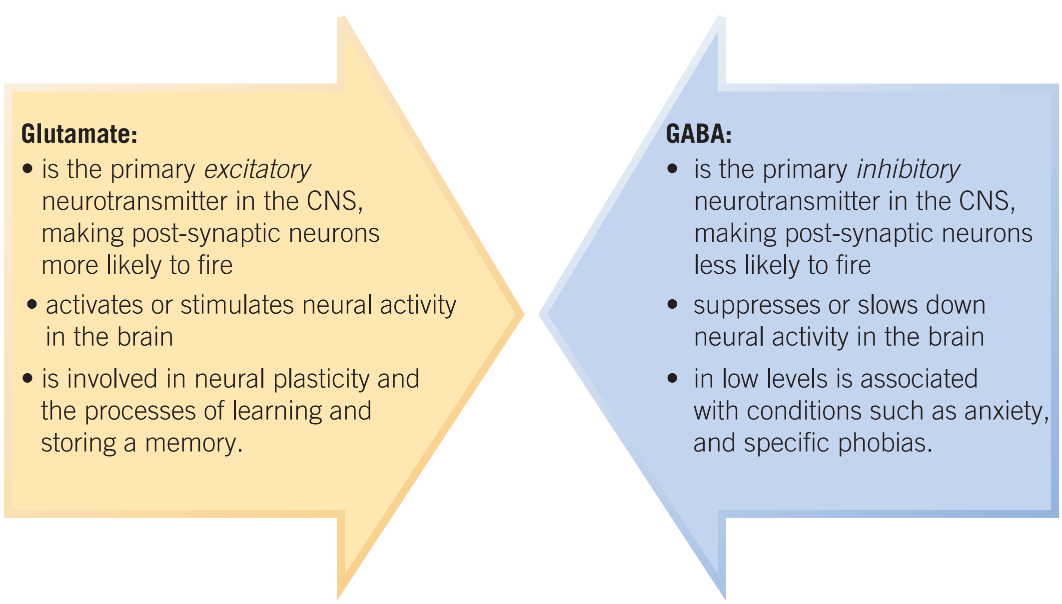


Figure 3B–10 A summary of the features of the main excitatory neurotransmitter in the brain (glutamate) and the main counteracting, inhibitory neurotransmitter in the brain (GABA)

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 3

1 Name an inhibitory neurotransmitter.
2 What is meant by an inhibitory effect in relation to neurotransmitters?
3 What is the of role of GABA within the nervous system?
4 Why does the brain (CNS) require that different neurotransmitters such as GABA and glutamate are in balance?
5 Provide two differences between glutamate and GABA.

The role of neuromodulators

Neuromodulator a subclass of neurotransmitters that alter the strength of neural transmission, by increasing or decreasing the responsiveness of neurons to neurotransmitter signals

Neuromodulators are a subclass of neurotransmitters. They are chemical molecules just like neurotransmitters; however, instead of simply enabling direct communication across a single synapse, as a neurotransmitter does, neuromodulators can also alter the overall effectiveness of neural transmission in entire regions of the brain. They do this by increasing or decreasing the responsiveness of many neurons to neurotransmitter signals or action potentials. Neuromodulators tend to be released in a slower, diffuse manner, meaning that targeted brain regions consisting of neural tissue can be affected by their chemical broadcast signals. This means that neuromodulators have a very wide range of action and are longer lasting than neurotransmitters, which act more quickly.

The act of neuromodulation also differs from neurotransmission, in that it does not result in excitation or inhibition of a specific neuron. Instead, it can alter both the cellular and synaptic properties of multiple neurons so that neurotransmission between them is altered. For example, they can modulate the efficiency of synaptic transfer, and strengthen neural pathways involved in learning and memory by activating neurons and triggering long-lasting changes to synaptic activity (long-term potentiation is discussed in Section 3C). Cellular changes that can occur include an increase in dendritic receptors in the post-synaptic neuron (improving post-synaptic stimulation) and increased production of neurotransmitters in the presynaptic neuron.

3C SYNAPTIC PLASTICITY LINK

Common neuromodulators in the CNS are serotonin, acetylcholine and dopamine, which can act both as a neurotransmitter targeting a specific post-synaptic neuron across a synapse, and as a neuromodulator. In this section, we will focus on dopamine and serotonin as examples of neuromodulators that can have a range of effects on brain activity.

Table 3B–1 The differences between neuromodulators and neurotransmitters

	Neurotransmitters	Neuromodulators
Description	Chemicals released by a presynaptic neuron to send signals to the post-synaptic neuron	Chemicals released by neurons to alter the effectiveness of neural transmission
Role	To transmit chemical signals to the adjacent neuron	To alter the neural transmission of neurons by controlling the synthesis and release of neurotransmitters
Site of release	Into the synapse	Outside the synapse into the neural tissue in brain regions
Target	A single post-synaptic neuron	Groups of neurons
Speed of action	Moderately fast	Moderately slow and last for longer periods

ISBN 978-1-009-25416-8 Gallagher et al

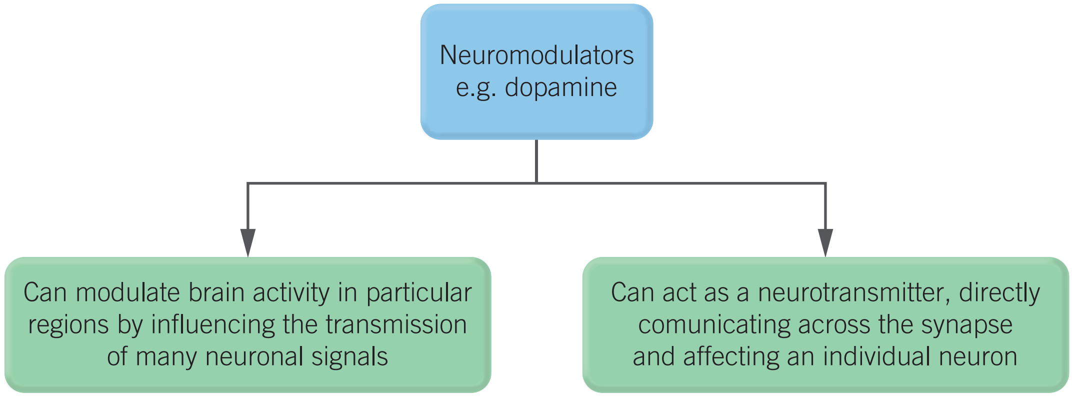


Figure 3B–11 Some neuromodulators such as dopamine can act as neurotransmitters, affecting a single neuron, but also in a modulating capacity, influencing many neurons in particular regions of the brain.

Dopamine as a neuromodulator

When you do any activity that you enjoy – spending time with friends, playing sport, playing computer games, watching your favourite show, shopping, eating your favourite food – dopamine is released, giving you feelings of pleasure and wellbeing. **Dopamine** is a multifunctional neurotransmitter with both excitatory and inhibitory effects that is involved in many CNS functions in addition to pleasure, such as movement, attention, mood, cognition and motivation. Dopamine is a modulating neurotransmitter or neuromodulator because it reinforces the neural activity in regions of the brain associated with these functions, for example the reward pathway.

Figure 3B–12 Dopamine is often referred to as a 'feel good' neurotransmitter because it gives us feelings of pleasure and wellbeing.

The **reward pathway** refers to a group of structures in the brain that are activated by rewarding or reinforcing stimuli, such as seeing a cupcake if you are hungry or anticipating a cold glass of water if you are thirsty. The pathway controls our responses to natural rewards, such as food, sex and social interactions, and is therefore an important determinant of motivation. When we are exposed to these rewarding stimuli, the brain increases the release of dopamine along this reward pathway in the brain, which modulates the brain activity of the structures along it. The more dopamine released within the reward centre, the more a stimulus is sensed as a reward. When we first see a stimulus we desire, or even just anticipate, dopamine travels throughout the reward pathway telling us to repeat what we just did to get that reward again. It also triggers memory regions of the brain to pay attention to all the features of that rewarding experience, so it can be repeated in the future. These regions are discussed in detail in Chapter 6.

Let's look more closely at some examples of brain activity and the associated behaviours that dopamine modulates, including thirst and drinking, hunger and eating, and addiction.

Dopamine
a multifunctional neurotransmitter with both excitatory and inhibitory effects, that is involved in many central nervous system functions such as movement, pleasure, attention, mood, cognition and motivation

Reward pathway
a group of structures in the brain that are activated by rewarding or reinforcing stimuli

LINK CHAPTER 6

ISBN 978-1-009-25416-8 Gallagher et al

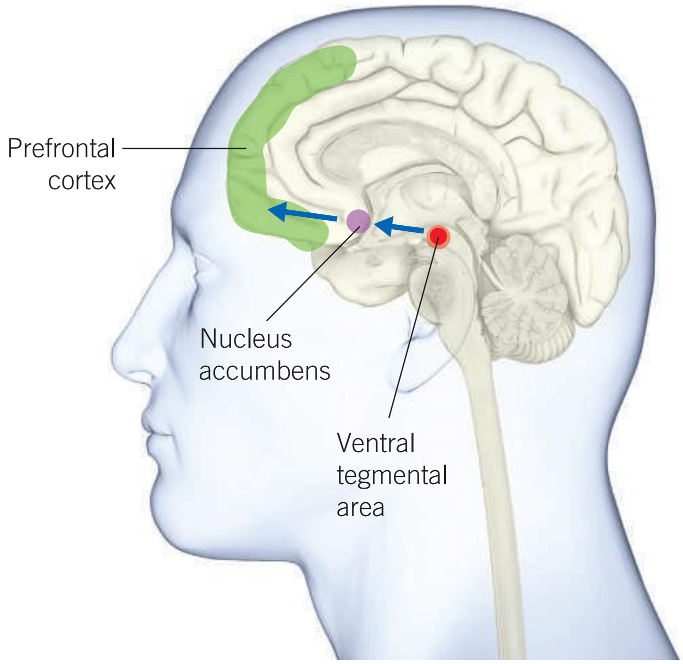


Figure 3B–13 A cross-section of the brain showing the dopamine reward pathway in blue. Dopamine is produced in the ventral tegmental area and travels in neurons to the nucleus accumbens and then the prefrontal cortex.

Check-in questions – Set 4

1 Why is dopamine considered to be neuromodulator?
2 What is the reward pathway and what is its function?
3 What happens to dopamine levels in the reward pathway when someone is exposed to a rewarding stimulus or anticipates one?

Figure 3B–14 When we drink in response to being thirsty, the process of sipping water releases dopamine in the reward pathway, producing feelings of pleasure.

The role of dopamine in thirst and drinking

Think of a time when you were extremely thirsty and how satisfying it was to finally drink a glass of water. Have you ever wondered why we find drinking water so rewarding when we are thirsty? Reward signals are carried by dopamine along the brain's reward pathway, and it appears to play a role in drinking behaviours and thirst. The gulping motion made by the throat as liquid is swallowed sends a message to the brain that water has been consumed, quieting the neurons that generate the urge to drink. Dopamine release is coupled with the gulping motion and drinking behaviour, which suggests that drinking is a learned behaviour. You have been drinking water all your life, and that may have been reinforced by the release of dopamine, which produces feelings of pleasure that we seek to repeat.

ISBN 978-1-009-25416-8 Gallagher et al

A team of researchers wanted to determine whether the release of dopamine associated with thirst and drinking is due to the behaviour of drinking itself or the resulting hydration. So they used a sensor that glows in the presence of dopamine. They put this sensor into mouse brains, and recorded dopamine levels in real time as the mice performed actions such as drinking water. The researchers looked at dopamine levels after thirsty mice drank water and other non-hydrating liquids. They also recorded dopamine levels after they injected water directly into the stomach of the mice, just like an intravenous drip, which simply hydrated the mice.

The researchers found that the thirsty mice had a large surge in dopamine levels after drinking water and that these dopamine changes happened even before drinking would have had any effect on the level of water in their bloodstream. In contrast, the mice that had water injected into their stomachs did not release any dopamine afterwards, suggesting that the act of drinking itself is rewarding, not the feeling of being hydrated. Interestingly, a spike in dopamine also occurs when you drink beverages that leave you feeling thirsty because this spike depends on the process of licking, sipping or gulping and not on hydration or the kind of liquid we drink.

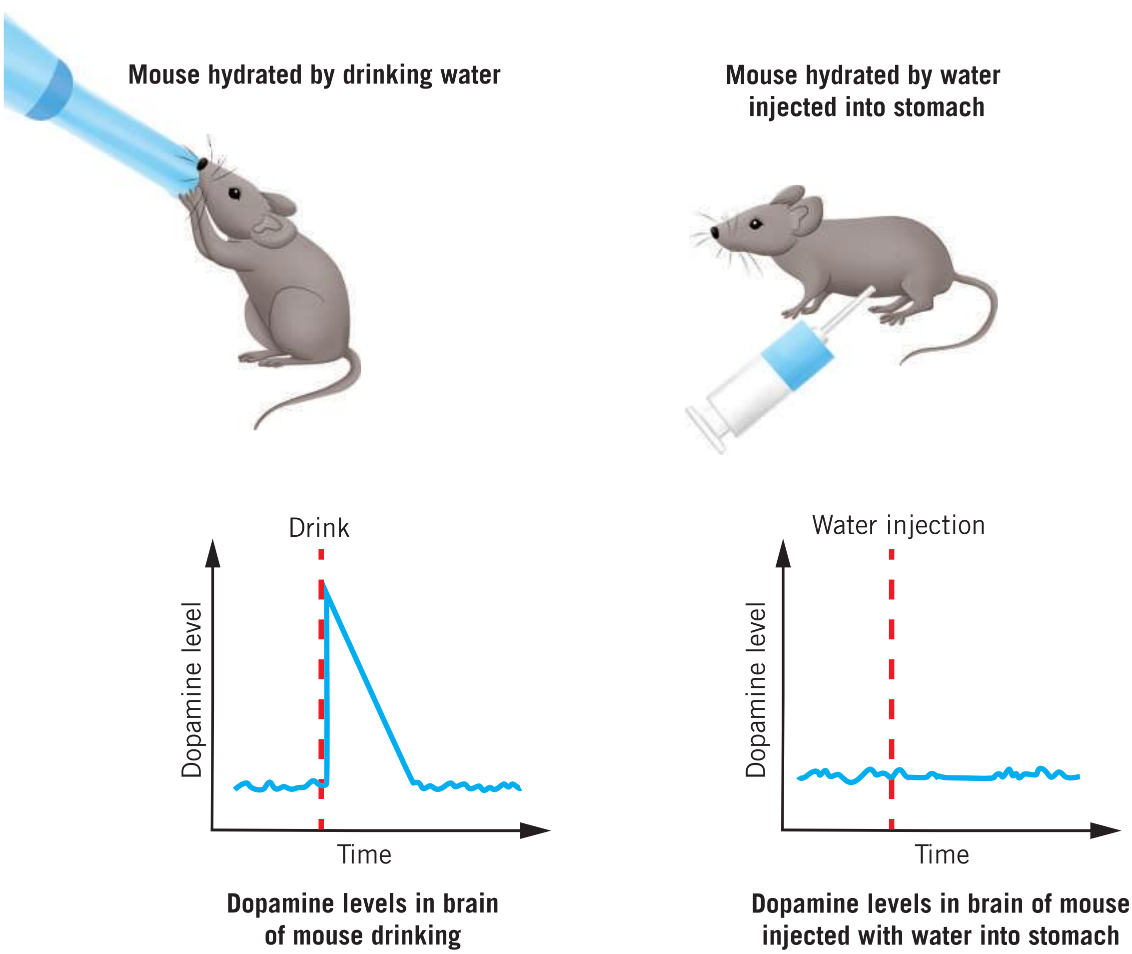


Figure 3B–15 A study showed that thirsty mice had a large surge of dopamine in their brains after drinking liquid, compared with mice that had water injected into their stomachs, not releasing any dopamine afterwards.

ISBN 978-1-009-25416-8 Gallagher et al

The role of dopamine in hunger and eating

Hunger is also a motivational sensation that leads us to consume food. The consumption of food releases dopamine and gives us feelings of pleasure, therefore increasing our chances of eating food the next time we experience hunger. The reward system is prominent in modulating our appetite and motivational drives for food. The brain receives signals from several hormones that indicate when food is needed or not. These signals modify dopamine output from the brain's reward pathway, controlling our motivation for food. Research indicates that dopamine plays an essential role in appetite control. For example, when laboratory mice are deprived of dopamine, they die of starvation, completely lacking motivation to feed themselves. When they were given dopamine supplementation, they then ate normally, which suggests that a base level of dopamine is required for a healthy appetite.

Hunger results from a decrease in the baseline dopamine levels in our brain. This decrease is thought to trigger a series of reactions in the brain, increasing dopamine-dependent behaviours such as seeking out food and eating it. When we then eat food, dopamine levels rise above the baseline, and we experience pleasure, reinforcing this pattern of brain activity and behaviour. Once our hunger is satisfied, dopamine levels fall back to the baseline. Interestingly, studies show that cravings can influence how much dopamine is released in our brain. For example, if you have a craving for chocolate, when you eat it, your brain releases more dopamine than if you ate something you were not craving.

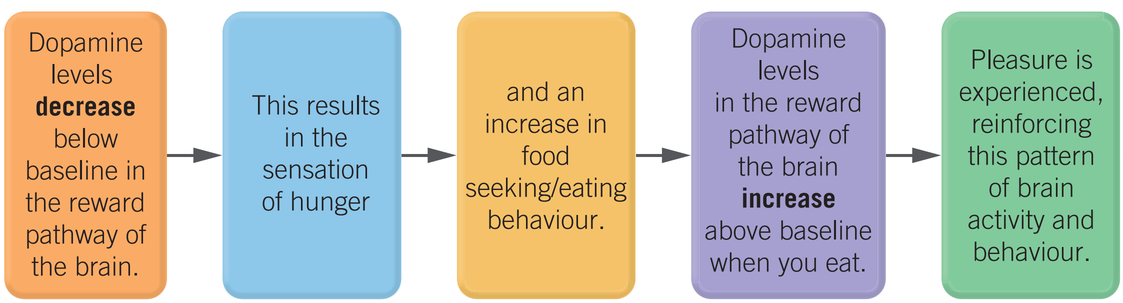


Figure 3B–16 A summary of how dopamine modulates hunger and reinforces eating behaviours

Figure 3B–17 If you eat a food you are craving, such as chocolate, more dopamine is released in the reward pathway of your brain than if you eat something you are not craving.

ISBN 978-1-009-25416-8 Gallagher et al

The role of dopamine in addiction

Dopamine's close connection to the reward centre in our brains and its ability to act as a motivating agent for completing pleasurable activities means that it is associated with unhealthy and addictive behaviours such as over-eating, smoking, drinking alcohol or using other addictive substances, excessive smartphone use, gambling and computer gaming. This is because whenever we see a reward worth chasing, our brain produces higher levels of dopamine, motivating us to complete the task, no matter how unhealthy or difficult the task might be.

Figure 3B–18 Some examples of unhealthy behaviours linked to dopamine

The dopamine theory of addiction suggests that most addictions are caused by the brain's inability to produce dopamine naturally without the behaviour or the substance that someone is addicted to. Only the behaviour or the substance provides enough dopamine to feel pleasure and excitement. Thus, when the person consumes more of the substance or performs more of the behaviour, their brain will require more of that same behaviour or substance to increase the levels of dopamine in their brain and experience pleasure. Eventually, this repetition leads to addiction.

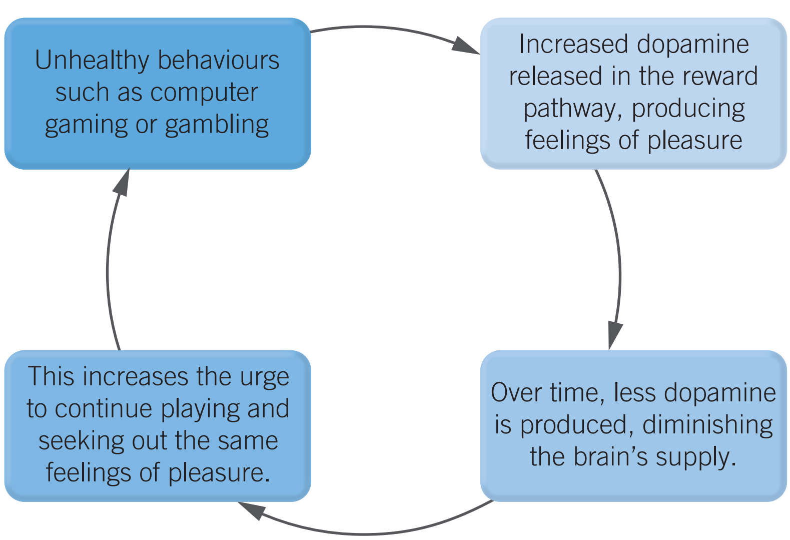


Figure 3B–19 The cycle of addictive behaviours such as gambling and computer gaming

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 5

1. Based on evidence from research with mice, what happens to dopamine levels in the brain after we drink a liquid of any kind when thirsty?
2. Describe the research evidence about the link between dopamine and hydration of the bloodstream when thirsty.
3. Why is hunger considered to be a motivational sensation?
4. Describe how dopamine modulates appetite or hunger.
5. What happens to dopamine levels in the brain when we eat and are satisfied?
6. How can eating something you crave influence the release of dopamine in the brain?

The most popular computer games today are completely immersive, involving vast digital landscapes that unfold in eye-popping detail, with characters that evolve from one level to the next. These games are deliberately designed, with the help of psychology consultants, to make players want to keep playing. This is because they flood the reward centre of the brain with dopamine, giving gamers a 'rush', like what is observed in the brains of people who use highly addictive stimulant drugs such as amphetamine or cocaine. The human brain is wired to crave instant gratification, fast pace and unpredictability, and all three of these aspects are satisfied by computer games.

Similarly, in gambling, one of the main drawcards is its uncertainty. This could be the size of the jackpot, the risk of losing or the probability of winning at all. In fact, dopamine release is increased during the moments leading up to a potential reward or win, referred to as an anticipation effect, giving gamers a rush or a 'high' even if they lose. This can often set off an urge to keep playing rather than walk away, referred to as 'chasing losses'.

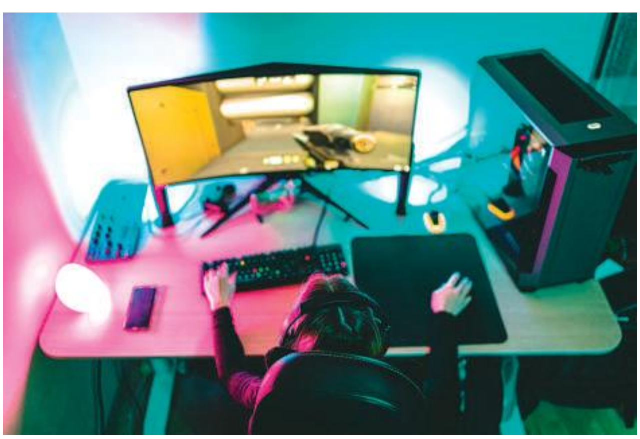


Figure 3B–20 Computer gaming is a potentially harmful behaviour because it has addictive qualities, flooding the reward centre with dopamine and giving gamers a 'rush'.

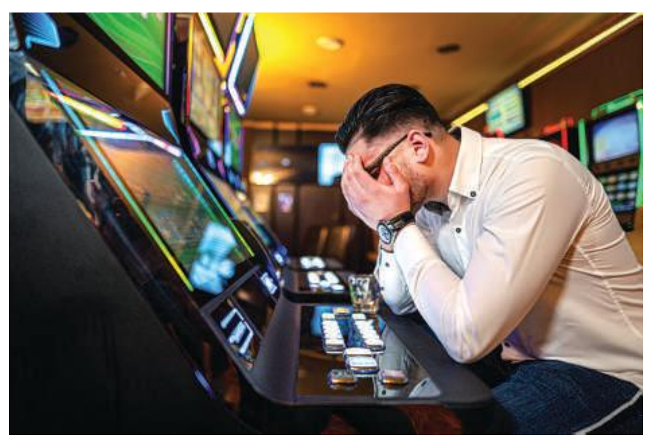


Figure 3B–21 Losing money when gambling triggers the rewarding release of dopamine almost to the same degree that winning money does. This can set off the urge to keep playing.

ACTIVITY 3B–2 RESEARCH TASK: DOPAMINE-BASED TREATMENTS FOR ADDICTION

There are a variety of treatments available for all types of addictions. With a partner, research treatments that target dopamine in the brain such as dopamine agonists. How do they work to treat addiction? You could share your ideas with the class in the form of a presentation.

ISBN 978-1-009-25416-8 Gallagher et al

Serotonin as a neuromodulator

Serotonin is an inhibitory neurotransmitter that also acts as a neuromodulator, influencing a variety of brain activities. Interestingly, more than 90% of the body's serotonin is found in the gastrointestinal tract as a part of the gut–brain axis (discussed in Chapter 4), where it has a role in regulating bowel function and in reducing appetite, as well as other important functions. However, it is best known for its role in the brain, where it modulates virtually all human behavioural processes, including mood, perception, reward, anger, aggression, appetite, memory, sexuality and attention.

The **serotonin pathway** originates in the brainstem and extends to almost all areas of the cerebrum including the cerebral cortex. Serotonin is produced in the brain stem and then travels in the direction of the arrows, modulating brain activity in these areas. Impairments to the serotonin pathway system have been linked to anxiety disorders and depression, as well as Parkinson's disease.

Let's look more closely at some examples of brain activity and the associated behaviours that serotonin modulates, including mood, impulsivity and aggression, as well as sleep.

Serotonin an inhibitory neurotransmitter that also acts as a neuromodulator, influencing a variety of brain activities

Serotonin pathway serotonin's neuromodulatory system, which originates in the brainstem and extends to almost all areas of the cerebrum including the cerebral cortex

LINK CHAPTER 4

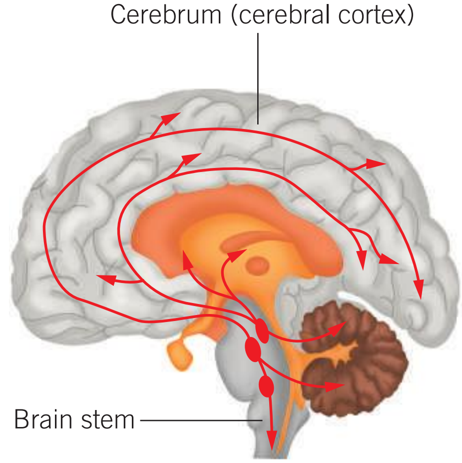


Figure 3B–22 The serotonin pathway in the brain

The role of serotonin in mood

Generally, research shows that when serotonin levels are high, mood improves. However, there are a lot of other chemical processes happening in the body, so it is difficult to establish a cause-and-effect relationship. For example, just like the chicken and the egg scenario, it is unclear whether depressed people stop making serotonin, or if low levels of serotonin lead to depression. It is also unclear whether there are other factors that cause both depression and low serotonin. Other possible causes include faulty serotonin receptors or a lack of tryptophan, which is an amino acid from which serotonin is made in the gut. Despite this uncertainty, it is clear from research that balanced serotonin levels often lead to calm, focused, happy and stable moods. When levels dip too low, this has devastating effects on the brain's ability to regulate mood, because low serotonin levels are mostly commonly associated with depression and anxiety.

Figure 3B–23 Lowered serotonin levels in the brain can be associated with depression and anxiety.

ISBN 978-1-009-25416-8 Gallagher et al

The role of serotonin in sleep

CHAPTER 7 LINK

Serotonin is generally required for us to have normal amounts of sleep. Research has also shown that lower levels of serotonin in the brain can also disrupt the circadian rhythm of sleep–wake cycles (discussed in detail in Chapter 7). By disrupting the circadian rhythm of sleep–wake cycles, an imbalance in serotonin leads to restless sleep during which a person wakes up often, leading them to lack sleep at night and desire sleep during the day. This is often a symptom of depression, which is also associated with lower levels of serotonin.

Figure 3B–24 A lower level of serotonin in the brain leads to increased restlessness and difficulty sleeping at night.

There are two main factors that control sleep. One is the circadian or body clock (also discussed in detail in Chapter 7): when it is light during the day, the body is awake, and when it gets dark, the body knows to sleep. The other factor is called homeostatic sleep pressure. When you wake up in the morning, you have just had some rest, and so you're energetic. As the day goes on, you get tired and sleepy, so the pressure to sleep increases. If you don't sleep that night, your sleep pressure is even higher, and you are even more tired the next day even though it's light outside, and your circadian clock dictates that you should be awake. The theory is that, in order to sleep, you need to have high sleep pressure and the circadian clock needs to be aligned with the time of day. Research generally shows that if the brain lacks serotonin, a person will have a reduced sleep pressure, thus increasing restlessness and wakefulness when they should be sleeping.

Check-in questions – Set 6

1. Describe the serotonin pathway.
2. Describe the link between serotonin and depression.
3. How can low serotonin levels affect our sleep patterns?

The role of serotonin in aggression and impulsivity

Research shows that serotonin helps regulate brain activity associated with impulsive and aggressive behaviours. Several studies have investigated serotonin's involvement in impulsivity, which is described as an assessment of whether to take an immediate reward, or to wait for a future, potentially larger, reward. It has been shown that a lower level of serotonin in the brain, particularly the cerebral cortex, leads people to discount a delayed reward, increasing impulsive behaviours.

ISBN 978-1-009-25416-8 Gallagher et al

It has also been determined that a higher serotonin level in the same brain area leads to people waiting longer for rewards, thus reducing impulsivity.

In terms of aggression, research indicates that low levels of serotonin in the brain can affect communication between specific structures within the limbic system responsible for regulating emotions. In particular, communication between a structure called the amygdala (discussed in relation to memory in Chapter 6) and the frontal region of the cerebral cortex becomes weaker, making it more difficult for the frontal area of our cerebral cortex (which makes decisions) to control and regulate emotional responses to anger that are generated within the amygdala, increasing aggressive and violent behaviours.

LINK CHAPTER 6

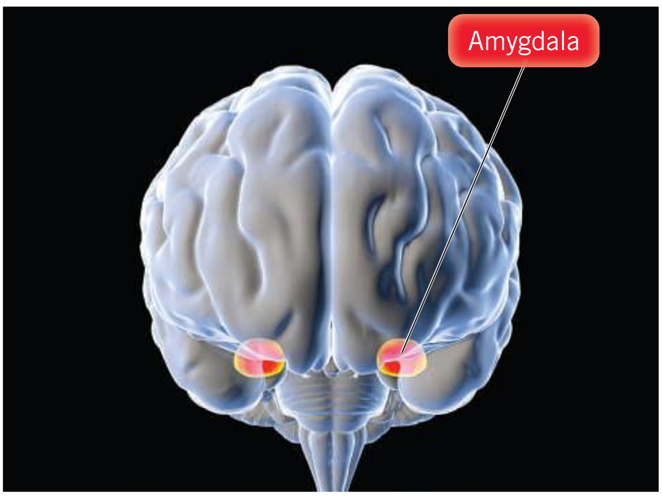


Figure 3B–25 The amygdala are responsible for producing various emotional responses, such as anger.

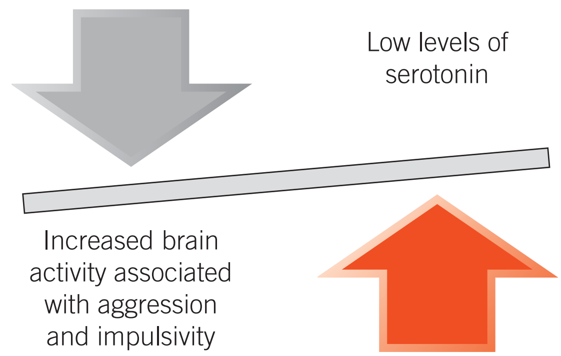


Figure 3B–26 A lower level of serotonin in the brain leads to an increase in impulsive and aggressive behaviours.

3B SKILLS

Explaining the process of neural transmission in a real-world context

In the VCE Psychology exam, it you are asked a question about any 'process' in psychology, you can represent it with a diagram if this is easier for you. You will not be marked down as long as the diagram is annotated with key terminology explaining the process. You could also use dot points, numbers or subheadings to help your explanation, particularly if there is an order to the process you are describing. The process of neural transmission has a lot of terminology, so the more succinct your responses relating to it are, the clearer they will be and the easier it should be to obtain marks.

Question:

The following question is from the 2020 VCAA examination.

Question 3b (4 marks)

When Raafe learnt to type when he was a child, he used only the index finger on each hand to develop his skills. As an adult, Raafe applied for a job as an administrative assistant and needed to learn a technique called touch-typing, which uses all fingers on both hands. His touch-typing skills would be tested as part of the job selection process.

With reference to the process of neural transmission, explain the role of glutamate in learning touch-typing.

VIDEO 3B–2
SKILLS: EXPLAINING NEURAL TRANSMISSION

ISBN 978-1-009-25416-8 Gallagher et al

Attempted answer:

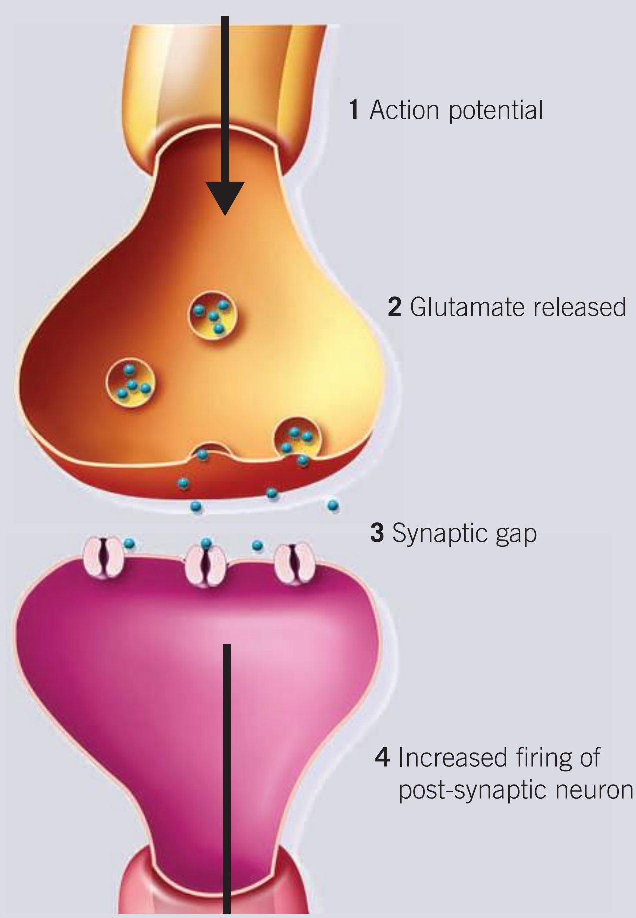
In the process of neural transmission, the action potential is activated and travels down the presynaptic neuron towards the synapse, which is where two neurons meet but do not touch. When the action potential reaches the axon terminal, neurotransmitters are released into the synaptic gap. Given that Raafe is learning to touch-type, glutamate would be the neurotransmitter involved. It would travel across the gap and be detected by receptor sites on the dendrites of the post-synaptic neuron. As glutamate is the main excitatory neurotransmitter in the nervous system, it would make this post-synaptic neuron more likely to fire, helping strengthen this pathway for Raafe, enabling him to learn how to touch-type.

Comments:

This answer would obtain 4 marks; however, it is wordy and could take too much time to produce under the time pressure of exam conditions. You could use a diagram and dot points to effectively minimise the words used and simplify the answer overall. The following answer uses fewer words but still includes all the key terminology. By using numbered dot points and a diagram, it makes the process very clear and still links back to the question and the scenario in order obtain full marks.

Suggested answer for full marks:

1. Action potential travels along the presynaptic neuron to the synapse.
2. Glutamate is released from the axon terminal into the synaptic gap.
3. Glutamate travels across the gap and is detected by receptor sites on dendrites of the post-synaptic neuron.
4. Glutamate is the main excitatory neurotransmitter in the nervous system, making the post-synaptic neuron more likely to fire, helping to strengthen this pathway for Raafe and enabling him to learn how to touch-type.



Section 3B questions

1 Using key terminology, explain how neurotransmitters enable two neurons to communicate across a synapse. You can use a diagram to aid your explanation if you wish.

2 Use a Venn diagram to compare excitatory and inhibitory effects of neurotransmitters in the nervous system.

3 Identify the main inhibitory neurotransmitter in the nervous system and explain its role.

4 Identify the neurotransmitter associated with learning and memory, and explain the role it plays in this process.

5 As well as dopamine, why is serotonin also considered to be a neuromodulator?

6 Explain the relationship between serotonin levels in the brain and brain activity relating to aggression and impulsivity.

7 Identify whether each statement is a feature of a neurotransmitter or a neuromodulator.
  - a They are chemicals released by neurons to alter the effectiveness of neural transmission.
  - b Their role is the transmission of chemical signals to the adjacent neuron.
  - c They are only released into the synapse.
  - d They are effective on groups of neurons.
  - e Their role is to alter the neural transmission of neurons by controlling the synthesis and release of neurotransmitters.
  - f They act moderately fast.

8 Describe the role of dopamine as a modulating neurotransmitter within the CNS.

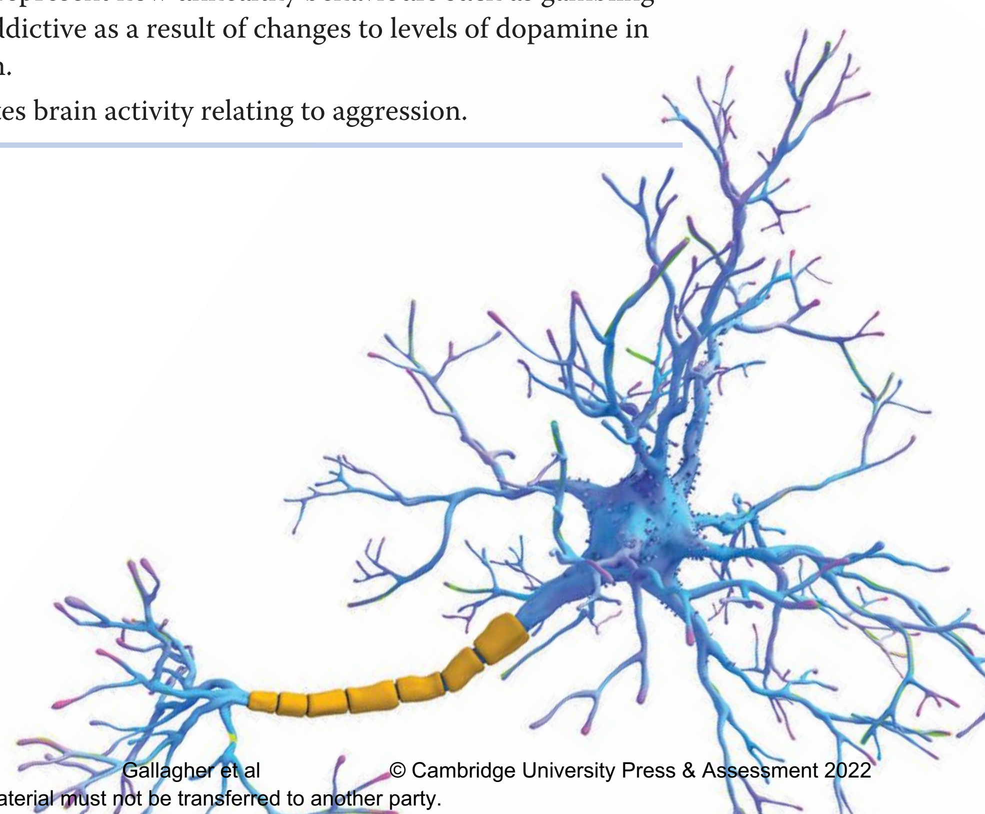
9 Explain how dopamine is associated with rewarding thirst-related behaviours such as drinking.

10 Describe how dopamine motivates us to eat.

11 Explain why dopamine is linked to unhealthy addictive behaviours.

12 Use a diagram or flow chart to represent how unhealthy behaviours such as gambling or computer gaming become addictive as a result of changes to levels of dopamine in the reward pathway of the brain.

13 Explain how serotonin modulates brain activity relating to aggression.



ISBN 978-1-009-25416-8 Gallagher et al

3C Synaptic plasticity

Study Design:
Synaptic plasticity – resulting from long-term potentiation and long-term depression, which together act to modify connections between neurons (sprouting, rerouting and pruning) – as the fundamental mechanism of memory formation that leads to learning

Glossary:
Dendritic spine
Filigree appendage
Long-term depression (LTD)
Long-term potentiation (LTP)
Pruning
Rerouting
Sprouting
Synaptic plasticity
Synaptogenesis

ENGAGE

Using neural plasticity to recover from brain damage

Cheryl was 39 years old when a routine operation caused an infection that damaged 98% of her vestibular system within her brain. The vestibular system is important for communicating and coordinating neural messages about the position of the head, movement of the eyes and maintaining postural balance. She explains to people she meets that it 'feels like I am a wet noodle' moving around without stability. Her doctors explained that because the neurons in her brain are not communicating between the synapses as they should, there is not much they can do. This was until a team of specialists in the field of neuroscience, including prominent psychiatrist Dr Norman Doidge, created a plastic helmet fitted with motion sensors. It contained an internal device to measure her movement, and a metal strip that connected in her mouth. While wearing the helmet, if Cheryl began falling uncontrollably forward, she would feel a sensation ripple to the tip of her tongue. If her head fell to the side, the sensation moved to the side of her tongue.

Figure 3C–1 Cheryl using a helmet fitted with motion sensors, connected to a mouthpiece that provides her with feedback sensations on her tongue.

Over time, Cheryl was able to use the helmet and the sensations on her tongue to retrain the neural connections in her brain to coordinate her head and eyes while maintaining balance within her environment. As life went on, she relied on the helmet less and less, as her brain was able to adapt using neural plasticity. Eventually, her brain could control her postural balance and head coordination significantly more than when she was first unwell. This has enabled her to live a relatively normal life and perform daily tasks such as driving her car.

ISBN 978-1-009-25416-8

EXPLAIN

Long-term potentiation and long-term depression

When we learn something new and store a memory of it, a relatively permanent or stable connection between neurons is formed. Specific changes usually occur within the synapse between neurons, referred to as **synaptic plasticity**, which results in a strengthening or a weakening of these connections based on activity levels. The ability of the entire brain and its neural networks to change, grow and reorganise is referred to as neural plasticity, or neuroplasticity, as covered in Unit 1. In the case of learning and the formation of a memory, glutamate is released each time a neural pathway associated with an experience is activated. Given that glutamate is an excitatory neurotransmitter, it stimulates activity in a pathway, and promotes neural connectivity in general, making our memory stronger.

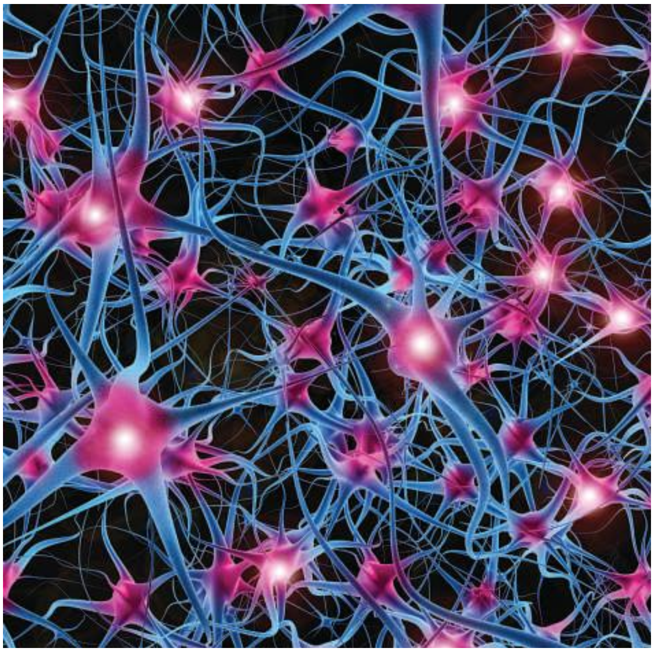


Figure 3C–2 A representation of the neural networks within the brain being activated

There are two important processes involved in neural plasticity: long-term potentiation (LTP) and long-term depression (LTD). Both processes are the result of repeated activation of neural pathways and are involved in the consolidation of long-term memories in specific brain regions such as the hippocampus, discussed in Section 6B.

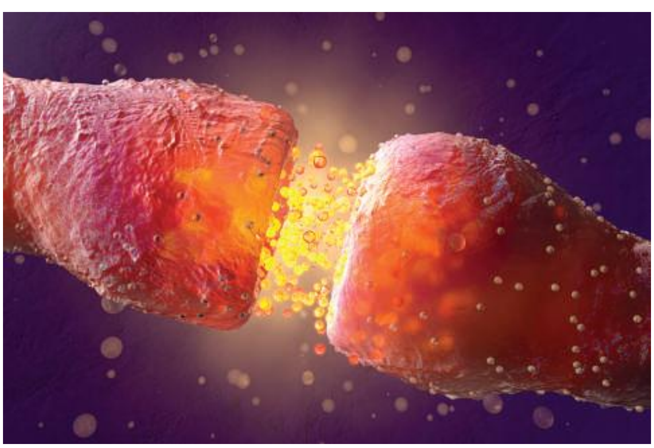


Figure 3C–3 A representation of a synapse, where both long-term potentiation and long-term depression occur

We have already established that when a neural pathway is activated during the process of learning, the excitatory neurotransmitter glutamate is released. Through repeated activation of this pathway, it will strengthen. This is **long-term potentiation (LTP)**, a relatively permanent strengthening of synaptic connections resulting from repeated activation of a neural pathway. For example, if your tennis coach teaches you a new serving technique, it may take you some time to learn. But each time you practise, you are activating the new pathway in your brain associated with this technique. Through LTP, this neural pathway becomes stronger, making it easier for you to serve.

LINK 3B NEUROTRANSMITTERS AND NEUROMODULATORS

VIDEO 3C–1 LTP AND LTD

Synaptic plasticity specific changes that occur within the synapse, between neurons

LINK UNIT 1

LINK 6B THE ROLES OF SPECIFIC REGIONS OF THE BRAIN IN LONG-TERM MEMORY

Long-term potentiation (LTP) the relatively permanent strengthening of synaptic connections as a result of repeated activation of a neural pathway

ISBN 978-1-009-25416-8 Gallagher et al

Long-term depression (LTD) the relatively permanent weakening of synaptic connections as a result of repeated low-level activation

Long-term depression (LTD) is essentially the opposite of LTP. It involves a relatively permanent weakening of synaptic connections. This is usually a result of repeatedly lower levels of activity in a neural pathway. It helps our brain to adapt or change neural pathways and to get rid of or 'prune' neural connections that are no longer useful. For example, when your tennis coach teaches you a new technique for serving, the neural pathway in your brain associated with the old way you used to serve is repeatedly going to receive a lower level of stimulation over time, and will eventually be used less and less. As you modify your technique, practising the new way and using the old way less and less, both LTD and LTP will be at play, enabling your brain to change and create a more efficient neural pathway.

Figure 3C–4 When learning a new serving technique with your tennis coach, both LTP and LTD are occurring in the neural pathway associated with this in your brain.

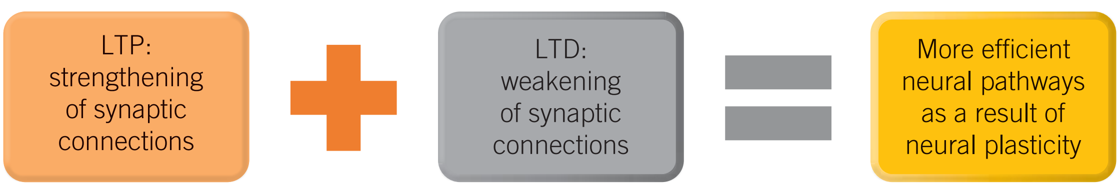


Figure 3C–5 Long-term potentiation and long-term depression work together to produce more efficient neural pathways.

Check-in questions – Set 1

1 Explain the term 'synaptic plasticity'.
2 Describe the role of synaptic plasticity in learning and memory formation.
3 Distinguish between the processes of LTP and LTD.
4 In terms of learning and the formation of a memory, explain how LTP and LTD work together to make neural pathways more efficient.

Modifications resulting from LTP and LTD

When tweaking its construction, the brain works like a sculptor – starting with more than it needs so it can carve away the excess and achieve the perfect design. This sculpting occurs via LTP and LTD, acting together to modify synaptic connections between neurons in our brain, making the process of learning more efficient. Specific modifications can be identified as a part of this process, including sprouting, rerouting and pruning. Let's look at these modifications more closely.

ISBN 978-1-009-25416-8 Gallagher et al

Sprouting

The process of **sprouting** involves the growth of axon and/or dendrite fibres at the synapse, as shown in Figure 3C–6. These 'sprouts' change the physical structure or appearance of the neurons, so they look 'bushier'. For example, after learning about sprouting and storing a memory of it, if you were to look at the associated neurons under a microscope, you would see changes to their physical appearance, such as the:

- growth of **dendritic spines** on the post-synaptic neuron, resulting in the dendrites appearing 'bushier'
- growth of axon sprouts called **filigree appendages** on the axon terminal of the presynaptic neuron
- formation of additional synapses where these dendritic spines and filigree appendages meet, referred to as **synaptogenesis**.

Sprouting the growth of axon or dendrite fibres at the synapse

Dendritic spine a dendrite fibre that grows by sprouting on the post-synaptic neuron

Filigree appendage a fibre that grows by sprouting from the axon terminal of the presynaptic neuron

Synaptogenesis the formation of new synapses that result from the process of sprouting

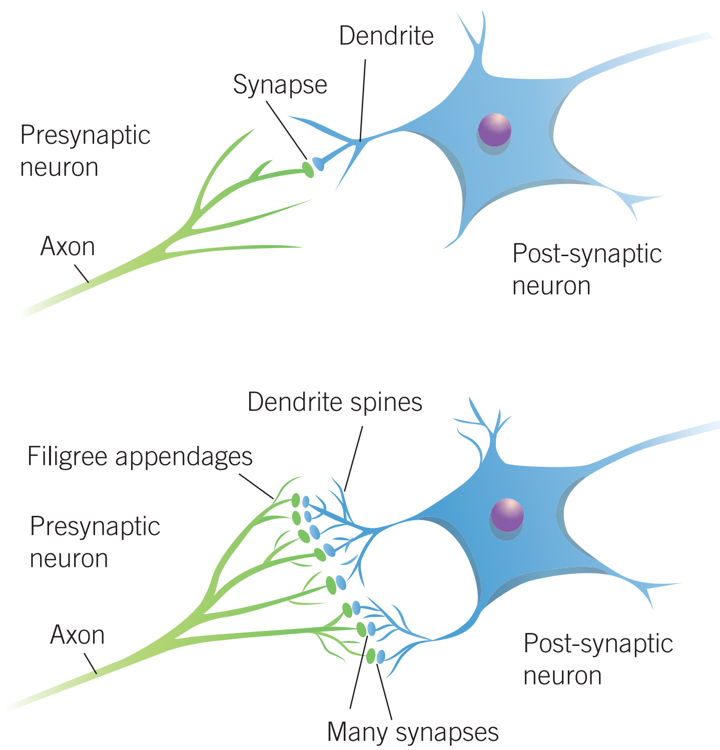


Figure 3C–6 Top: A synapse between two neurons before the process of long-term potentiation. Bottom: The same neurons after the process of long-term potentiation. Filigree appendages have grown from the axon of the presynaptic neuron, and dendritic spines have grown from the post synaptic neuron, forming new synapses between them, through synaptogenesis.

Rerouting

Human beings are constantly adapting their behaviours and learning more efficient ways of doing things. This usually requires **rerouting**, the formation of new neural connections to establish alternative neural pathways. Let's return to the example of your tennis coach teaching you a new serving technique. When you first learned your original serving technique and practised this, a well-established neural pathway or 'route' would have been formed and strengthened over time as a result of LTP. When your coach then teaches you the new technique for serving, the original neural pathway may undergo some rerouting as a result of LTD, and an alternative pathway associated with the new technique would be formed. It is also likely that the process of sprouting will also occur as the neurons in this alternative or 'rerouted' pathway would strengthen their connections due to your practising the new serving technique over time.

Rerouting the formation of new connections between neurons to establish alternative neural pathways

ISBN 978-1-009-25416-8

Pruning

Pruning the removal of excess neurons and synaptic connections to increase the efficiency of neuronal transmissions

Synaptic **pruning** allows the brain to fine-tune its neural networks and strengthen the connections between neurons that are important for brain functioning. This is similar to how a gardener prunes or trims away excess branches on a fruit tree so that the resulting branches can produce healthier and better-tasting fruit. As we previously established, the process of LTD usually involves some pruning, where excess neurons and synaptic connections are eliminated in order to increase the efficiency of neuronal transmissions. Excess dendritic spines and filigree appendages are formed when we learn something and activate this pathway each time we practise the skill or revise the information and form a long-term memory of it. Over time, our brain works out which route(s) is/are most efficient or optimum so that excess branches can be pruned away once this is established, making communication between neurons in this pathway more direct and efficient.

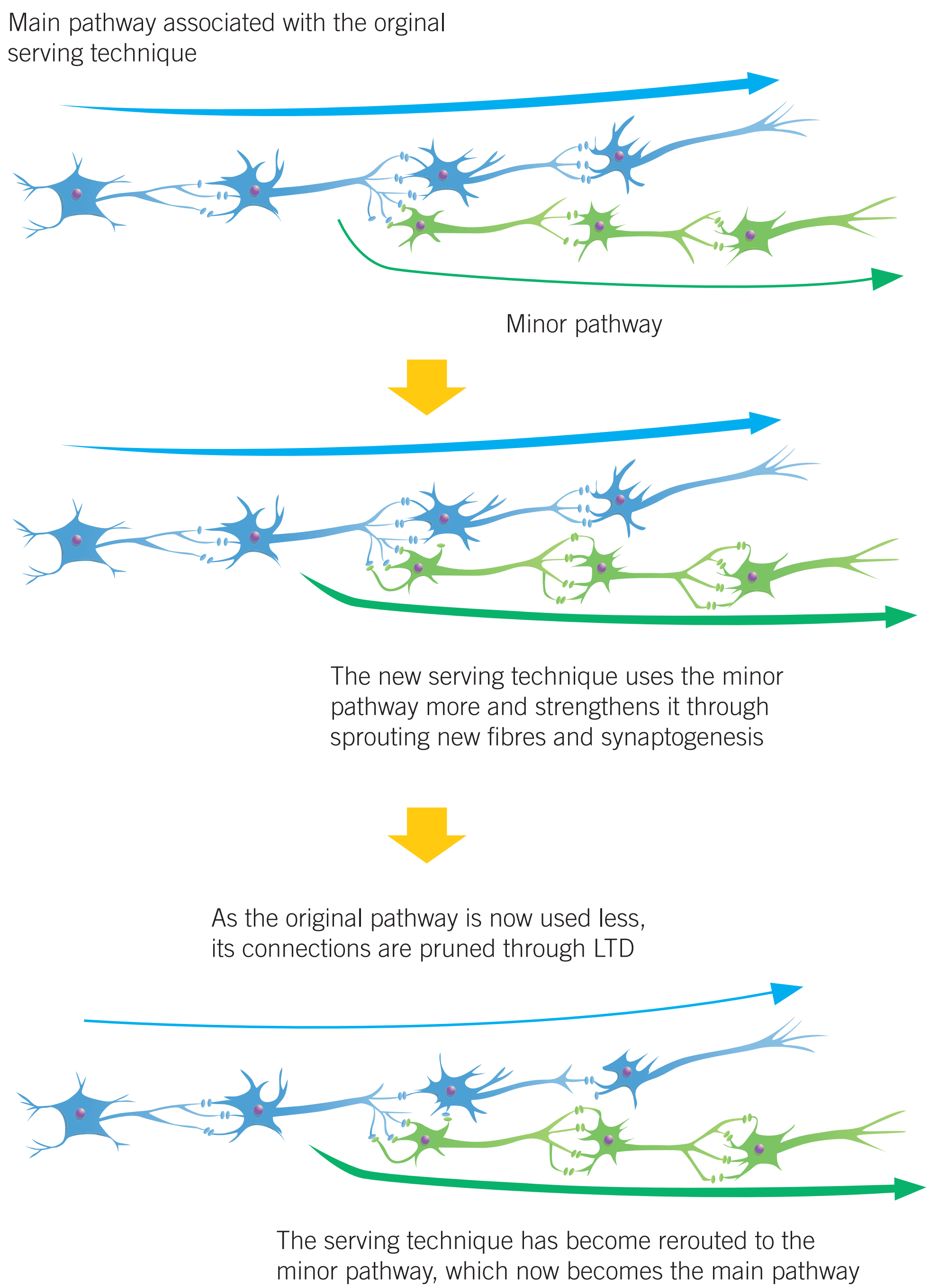


Figure 3C–7 Rerouting a neural pathway and pruning less-used connections through long-term depression when learning a new tennis serve

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 2

1 Describe two modifications that occur as a result of sprouting at a synapse.
2 Explain the difference between sprouting and pruning
3 Using your own example, explain the role of rerouting when learning and forming a memory.

3C SKILLS

Synaptic plasticity as the fundamental mechanism of memory formation that leads to learning

You have read in this section how synaptic plasticity and in particular the processes of LTP and LTD are essential to learning and memory formation. The involvement of both processes enhances neural pathways, making them more efficient. This underpins the topics of memory and learning covered later in this unit.

Assessment questions in relation to synaptic plasticity are often based on a scenario in which someone is learning a new skill. It is essential that you can explain the importance of both LTP and LTD in this case.

The following question is based on the question from the 2020 VCAA examination that you looked at in 3B Skills.

Question (4 marks):

> When Raafe learnt to type when he was a child, he used only the index finger on each hand to develop his skills. As an adult, Raafe applied for a job as an administrative assistant and needed to learn a technique called touch-typing, which uses all fingers on both hands. His touch-typing skills would be tested as part of the job selection process.

Explain how both LTP and LTD were involved when Raafe learned the new touch-typing technique.

Answer:

LTP involves a relatively permanent strengthening of synaptic connections as a result of repeated activation of a neural pathway. In Raafe's case, each time he practises the new touch-typing technique, the neurons in this pathway are activated, strengthening his memory of the technique and making it easier for him to perform the technique in future.

LTD involves a relatively permanent weakening of synaptic connections as a result of minimal stimulation. So as an adult, Raafe's neural connections and memory of how to type using only his index finger would have been weakened due to minimal activation, as he learned how to use the new touch-typing technique, using this old pathway less and less.

VIDEO 3C–2
SKILLS: SYNAPTIC PLASTICITY

WORKSHEET 3C–1
DOC
MODIFICATIONS RESULTING FROM LTP AND LTD

LINK
3B NEUROTRANSMITTERS AND NEUROMODULATORS

ISBN 978-1-009-25416-8 Gallagher et al

Section 3C questions

1 Identify whether these statements are true or false.
   - a The ability of the entire brain and its neural networks to change, grow and reorganise themselves is referred to as neural plasticity.
   - b Glutamate is an excitatory neurotransmitter, meaning it slows activity in a pathway, and does not promote neural plasticity, making memories weaker.
   - c Only the process of LTP is involved in the consolidation of long-term memories in specific brain regions such as the hippocampus.
   - d A relatively permanent strengthening of synaptic connections due to repeated activation is referred to as long-term potentiation.

2 Identify whether the following changes are associated with LTP or LTD.
   - a Presynaptic neurons appearing bushier as a result of filigree appendages growing on axon terminals
   - b An increase in the number of synapses between presynaptic and post-synaptic neurons
   - c New connections formed between neurons in an alternative neural pathway
   - d Post-synaptic neurons appearing bushier because of dendritic spines growing
   - e A decrease in the number of synapses between presynaptic and post-synaptic neurons

3 Rico is going on a skiing trip with his friends for his 30th birthday. He learned how to ski when he was a child but has not been skiing since.
   - a Explain the role of LTP in the formation of Rico's memory of how to ski that he would have learned and practised as a child.
   - b Describe the associated modifications that would occur to Rico's neural pathway associated with skiing as a child.
   - c When Rico goes skiing on the first day of his trip, he realises his skiing skills are a little rusty. He finds it difficult to stop and to perform turns. In terms of LTD, explain why Rico is finding it harder to ski as an adult.

ISBN 978-1-009-25416-8 Gallagher et al

Chapter 3 review

Summary

Create your own set of summary notes for this chapter on paper or in a digital document. A model summary is provided in the Teacher Resources, which can be used to compare with yours.

Checklist

In the Interactive Textbook, the success criteria are linked from the review questions and will be automatically ticked when answers are correct. Alternatively, print or photocopy this page and tick the boxes when you have answered the corresponding questions correctly.

	Success criteria – I am now able to:	Linked questions
3A.1	Identify the different divisions of the nervous system	1☐
3A.2	Explain the role of the central nervous system, including the brain and spinal cord	18c☐
3A.3	Explain the role of the peripheral nervous system, including the somatic and autonomic subdivisions and the further subdivisions of the sympathetic and parasympathetic nervous systems	2☐, 5☐
3A.4	Compare and contrast the roles of the different divisions and subdivisions of the nervous system	17☐
3A.5	Apply my understanding of the role of each division and subdivision of the nervous system to real-life examples of sensory stimuli received by the body	17☐
3A.6	Describe the key features of both a conscious and unconscious response and provide examples of each	18a☐, b☐
3A.7	Distinguish between the key features of conscious and unconscious responses	18a☐, b☐
3A.8	Correctly identify a conscious or an unconscious response from a real-life example	18a☐, b☐
3A.9	Explain the role of the spinal reflex as an example of an adaptive, unconscious response	18e☐
3A.10	Explain how a spinal reflex occurs when responding to sensory stimuli	3☐, 18d☐
3A.11	Apply my understanding of the spinal reflex to a real-life example of sensory stimuli received by the body	18b☐
3B.1	Explain the role of neurotransmitters in transmitting information across a neural synapse	4☐, 19☐
3B.2	Distinguish between the excitatory and inhibitory effects of neurotransmitters on the post-synaptic neuron	6☐, 7☐
3B.3	Explain the role of glutamate in the production of excitatory effects	9☐
3B.4	Explain the role of GABA in the production of inhibitory effects	8☐, 19☐

ISBN 978-1-009-25416-8 Gallagher et al

Success criteria – I am now able to:		Linked questions
3B.5	Explain the role of neuromodulators and their effects on brain activity	14☐, 21☐
3B.6	Explain how dopamine and serotonin both work as neuromodulators in the brain	12☐, 20a☐
3B.7	Compare the effects of dopamine and serotonin on brain activity	14☐, 21☐
3B.8	Distinguish between neurotransmitters and neuromodulators	13☐
3C.1	Explain what is meant by synaptic plasticity	10☐, 16☐
3C.2	Describe the modifications that occur to connections between neurons as a result of sprouting, rerouting and pruning	15☐
3C.3	Explain how both long-term depression and long-term potentiation modify the connections between neurons	9☐, 11☐
3C.4	Explain the relationship between synaptic/neural plasticity and the formation of memories that leads to learning	10☐

Key Science Skills

Skills	Questions and Skills boxes
Identify, research and construct aims and questions for investigation	3A Key Science Skills Chapter review – 17c
Identify independent, dependent and controlled variables in controlled experiments	3A Key Science Skills Chapter review – 17b–f
Formulate hypotheses to focus investigations	3A Key Science Skills Chapter review – 17g
Predict possible outcomes of investigations	Chapter review – 17b
Design and conduct investigations; select and use methods appropriate to the investigation, including consideration of sampling technique (random and stratified) and size, equipment and procedures, taking into account potential sources of error and uncertainty; determine the type and amount of qualitative and/or quantitative data to be generated or collated.	Chapter review – 17e

Multiple-choice questions

1 The central nervous system is composed of
  A all of the nerves and neurons throughout the body.
  B the somatic and autonomic nervous systems.
  C the brain and spinal cord.
  D the sympathetic and parasympathetic nervous systems.

2 The autonomic nervous system
  A consists of the somatic and peripheral nervous systems.
  B functions mostly without our conscious awareness and controls involuntary bodily functions such as heart rate, blood pressure and digestion.
  C functions consciously and controls voluntary movements of skeletal muscles.
  D consists of the brain and spinal cord.

ISBN 978-1-009-25416-8 Gallagher et al

3 A spinal reflex is

A a conscious response because it involves input from the brain in order to perform the movement.

B an unconscious response because it involves input from the brain in order to respond to a stimulus.

C a conscious response because it involves awareness in order to ensure our response to the stimulus is quick.

D an unconscious response because it occurs before the brain provides input and is initiated by the spinal cord.

4 Which of the following correctly identifies the specialised structure and corresponding function at any given synapse?

	Structure	Function
A	synaptic gap	neurotransmitters are stored
B	post-synaptic neuron	action potential is initiated
C	receptor site	neurotransmitters travel across this space
D	presynaptic neuron	releases neurotransmitters from vesicles

5 Dion is playing soccer with his father. His father is defending the goals when Dion kicks the ball with his left foot and shoots a goal. Which of the following identifies the correct response and nervous system division/subdivision involved?

	Response	Nervous system
A	muscles in his left leg contract	somatic
B	spinal reflex initiated	CNS
C	spinal reflex initiated	autonomic
D	muscles in his left leg relax	somatic

6 Which of the following is correct in relation to excitatory effects of neurotransmitters?

A They involve the increased likelihood of presynaptic neurons firing and include neurotransmitters such as glutamate.

B They involve the decreased likelihood of post-synaptic neurons firing and include neurotransmitters such as GABA.

C They involve the increased likelihood of post-synaptic neurons firing and include neurotransmitters such as glutamate.

D They involve the decreased likelihood of presynaptic neurons firing and include neurotransmitters such as GABA.

7 The two main neurotransmitters that need to be in balance for optimal functioning of the brain are

A glutamate because it is inhibitory and dopamine because it is excitatory.

B dopamine because it is both excitatory and inhibitory, and GABA because it is inhibitory.

C dopamine because it is inhibitory and glutamate because it is excitatory.

D glutamate because it is excitatory and GABA because it is inhibitory.

ISBN 978-1-009-25416-8 Gallagher et al

8 In terms of neurotransmitters, anxiety can be explained by
- **A** a lack of GABA, causing increased neural activity in the brain.
- **B** excess GABA, causing decreased neural activity in the brain.
- **C** a lack of glutamate, causing increased neural activity in the brain.
- **D** excess dopamine, causing decreased neural activity in the brain.

9 Which of the following identifies a difference between long-term potentiation and long-term depression?

	Long-term potentiation	Long-term depression
A	changes are relatively permanent	changes are not relatively permanent
B	occurs in the synapse	does not occur in the synapse
C	involves the neurotransmitter glutamate	involves the neurotransmitter dopamine
D	involves an increase in the activity of the post-synaptic neuron because of the increased release of glutamate	does not involve an increase in the activity of the post-synaptic neuron

10 The role of synaptic plasticity in the formation of a memory leading to learning is that
- **A** it enables a relatively permanent or stable connection between neurons to be formed as a result of neural activation.
- **B** a temporary or unstable connection between neurons is formed as a result of a lack of neural activation.
- **C** it promotes neural disconnection in general, making our memories weaker.
- **D** it promotes the stability of the brain's neural structure, making it more difficult to change and adapt as a result of experience.

11 Which of the following correctly identifies a modification that would occur as a result of LTD at the synapse?
- **A** The post-synaptic neuron becomes more sensitive in response to presynaptic neurotransmitter release because of additional receptor sites growing.
- **B** More neurotransmitters (glutamate) are released over time, as a larger amount is required to stimulate the post-synaptic neuron.
- **C** The post-synaptic neuron becomes faster at detecting a signal, speeding up the firing of an action potential and more efficient communication overall.
- **D** The post-synaptic neuron becomes less sensitive in response to presynaptic neurotransmitter release because of a reduction in the number of receptor sites.

12 Which of the following is correct in relation to dopamine and hunger?
- **A** Dopamine levels in the brain decrease below the baseline level when we are hungry, and increase above the baseline after we eat and are satiated.
- **B** Dopamine levels in the brain decrease below the baseline level when we are hungry, and increase back to baseline after we eat and are satiated.
- **C** Dopamine levels do not change from our baseline in relation to hunger.
- **D** Dopamine levels in the brain increase above the baseline level when we are hungry, and decrease below the baseline after we eat and are satiated.

ISBN 978-1-009-25416-8

13 Which statement about neuromodulators is incorrect?
- **A** They only communicate across the synapse.
- **B** Their speed of action is moderately slow.
- **C** They alter the effectiveness of neural transmission in entire regions of the brain.
- **D** They transmit a signal to groups of neurons in brain tissue.

14 Which of the following is true of dopamine's effect on brain activity?
- **A** Hunger results from an increase in the baseline dopamine levels in the brain.
- **B** Dopamine acts as a motivating agent for avoiding pleasurable activities
- **C** When we are thirsty, there is a surge of dopamine in our brain.
- **D** Dopamine release decreases during the moments leading up to a potential reward or win when gambling.

15 Rerouting primarily involves the
- **A** formation of new connections in order to establish alternative neural pathways.
- **B** removal of excess neurons and synaptic connections.
- **C** formation of filigree appendages on the post-synaptic neuron.
- **D** formation of dendritic spines on the post-synaptic neuron.

16 Synaptic plasticity
- **A** only involves the process of long-term potentiation.
- **B** is defined as the ability of the entire brain and its neural networks to change, grow and reorganise.
- **C** involves the release of GABA when forming and storing a memory.
- **D** is defined as the specific changes that occur within the synapse, between neurons.

Short-answer questions

17 Outline two differences between the somatic and autonomic nervous systems. (4 marks)

18 Kira is cooking spaghetti bolognese for her sister Verity. While she prepares the finishing touches to the meal, the oven timer goes off, letting her know that the garlic bread she has baked is ready. As Kira reaches into the oven to take it out, she begins to salivate and her stomach rumbles in response to the delicious smell wafting out of the oven.
- **a** Describe what is meant by a conscious response and provide an example from the scenario. (2 marks)
- **b** Use another example to distinguish the response you chose in part **a** from an unconscious response. (2 marks)
- **c** Identify one role of Kira's brain while she prepares dinner for her sister. (1 mark)
- **d** As Kira reaches into the oven to take out the garlic bread, her forearm brushes the side of the oven. Her arm quickly withdraws, and she realises that she has burned herself. Identify the type of response involved in Kira's arm quickly withdrawing and outline the neural process involved. (4 marks)
- **e** Explain why Kira's response in part **d** is considered to be adaptive for her. (2 marks)

19 With reference to GABA, explain how a neural message is communicated at the synapse between two neurons. (3 marks)

ISBN 978-1-009-25416-8 Gallagher et al

20 Professor Rankin plans to conduct a study to determine whether changes to dopamine levels in the brain are linked to computer gaming addiction in males aged 14–16 years. She and her team believe that gaming addiction occurs because of depleted levels of the modulating neurotransmitter dopamine in the reward pathway of the brain over time.

Professor Rankin wishes to observe the patterns of brain activity and levels of dopamine associated with computer gaming. She plans to obtain teenage male volunteers who respond to an advertisement to schools in her local area. She wishes to have a control group of 20 teenage males who do not play computer games at all, who will be compared to an experimental group of teenage males who play computer games for more than 20 hours a week, a level which she considers problematic.

Brain scanning will be used to observe the neural activity of dopaminergic neurons (neurons that produce dopamine) and therefore the level of dopamine present in the reward pathway before and after playing a computer game in the laboratory.

a Provide two roles of dopamine as a neuromodulator within the nervous system. (2 marks)

b Using your understanding of the relationship between dopamine and computer gaming, predict an observation Professor Rankin is likely to make when measuring the neural activity of dopaminergic neurons in the reward pathway of teenage males in the control group compared to those in the experimental group. (1 mark)

c Construct an aim for Professor Rankin's research. (1 mark)

d Identify the independent variable. (1 mark)

e Identify a possible source of error and explain how Professor Rankin could use a controlled variable to account for this. (2 marks)

f Identify the DV. (1 mark)

g Formulate a hypothesis for the study. (3 marks)

21 Distinguish between the neuromodulators dopamine and serotonin. (2 marks)

ISBN 978-1-009-25416-8 Gallagher et al

ISBN 978-1-009-25416-8 Gallagher et al

UNIT 3 HOW DOES EXPERIENCE AFFECT BEHAVIOUR AND MENTAL PROCESSES?

CHAPTER 4 STRESS AS AN EXAMPLE OF A PSYCHOBIOLOGICAL PROCESS

Introduction

Stress is an unavoidable part of our lives. Daily hassles such as waiting in a queue at the supermarket checkout, life events such as completing your final VCE examinations and receiving your ATAR, and traumatic events such as being in a car crash, will result in some level of stress. These experiences cause familiar symptoms such as increased heart rate, muscle tension, headaches, upset stomach and sleepless nights.

The bad news is that stress can affect us both psychologically, within our mind, and biologically, within our body. In particular, it can affect our nervous system functioning, which you already have an understanding of from Chapter 3.

The good news is that stress is normally an adaptive response that primes you to confront a challenge if it gets out of hand or is unnecessary, it can be managed. In this chapter, you will explore the different ways in which stress can affect nervous system functioning, the role that our thought processes can have on the stress we experience, and how emerging research indicates there is a two-way relationship between our brain and gut when it comes to experiencing stress and anxiety.

Curriculum

Area of Study 1 Outcome 1
How does the nervous system enable psychological functioning?

Study Design:	Learning intentions – at the end of this chapter I will be able to:
• Internal and external stressors causing psychological and physiological stress responses, including the flight-or-fight-or-freeze response in acute stress and the role of cortisol in chronic stress	**4A Internal and external stressors** **4A.1** Understand that internal and external stressors cause psychological and physiological stress responses, including the flight-or-fight-or-freeze response, and understand the role of cortisol in chronic stress **4A.2** Define 'stress', 'stressor' and 'stress response' **4A.3** Distinguish between internal and external stressors and provide examples of each **4A.4** Explain what is meant by acute stress **4A.5** Explain the features of the flight-or-fight-or-freeze response as an example of an acute stress response **4A.6** Apply my understanding of the flight-or-fight-or-freeze response

ISBN 978-1-009-25416-8 Gallagher et al

Study Design:	Learning intentions – at the end of this chapter I will be able to:
	4A.7 Explain what is meant by chronic stress **4A.8** Describe the role of the hormone cortisol in chronic stress responses **4A.9** Apply my understanding of the role of cortisol to examples of chronic stress
• The gut–brain axis (GBA) as an area of emerging research with reference to the interaction of gut microbiota with stress and nervous system in the control of psychological processes and behaviour	**4B The gut–brain axis** **4B.1** Understand the GBA, and how stress can interact with gut microbiota and the nervous system, affecting our psychological processes and behaviour **4B.2** Explain the structure and role of the GBA **4B.3** Understand the relationship between gut microbiota and the nervous system **4B.4** Explain how stress can influence the relationship between gut microbiota and the nervous system and how this affects our psychological processes and behaviours **4B.5** Apply the relationship between stress, gut microbiota and the nervous system to psychological processes and behaviours
• The explanatory power of Selye's general adaptation syndrome (GAS) as a biological model of stress, including alarm reaction (shock/counter shock), resistance and exhaustion	**4C A biological model of stress** **4C.1** Understand the explanatory power of Selye's GAS as a biological model of stress **4C.2** Describe the key features of Selye's GAS, including the stages of alarm reaction (shock/counter shock), resistance and exhaustion **4C.3** Apply my understanding of the GAS to explain real-world examples of responses to stressful events **4C.4** Evaluate the explanatory power of the GAS as a biological model of stress, by outlining its strengths and limitations
• The explanatory power of Lazarus and Folkman's transactional model of stress and coping to explain stress as a psychological process (primary and secondary appraisal only)	**4D A psychological model of stress** **4D.1** Describe Lazarus and Folkman's transactional model of stress and coping, including the stages of primary and secondary appraisal **4D.2** Understand how Lazarus and Folkman's transactional model of stress and coping explains stress as a psychological process **4D.3** Outline why Richard Lazarus and Susan Folkman propose that stress is a psychological process that is unique to the individual **4D.4** Apply my understanding of the transactional model of stress and coping to explain real-world examples of responses to stressful events **4D.5** Evaluate the explanatory power of the transactional model of stress and coping, as a model used to explain stress as a psychological process **4D.6** Compare and contrast the GAS and the transactional model of stress and coping as models used to explain stress

ISBN 978-1-009-25416-8 Gallagher et al

Study Design:	Learning intentions – at the end of this chapter I will be able to:
• Use of strategies (approach and avoidance) for coping with stress and improving mental wellbeing, including context-specific effectiveness and coping flexibility	**4E** **Strategies for coping with stress and improving mental wellbeing** **4E.1** Identify and describe strategies for coping with stress and improving mental wellbeing **4E.2** Explain and apply strategies for coping with stress and improving mental wellbeing **4E.3** Explain the importance of context-specific effectiveness and coping flexibility in relation to the successful use of coping strategies

Key Science Skills

- Determine appropriate investigation methodology: case study; classification and identification; controlled experiment; correlational study; fieldwork; literature review; modelling; product, process or system development; simulation
- Work independently and collaboratively as appropriate and within identified research constraints, adapting or extending processes as required and recording such modifications

Glossary

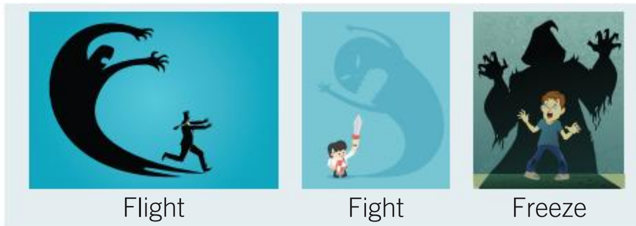
Acute stress
Alarm reaction stage
Appraisal
Approach strategy
Avoidance strategy
Benign/positive
Challenge
Chronic stress
Context-specific effectiveness
Coping
Coping flexibility
Coping strategy
Cortisol
Countershock
Enteric nervous system (ENS)
Exhaustion stage
External stressor
Flight-or-fight-or-freeze response
General adaptation syndrome (GAS)
Gut
Gut microbiota
Gut–brain axis (GBA)
Harm/loss
Internal stressor
Irrelevant
Microbe
Primary appraisal
Resistance stage
Secondary appraisal
Shock
Stress
Stressor
Threat
Transactional model of stress and coping
Vagus nerve

ISBN 978-1-009-25416-8 Gallagher et al

Concept map

The flight-or-fight-or-freeze response and the role of cortisol in chronic stress

4A Internal and external stressors



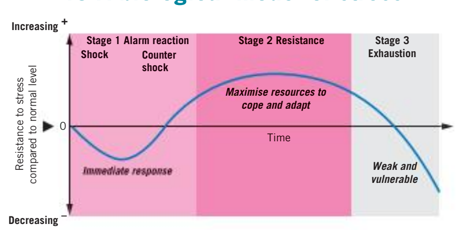
Emerging research into the interaction of gut microbiota with stress and nervous system

Selye's general adaptation syndrome, including alarm reaction (shock/counter shock), resistance and exhaustion)

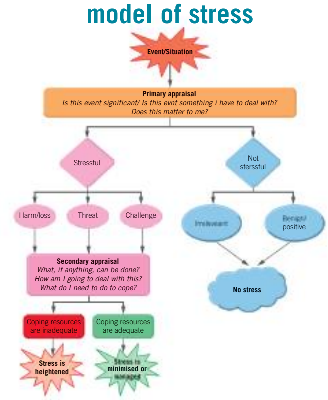
Lazarus and Folkman's transactional model of stress and coping (primary and secondary appraisal)

4B The gut–brain axis

4C A biological model of stress



4D A psychological model of stress



Use of different strategies such as approach and avoidance for coping with the physiological and psychological symptoms of stress

4E Strategies for coping with stress and improving mental wellbeing

See the Interactive Textbook for an interactive version of this concept map interlinked with all concept maps for the course.

ISBN 978-1-009-25416-8 Gallagher et al

4A Internal and external stressors

Study Design:
Internal and external stressors causing psychological and physiological stress responses, including the flight-or-fight-or-freeze response in acute stress and the role of cortisol in chronic stress

Glossary:
Acute stress
Chronic stress
Cortisol
External stressor
Flight-or-fight-or-freeze response
Internal stressor
Stress
Stressor

ENGAGE

Stress levels in healthcare workers during the COVID-19 pandemic

During the COVID-19 pandemic, healthcare workers were on the front line, participating directly in the care, diagnosis and treatment of patients with COVID-19. This exposed them to a higher risk of developing chronic stress, psychological distress, and many other mental health symptoms. In a study conducted with a population of around 200 healthcare workers at a hospital in Buenos Aires, Argentina, workers provided hair samples that were tested for the hormone cortisol. In this section, you will learn about the role of cortisol (a hormone) in the stress response and how it is associated with chronic stress.

Figure 4A–1 Healthcare workers experienced high levels of stress working during the COVID-19 pandemic.

The healthcare workers also completed surveys about their perceived stress, social support, burnout scale and life event scales. The results showed that 40% of the healthcare workers had hair cortisol levels outside the healthy reference range. These higher cortisol levels were correlated with higher perceived stress levels, as well as emotional exhaustion and burnout. This study concluded that healthcare workers were subjected to significantly increased levels of stress and burnout, which could have had long-term effects on their health that would need to be managed.

EXPLAIN

Stressors and the stress response

Stressor
any event that causes stress or is perceived as a threat and a challenge to our ability to cope

We experience many events that can be stressful. These range from minor irritating events, such as being stuck in a traffic jam or having a lot of homework, through to challenging, life-changing events such as a significant injury or losing your home in a bushfire. Stressful events can also be positive, such as being offered entry into two equally exciting university courses. Any event that causes stress is referred to as a **stressor**.

ISBN 978-1-009-25416-8 Gallagher et al

When we feel stressed, we experience both psychological and biological symptoms (Figure 4A–2). This is because **stress** is a psychobiological process, a state of mental, emotional and physiological tension in response to something that is perceived as challenging or threatening our ability to cope. This 'something' is a stressor. The biological response includes various symptoms, such as an increase in heart rate and muscle tension. Psychologically, we experience feelings and thoughts that are unique to us and subjective, such as fear, anxiety or excitement and anticipation. We will generally only experience stress if we believe that the demands of the situation are threatening our ability or resources to cope. However, if we believe we can cope, then an event may be perceived as challenging, but not necessarily as a stressor. For example, some people may find a job interview extremely stressful and anxiety provoking, but others may see it as an opportunity to highlight their skills to a potential employer.

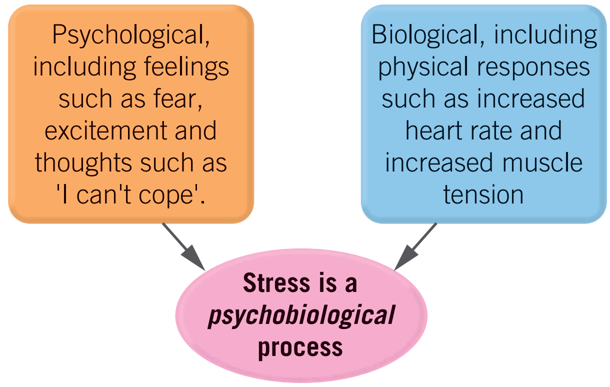


Figure 4A–2 Stress is a psychobiological process involving psychological components, such as thoughts and feelings, and biological components, such as increased heart rate and muscle tension.

Stress a state of mental, emotional and physiological tension, resulting from a stressor

VIDEO 4A–1 STRESS AS A PSYCHO-BIOLOGICAL PROCESS

Figure 4A–3 Some situations or events that can cause stress: a traffic jam, schoolwork, arguing with a loved one or losing your home in a bushfire

Check-in questions – Set 1

1 Define 'stress'.
2 Use an example to explain why stress is considered to be a psychobiological process.
3 Use an example to explain the relationship between stress and a stressor.

Internal stressor a cause of stress that originates within an individual; can be both psychological and biological/ physiological

Internal and external stressors

Stressors can be classed as either internal or external. Both the physical pain from an injury and the high expectations you have of yourself are **internal stressors**. These are causes of stress that originate within an individual and can be both psychological and biological.

Figure 4A–4 Some internal stressors are having high expectations and the pain from an injury.

Pain that results from an injury is a biological internal stressor because it is caused by physiological damage to cells in the body, activating pain receptors in the nervous system, thus potentially resulting in stress. Other biological internal stressors are having an illness, disease or condition that causes unpleasant physical symptoms; for example, a virus, cancer or chronic fatigue syndrome, which cause aches and pains or a lack of energy. These physical symptoms could impair your ability to complete daily tasks, meet deadlines or attend school or work, therefore causing you stress.

Psychological internal stressors result from a person's mental processes – their thoughts, mindset and feelings such as fear. Having high expectations of yourself is a psychological internal stressor because it places unrealistic pressure on you to be perfect, leading to negative thoughts and inevitably causing you stress.

External stressor a cause of stress that originates from outside an individual, such as an event or environmental extreme

External stressors are sources of stress that originate outside of an individual. They include environmental events and social or cultural stressors, such as:

- loud noises and extreme temperatures
- life events, such as planning a wedding or graduating from high school
- loss of a significant relationship, such as through divorce or death
- environmental catastrophes such as earthquakes, bushfires and floods.

ISBN 978-1-009-25416-8 Gallagher et al

Figure 4A–5 summarises the features of internal and external stressors.

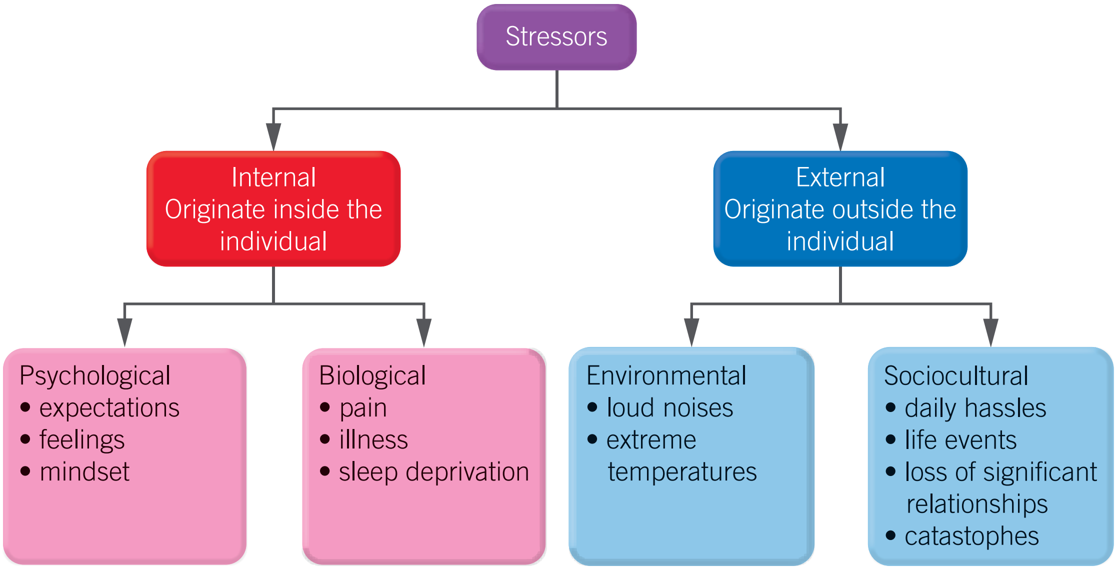
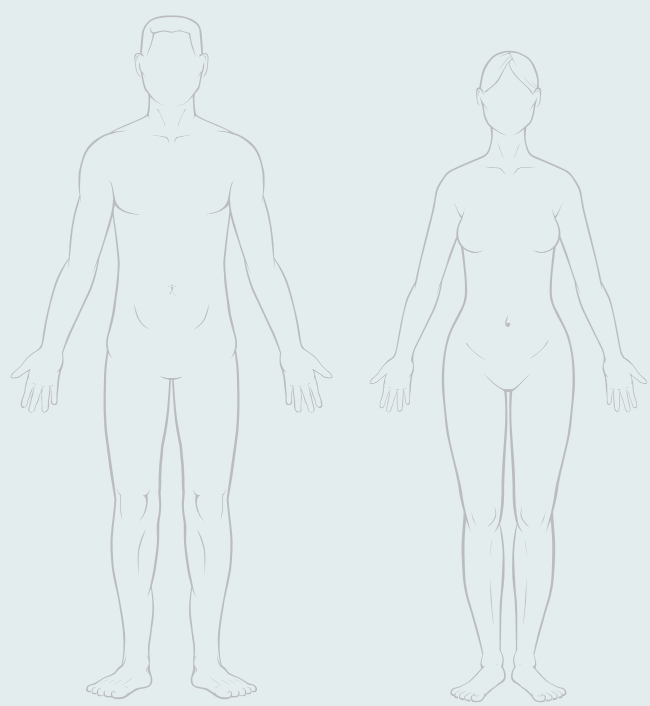


Figure 4A–5 The features of internal and external stressors

ACTIVITY 4A–1 YOUR SOURCES OF STRESS

DOCUMENT 4A–1 YOUR SOURCES OF STRESS

To distinguish between the different internal and external stressors in your life right now, draw an outline of your body such as the one shown here (or download a copy of this activity from the Interactive Textbook). Inside the body outline, write all the internal stressors you are currently experiencing. Outside the body outline, write all the external stressors you are currently experiencing.



Are you experiencing more internal or more external stressors? Why? Even though they can be distinguished from one another, how might internal and external stressors be related? Discuss this by referring to examples from your own life.

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 2

1 Distinguish between internal and external stressors.
2 Identify whether these stressors are internal or external.
   a A stomach-ache
   b A deadline for an assignment
   c A heatwave of 40°C
   d A loud party next door when you are trying to sleep
   e Feeling overwhelmed
   f A headache
   g Moving house and changing schools
   h Having a mindset that you are going to fail your next SAC
   i An argument with your best friend
   j Expecting to get a 99.95 ATAR

Acute and chronic stress

Acute stress stress that usually occurs because of a sudden threat and only lasts for a short time

Chronic stress stress that lasts for a long time

Our environment is constantly changing, which exposes us to a variety of stressors of different severity and time frames. **Acute stress** usually occurs because of a sudden threat that only lasts for a short time and can include situations such as sitting an exam, starting a new job, giving a speech, or being faced with a work deadline. This type of stress can be beneficial because it can help us deal more effectively with the challenge. However, it can also be more intense and involve life-threatening situations, such as being the victim of an assault. Once the stressor is removed or is successfully dealt with, we tend to make a quick recovery, and our body promptly returns to homeostasis.

In contrast, **chronic stress** involves a prolonged and constant feeling of stress. This might be due to social isolation and loneliness, relationship problems, bullying, or living in an unsafe environment such as a war zone. Chronic stress tends to be worse for your body because it can suppress your immune system, upset your digestive and reproductive systems, increase the risk of heart attack and stroke, and speed up the ageing process. It can leave you more vulnerable to anxiety, depression and other mental health problems.

Despite being worse for your ongoing physical health and mental wellbeing, chronic stress tends to be less intense or severe than acute stress. However, recovering from chronic stress can take a lot longer, given the ongoing problems it can cause.

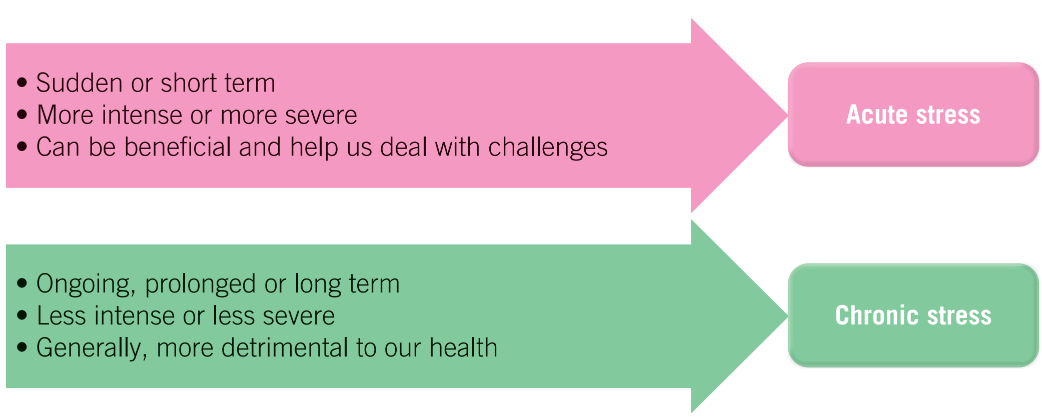


Figure 4A–6 The features of acute and chronic stress

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 3

1 Describe acute stress and provide an example.
2 Describe chronic stress and provide an example.
3 Explain why chronic stress is detrimental to our ongoing physical and mental health.
4 Create a Venn diagram to compare and contrast acute and chronic stress.

Flight-or-fight-or-freeze response

An example of an acute stressor is an upcoming interview for the school captaincy. If you really wanted the position and you were worried about whether you had done enough extracurricular work to secure the captaincy, you might experience a variety of physiological symptoms in the lead-up to your interview, such as a racing heart rate, sweaty palms or an upset stomach. These symptoms are the result of involuntary, biological processes that we all experience automatically, irrespective of the type of stressor to which we are exposed.

These physiological changes occur very rapidly, without our awareness, because of the **flight-or-fight-or-freeze** response. This is an automatic, biological response to a perceived stressor that increases our chances of survival in our environment. It is an acute stress response and is also considered to be adaptive, in that it minimises possible harm, and enables us to deal with the stressor most effectively by instinctively adopting one of three options:

- *a 'flight' response* – which involves evading or escaping the stressor; for example, quickly running out of your home to escape an intruder
- *a 'fight' response* – which involves dealing with the stressor directly; for example, picking up a cricket bat to potentially hit an intruder in your home
- *a 'freeze' response* – which involves the immobilisation of the body such as minimising movement or vocal sounds to avoid detection; for example, hiding quietly in a cupboard when an intruder is in your home.

Flight-or-fight-or-freeze response an automatic biological response to a perceived stressor that increases our chances of survival in our environment

Flight Fight Freeze

Figure 4A–7 In a flight response, we run away or escape. In a fight response, we respond to deal with or confront the stressor. In a freeze response, we hide or remain still to avoid the stressor.

Fight or flight responses

In fight or flight responses, you experience similar physiological responses, such as increased heart rate, sweaty palms and dilated pupils as a part of an acute stress response. This is because the fight or flight response is activated by the sympathetic subdivision of the autonomic nervous system. As was discussed in Chapter 3, the autonomic nervous system works unconsciously, without our awareness, to regulate our arousal and internal bodily functions. In the case of a fight or flight response, our arousal is increased because a

LINK 3A THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS

threat or stressor has been identified by our nervous system. This increased arousal helps prepare us to deal with the situation and increase our chances of survival.

Table 4A–1 includes some examples of how these changes may benefit us in a fight or flight situation.

Table 4A–1 The adaptive benefit of different fight or flight responses for survival

Physiological changes	Adaptive benefit of these changes
Increased heart rate, breathing rate and blood pressure	To quickly transport oxygenated blood to the muscles in our extremities to prepare them for action
Dilated pupils	To increase the amount of light entering the eye to potentially see more clearly
Slowed digestion rate and decreased salivation	To divert energy to where it is needed most, such as the muscles in our extremities
Increased sweat production	To keep the body cool when increased energy is expended
Increased muscle tension	To prepare our muscles for action

Freeze response

The freeze response is also thought to have adaptive value. When attacked by a predator, some animals freeze or 'play dead'. This type of response is often referred to as 'tonic immobility' and includes motor and vocal inhibitions. It is also thought that freezing is a way for the nervous system to prepare to immediately shift into fight or flight action. Therefore, freezing is not considered to be a passive state but rather a parasympathetic brake on certain body systems. For example, our skeletal muscles will be inactive in order to conserve energy but will still remain ready for action by being slightly tense. If we are hiding from an intruder in our home, the freeze response would enable us to remain quiet and still to avoid detection. However, if we could sense that we were about to be found, it would enable us to run and escape if needed, because our muscles are prepared to do so.

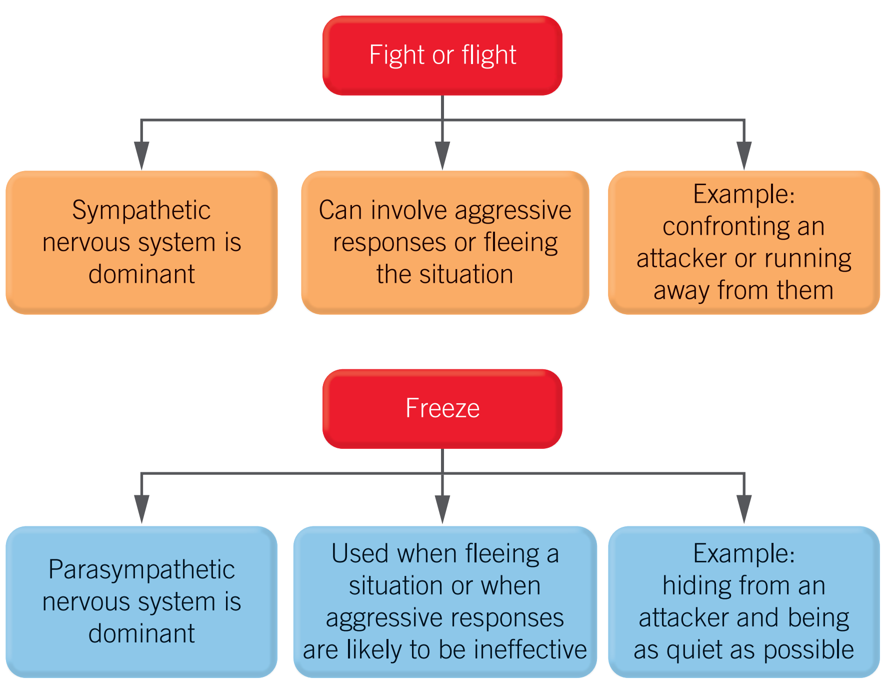


Figure 4A–8 A brief summary of the key features that distinguish a freeze response from a fight or flight response

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 4

1 a What is the flight-or-fight-or-freeze response?
  b Explain why it is considered to be adaptive.
2 Why is a flight-or-fight-or-freeze response also considered to be an example of acute stress?
3 Use an example other than those in the text to explain the fight, flight and freeze responses.
4 Using the table, list two different physiological changes that occur as a result of the flight-or-fight-or-freeze response and explain their potential adaptive benefit for someone completing their driving test to obtain their P plates.

Physiological changes	Adaptive benefit

5 Provide one similarity and one difference between a fight or flight response and a freeze response.

Role of cortisol in chronic stress

When we are stressed, a cascade of hormonal and physiological responses occur. If we perceive an event to be stressful, the adrenal glands, which sit on top of each of the kidneys, are activated as a part of the flight-or-fight-or-freeze response (Figure 4A–9). A surge of stress hormones, including adrenaline (or epinephrine), occurs and is associated with the various biological responses we experience, such as increased heart rate and respiratory rate. In times of prolonged and chronic stress, when the stressor persists and the body continues to perceive it as a threat, another stress hormone called **cortisol** is produced and is released from the adrenal cortex, the outer layer of the adrenal glands (Figure 4A–10). Cortisol allows the body to continue to stay on high alert over long periods of time.

Cortisol
a hormone produced by the adrenal glands that regulates a wide range of bodily processes, including metabolism, and is released in response to stress

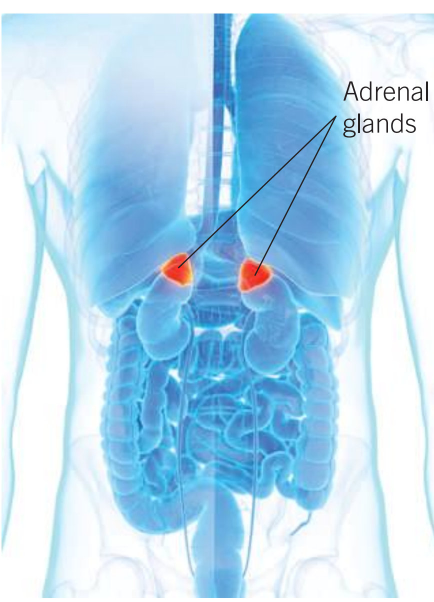


Figure 4A–9 The adrenal glands are small, triangular-shaped glands on top of both kidneys. They produce hormones that help regulate your metabolism, immune system, blood pressure and response to stress.

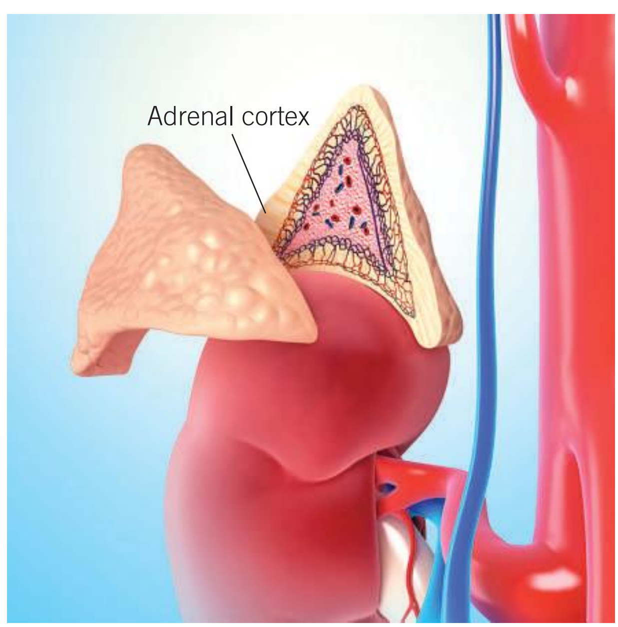


Figure 4A–10 Cortisol is produced in the adrenal cortex, which is the outer layer of each adrenal gland.

ISBN 978-1-009-25416-8 Gallagher et al

Cortisol regulates a wide range of processes throughout the body, including metabolism and the immune response. It is released directly into the bloodstream and transported throughout the body. Almost every cell in your body contains receptors for cortisol, so it can have many different actions depending on the cells it is acting upon. In conjunction with other hormones, cortisol modifies the body's glucose levels, regulates metabolism, acts as an anti-inflammatory agent, controls salt and water balance and influences blood pressure. It also has a very important role in helping the body respond to stress. It predominately benefits us in times of chronic stress by:

- boosting our energy levels and increasing blood glucose levels
- heightening our alertness, increasing the brain's use of glucose
- increasing the body's ability to repair tissue
- diverting energy from non-essential bodily functions such as digestion, growth and reproduction.

Despite the benefits of cortisol (Figure 4A–11), high levels of cortisol in our bloodstream for prolonged periods can be detrimental. Cortisol suppresses the immune system, making us more susceptible to colds and contagious illnesses. When we experience ongoing chronic stress, our risk of cancer and autoimmune diseases, as well as psychiatric conditions such as anxiety and depression, increases.

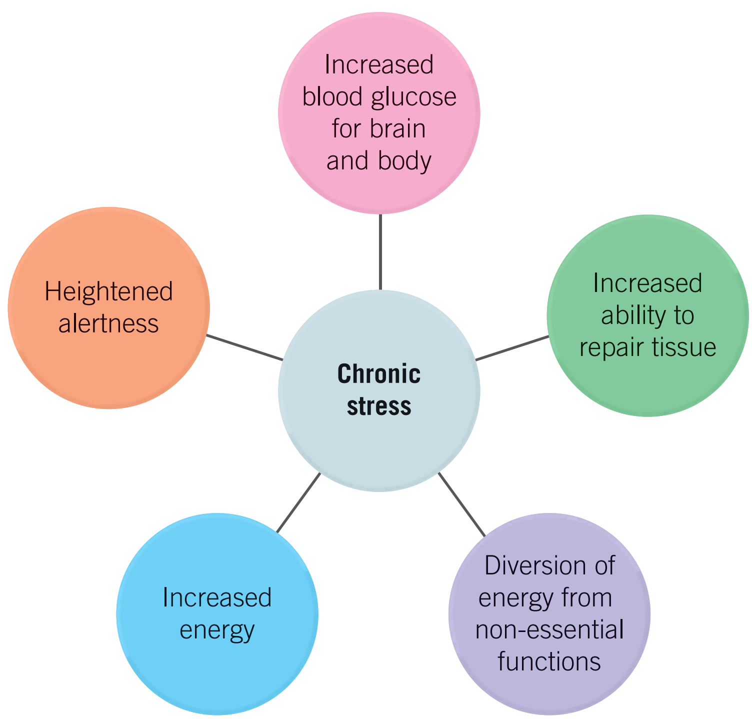


Figure 4A–11 The benefits of cortisol in times of chronic stress

Check-in questions – Set 5

1 What is cortisol?
2 List the general functions of cortisol within the body.
3 How does cortisol benefit us in times of stress?
4 Why is having high levels of cortisol in the body for a prolonged period problematic?

ISBN 978-1-009-25416-8 Gallagher et al

4A SKILLS

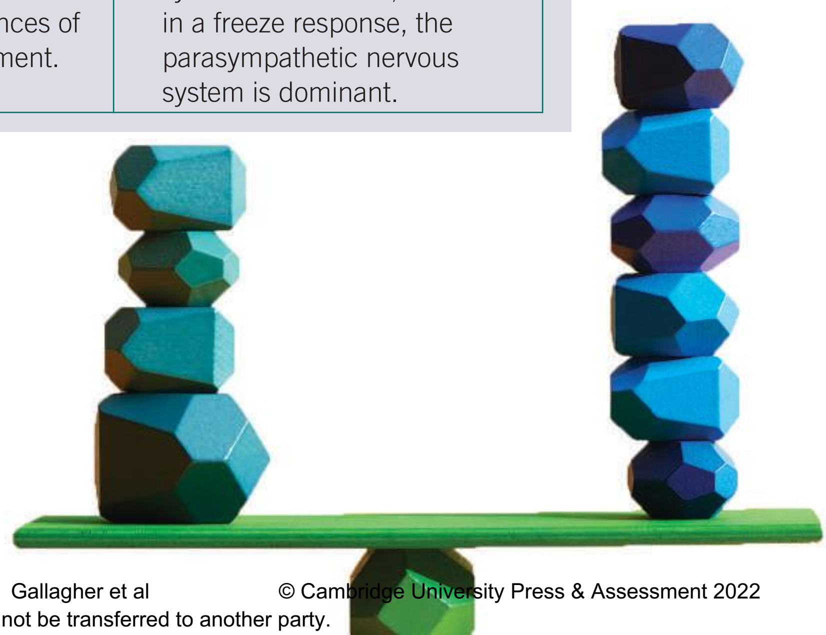
VIDEO 4A–2
SKILLS: COMPARING CONCEPTS

Comparing concepts throughout the course for deeper understanding
Already, in this first section of the chapter, you will notice how useful it is to compare and contrast different concepts when trying to understand them at a deeper level. Even if the key knowledge dot point does not explicitly use a word such as 'distinguish', you could still be asked to do it in assessment questions on any dot point. You might find it useful to put together a summary table, Venn diagram or other tool to identify the key similarities and differences between important concepts. When stating differences, make sure you use a word or phrase such as 'whereas' or 'in contrast to'. If possible, state more than one similarity and more than one difference for each comparison made.

Table 4A–2 is an example of a summary table for the main concepts covered in this section.

Table 4A–2 A summary of the similarities and differences between concepts

Concept for comparison	Similarities	Differences
Internal and external stressors	• Both are stressors that cause a stress response. • Both can cause psychological and biological stress responses.	• Internal stressors originate within the person, whereas external originate outside of the individual in their environment. • Internal stressors tend to include biological and psychological stressors, whereas external stressors can also include sociocultural stressors.
Acute and chronic stress	• Both are stress responses. • Both increase arousal and activate the sympathetic nervous system.	• Acute stress is short term, whereas chronic stress is prolonged or long-term. • Acute stress is more intense, whereas chronic stress is less intense.
Flight-or-fight-or-freeze response	• Both prepare us for an encounter with a perceived stressor. • Both increase our chances of survival in the environment.	• In a flight-or-fight response, the sympathetic nervous system is dominant, whereas in a freeze response, the parasympathetic nervous system is dominant.



ISBN 978-1-009-25416-8 Gallagher et al

Section 4A questions

1 Explain how a stressor and stress are related.

2 A student is nervous about presenting at the next school assembly and speaking in front of their peers. Using examples, explain why the stress response to this event would be a psychobiological one.

3 a Provide an example of a source of acute stress.
  b Provide an example of a source of chronic stress.
  c How could a person's response to the source of stress you identified in part **a** be beneficial for them?
  d Why would the source of stress you identified in part **b** be detrimental to a person's mental and physical health?

4 Dinushi is out for her daily walk when a car backfires, startling her. She notices her palms are sweaty, her heart rate has increased, and her breathing rate is faster. However, once she realises it is only a car and not a gunshot, she immediately feels relieved.
  a Identify the response that Dinushi is experiencing and explain why it is adaptive.
  b Why is Dinushi's response to the car backfiring an example of acute stress?
  c Choose two examples of Dinushi's physiological responses to the car backfiring, and explain the adaptive value of each response.

5 a Where in the body is cortisol produced and released?
  b Provide two functions of cortisol in the body and how these might be adjusted to benefit us.
  c How is cortisol linked to chronic stress and an increased susceptibility to illness?

Figure 4A–12 The eastern hog-nosed snake, found in parts of North America, 'plays dead' in the face of predators. It will roll onto its back, stick its tongue out, and even defecate to convince an attacker that it is no longer alive.

ISBN 978-1-009-25416-8 Gallagher et al

The gut–brain axis

Study Design:
The gut–brain axis (GBA) as an area of emerging research with reference to the interaction of gut microbiota with stress and nervous system in the control of psychological processes and behaviour

Glossary:
Enteric nervous system (ENS)
Gut
Gut microbiota
Gut–brain axis (GBA)
Microbe
Vagus nerve

ENGAGE

Using faecal transplants to treat mental illness

Our nervous system and gut are connected in a complex way that researchers are still trying to fully understand. As a result, many people who struggle for years with mental health issues are willing to try experimental treatments such as a transplant of faeces from a healthy person into their own gut.

Kerwin, a 45-year-old industrial engineer who lives in Peru, tried many medications for his depression and anxiety, with little success. As a result, he sank into a deep depression. 'I kept crying, feeling trapped. I had many suicidal thoughts.' The illness affected all aspects of Kerwin's life; he could not work, and it was very difficult for his wife and five children. While Kerwin was in the depths of his depression he came across a website describing a radical new treatment for bipolar disorder – faecal transplant. This involves taking stools from a person with a 'healthy' gut microbiome and transplanting it into the gut of another.

Kerwin used his wife's stools and after several treatments, he noticed gradual improvement in his symptoms. 'It took at least two months,' he said. 'I was feeling much better and I was totally recovered by three months in, to the point that I was able to go back to work.' He also maintained his healthier gut by sticking to a microbiome-friendly diet, which included more vegetables, high fibre and probiotics (tablets with live bacteria in them). He now takes a more holistic view of maintaining his mental health and wellbeing.

Gut–brain axis (GBA) the connection between the central nervous system and the enteric nervous system, that enables bidirectional communication between the brain and the gastrointestinal tract

Enteric nervous system (ENS) a subdivision of the autonomic nervous system; it consists of nerve cells lining the gastrointestinal tract and controls the digestive system

VIDEO 4B–1 THE GUT-BRAIN AXIS

EXPLAIN

What is the gut–brain axis?

The **gut–brain axis (GBA)** refers to the connection that exists between the central nervous system (CNS) and a further division of the autonomic nervous system called the **enteric nervous system (ENS)**. The GBA enables bidirectional communication between the brain and the gastrointestinal tract. This means that communication can occur in both directions, from brain to gut and gut to brain.

Figure 4B–1 The small and large intestines are part of the enteric nervous system, which runs from the oesophagus to the rectum and contains more than 200 million neurons.

Enteric nervous system

Alongside the sympathetic and parasympathetic nervous systems, the ENS controls the digestive system and is directly connected to the CNS. It is hidden in the walls of the digestive system and is similar in structure and function to the brain. It comprises 200–600 million sensory, motor and interneurons that line the gastrointestinal tract

ISBN 978-1-009-25416-8 Gallagher et al

from the lower part of the oesophagus to the rectum. This is many more neurons than are in any other peripheral organ and is similar to the number of neurons in our spinal cord.

The ENS coordinates the rhythmic muscle contractions that move material along the digestive tract; it also regulates gastric acid secretion, changes in local blood flow and the release of gut hormones; and it interacts with the immune system. As in other peripheral nervous systems, the connections between the enteric nervous system and the brain contain both afferent (sensory) nerves and efferent (motor) nerves. The bidirectional communication that occurs between the CNS and the ENS happens via the vagus nerve and gut microbiota.

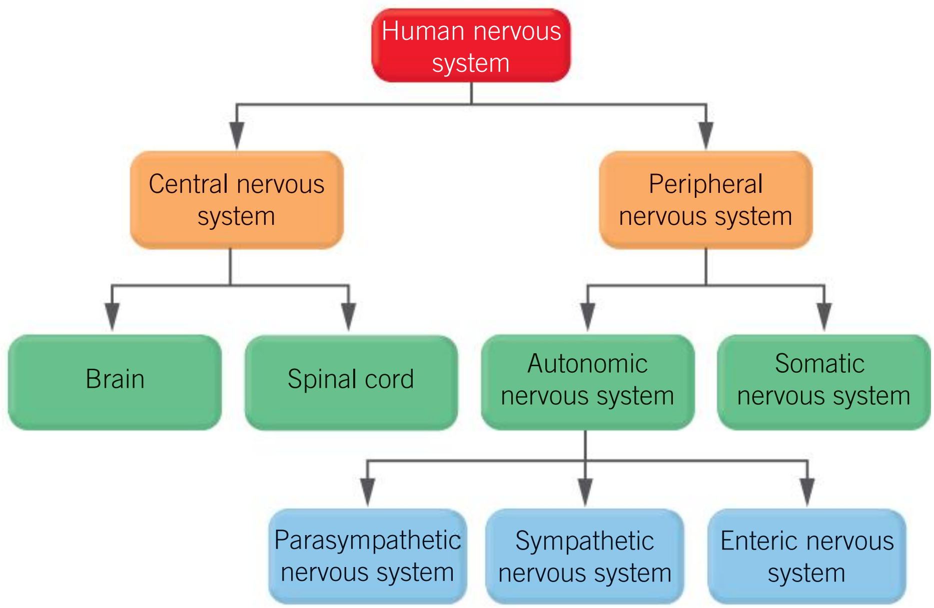


Figure 4B–2 The divisions of the human nervous system, including the enteric nervous system, one of the subdivisions of the autonomic nervous system

Vagus nerve

Vagus nerve
a nerve that connects the brain (central nervous system) to organs within the autonomic nervous system, via nerve fibres that directly link organs such as the lungs, heart, oesophagus and intestinal tract

The **vagus nerve** is one of the body's biggest nerves, connecting the brain (CNS) to organs within the autonomic nervous system, via nerve fibres that directly link to the pharynx (throat), larynx (voice box), trachea (windpipe), lungs, heart, oesophagus and intestinal tract. It originates in the brain stem and extends to the colon.

The vagus nerve controls many crucial bodily functions, including mood, immune response, digestion and heart rate. It establishes one of the connections between the brain and the gastrointestinal tract. For example, information about the state of the gastrointestinal tract, including pain and discomfort from the gut and feelings of hunger and satiety (fullness), can be sent 'up' from the gut to the brain. Signals are also sent 'down' to the gut from the brain, such as initiating salivation and gastric acid secretion on smelling food and anticipating eating.

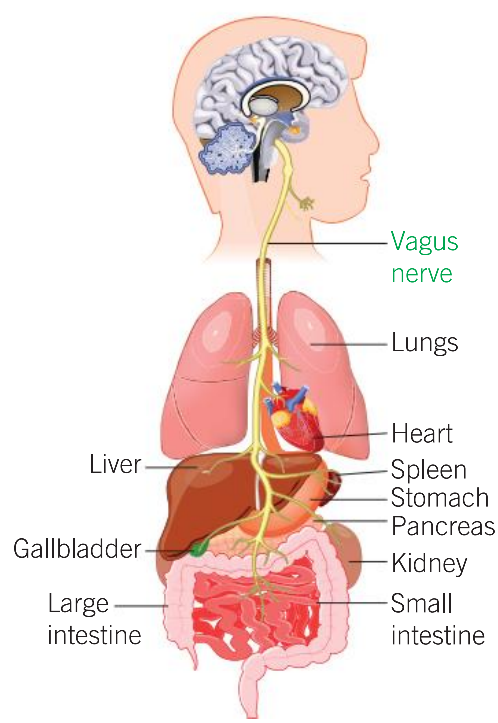


Figure 4B–3 The vagus nerve and its connection from the brain stem to the organs of the peripheral nervous system, such as the heart, lungs, stomach and intestinal tract

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 1

1 What is the gut–brain axis (GBA)?
2 What is meant by the GBA being able to communicate in a bidirectional manner?
3 Which nervous system is the enteric nervous system (ENS) a subdivision of?
4 What is the ENS made up of?
5 List three functions of the ENS.
6 Describe the vagus nerve.
7 Why is the vagus nerve an important part of the GBA?

Gut microbiota

Our **gut** contains more than 1000 microbe species, also referred to as **gut microbiota**. These **microbes** digest the components of our food to provide their own nutrition while also simultaneously providing us with energy and nutrients. Gut microbiota are also involved in the production of some neurotransmitters, which can affect the concentrations of related neurotransmitters in the brain. Interestingly, certain microbiota in the gut are involved in regulating the production, storage and release of neurotransmitters by neurons in the ENS. This can have effects within the ENS itself as well as enabling fast signals to be transmitted to the brain via the vagus nerve.

Gut
the gastrointestinal tract or long tube that starts at the mouth and ends at the anus

Gut microbiota
the microbe population found in the gut (digestive system)

Microbe
a microscopic living thing found in water, soil and the air

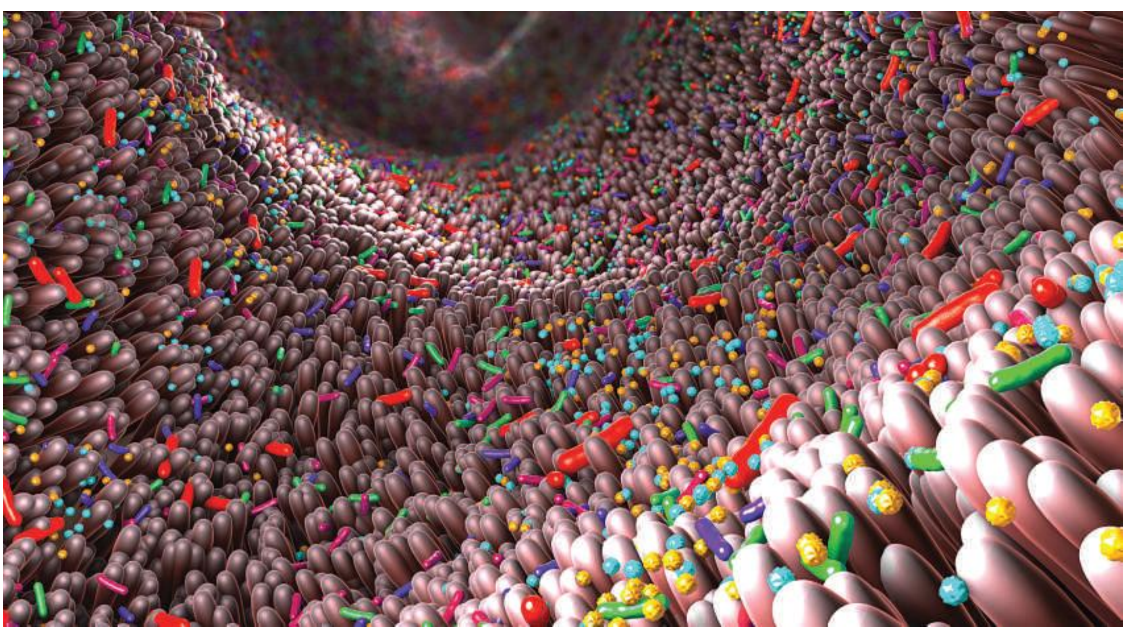


Figure 4B–4 A representation of microbiota in the human intestine. The pink is the intestinal lining (intestinal villi) and the coloured parts are different species of bacteria (microbes).

Ultimately, it is neurotransmitters that allow the bidirectional communication between the CNS and ENS to occur. The ENS uses more than 30 different neurotransmitters, just like the brain.

Emerging research indicates that neurotransmitters in the gastrointestinal tract affect the neuronal activity and cognitive functions of the brain. One study involves the neurotransmitter gamma-aminobutyric acid (GABA), which, as you learned in Chapter 3, is the main inhibitory neurotransmitter in the nervous system. In 2018, researchers at Weill Cornell Medicine in the United States determined that certain microbiota in the gut are associated with the production of GABA. The bacterium *Bacteroides* was found to produce GABA within the ENS.

LINK 3B NEUROTRANSMITTERS AND NEUROMODULATORS

ISBN 978-1-009-25416-8 Gallagher et al

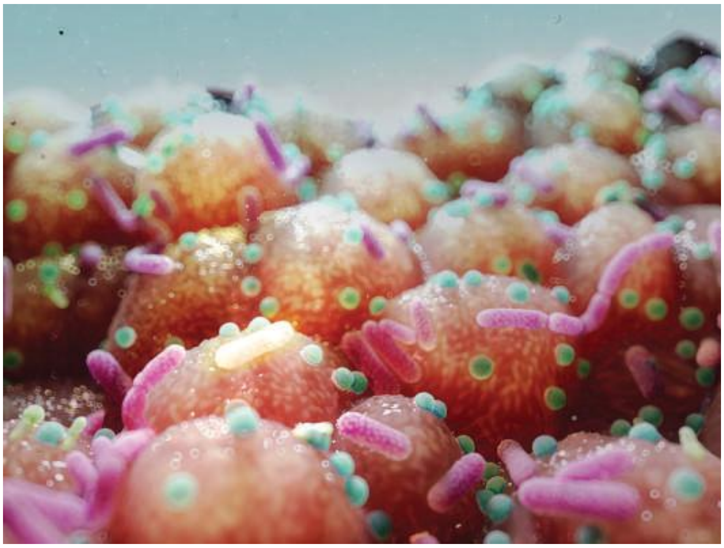


Figure 4B–5 A representation of bacteria (pink) on the lining of the colon, called the epithelium

The researchers scanned the brains of 23 people diagnosed with depression and found that those people with fewer *Bacteroides* in their gut had a stronger pattern of hyperactivity in their cerebral cortex, which has been associated with severe depression.

In further research with rats, the researchers also determined that *Bacteroides* produce GABA in the rat digestive tract, which can increase GABA levels in the brain. More GABA-producing bacteria in the gut were found to reduce learned helplessness (a symptom of depression) in those animals. It was also observed that rats with more *Bacteroides* were more likely to stay longer on an uncomfortably warm surface (a test of pain tolerance), perhaps because elevated GABA reduced their stress response.

Check-in questions – Set 2

1 What are gut microbiota and what is their main function?
2 How are gut microbiota linked to neurotransmitter levels in the brain?
3 Explain the relationship between bacteria such as *Bacteroides* and the neurotransmitter GABA.
4 What does research indicate about the link between the level of *Bacteroides* in the gut and depression?

Stress, gut microbiota and nervous system function

4A INTERNAL AND EXTERNAL STRESSORS LINK

Earlier in this chapter, you learned how chronic stress increases the levels of cortisol in the body. This has detrimental effects on our physical health, suppressing the immune system and increasing the risk of heart attack and stroke.

More recent research also indicates that chronic stress and increased levels of cortisol can have a profound impact on our gut microbiota as well as our psychological processes and behaviour. For example, rhesus monkeys and rats that were stressed by separation from their mothers early in life and had high cortisol levels, showed associated changes in their gut microbiota, which have been linked to anxiety and depression. Another study conducted in 2020 at Swansea University, United Kingdom, involved Atlantic salmon that were stressed because they were confined for two weeks. It was demonstrated that the fish had increased cortisol levels in their gut and that this was associated with significant changes to their microbiome.

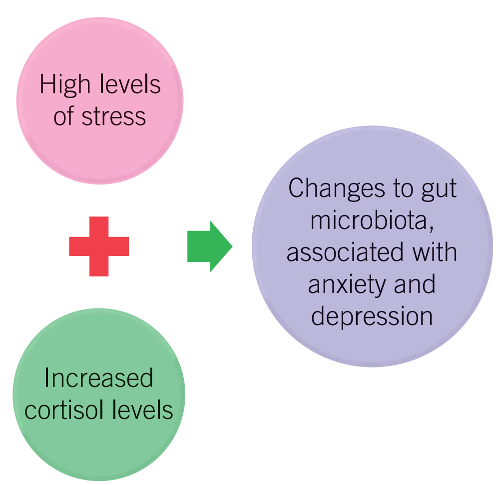


Figure 4B–6 The combined effects of stress and increased cortisol levels can lead to imbalanced gut microbiota, which is associated with anxiety-based behaviours and depression.

ISBN 978-1-009-25416-8 Gallagher et al

Some emerging research has looked at mice that were delivered surgically and raised under sterile conditions with no microbial exposure. These 'germ-free' mice also demonstrated that gut microbiota can influence stress-related behaviours, including those relevant to anxiety. These mice are particularly useful because they have very low levels of gut microbiota. Scientists can manipulate the microbiota to determine the effects of changes to specific gut microbes on behaviours compared with 'normal' mice that have a variety of gut flora or microbiota.

WORKSHEET 4B–1 ANALYSIS OF EMERGING RESEARCH INTO STRESS AND THE GUT

Figure 4B–7 Much emerging research into the relationship of stress and the gut has used germ-free mice and compared them with mice that have normal gut bacteria.

For example, when microbiota associated with stress were transferred to germ-free mice, the mice showed more anxiety-related behaviours than mice with normal gut microbiota. However, these effects were reversed when microbiota from normal mice were transferred to germ-free mice – the germ-free mice showed reduced anxiety-related behaviour compared with normal mice.

Gut microbiota have also been found to play a role in regulating stress-related changes in physiology, behaviour and brain function. In 2004, researchers found that germ-free mice who have less variety of gut flora had an exaggerated response to stress in comparison to normal (non-germ-free) mice. Importantly, the researchers also discovered that this could be reversed by colonising the gut of germ-free mice with specific bacteria their gut was depleted of. Results from subsequent studies with humans have continued to support a connection between gut microbiota and stress responsiveness, including reports that stress exposure early in life or in adulthood can change a person's microbiota composition, and that the types and variety of microbe populations we have in our gut can shape our stress responsiveness.

In summary:

- stress causes changes in gut microbiota and deficiencies in certain bacteria, which have been linked to anxiety and depression
- specific gut microbiota associated with stress have been shown to increase anxiety-related behaviours
- stress exposure early in life or in adulthood can change an organism's microbiota composition
- the types and variety of microbe populations we have in our gut can shape our stress responsiveness
- treatment with healthy microbiota can reduce anxiety-like behaviour and reduce stress responsiveness in humans and mice.

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 3

1 How do increased stress and high levels of cortisol affect our gut microbiota?
2 What is meant by 'germ-free' mice and why are they used in research about the links between gut microbiota and conditions such as anxiety?
3 Explain the relationship between microbiota associated with stress and anxiety-related behaviours in germ-free mice.
4 Explain the link between gut microbiota and the regulation of the stress response in 'germ-free' mice.

4B SKILLS

Analysis of 'emerging research'
The term 'emerging research' is used by VCAA in various dot points throughout the Psychology study design. 'Emerging research' includes any research topic that is particularly innovative and is a rapidly developing area of interest, usually with considerable scientific impact. In this case, no particular pieces of research are named or identified. This means that in an exam or assessment situation, you could be presented with any study conducted in this area of interest and be asked to implement one or more of the Key Science Skills to interpret the procedures and results, discuss conclusions and implications or evaluate its merits in terms of generalisability or validity.

ACTIVITY 4B–1 EMERGING RESEARCH INTO THE RELATIONSHIP BETWEEN ANXIETY AND GUT MICROBIOTA

Individually or in a small group, find a recent piece of research conducted into the link between stress and gut microbiota. Try to find an example of a controlled experiment rather than a literature review. Use a critical eye and perform an evaluation of the study. You could determine the following:

- What were the independent variable and the dependent variable?
- How did the researchers determine cause and effect between these two variables?
- What were the controlled variables?
- How effectively did the researchers control for these variables?

Section 4B questions

1 Explain how our gut and brain communicate.
2 Describe the role of the enteric nervous system.
3 Explain the role of the vagus nerve in the communication between gut and brain.
4 How are gut microbiota and neurotransmitters related?
5 Briefly describe the relationship between stress, gut microbiota and nervous system functioning.

ISBN 978-1-009-25416-8

4C A biological model of stress

Study Design:
The explanatory power of Selye's general adaptation syndrome as a biological model of stress, including alarm reaction (shock/counter shock), resistance and exhaustion

Glossary:
Alarm reaction stage
Countershock
Exhaustion stage
General adaptation syndrome (GAS)
Resistance stage
Shock

ENGAGE

The link between stress and disease or illness

Hans Selye was one of the pioneer researchers of stress. In 1936, he established that stress is directly linked to the development of physical illnesses such as peptic ulcers, which are holes in the lining of the small intestine, lower oesophagus or stomach. Several more recent studies in humans and rodents have also established a similar link. For example, researchers studied survivors of the Hanshin-Awaji earthquake, which occurred on 17 January 1995 in Japan, killing 6434 people and injuring tens of thousands. A significant increase in the number of people with peptic ulceration was observed. A comprehensive study in Thailand of 70 patients with perforated peptic ulcers compared with a control group, led to the conclusion that stress was associated with peptic ulcer disease. Finally, a recent Danish study also showed that psychological stress increased the incidence of peptic ulcers.

Figure 4C–1 A link has been well established between stress and painful physical ailments such as stomach ulcers.

Figure 4C–2 A magnified image of an ulcer in the lining of the stomach

EXPLAIN

General adaptation syndrome as a biological model of stress

In 1936, Austrian endocrinologist Hans Selye reported on experiments in which he exposed rats to a variety of stressful stimuli such as extreme temperatures, surgical injuries, excessive exercise or intoxication with non-lethal doses of diverse drugs.

Selye found that despite differences in these stressors, a typical physiological syndrome appeared, which he called the **general adaptation syndrome (GAS)**.

General adaptation syndrome (GAS) a biological model of stress that proposes we have a non-specific biological response to stress that occurs in three stages

ISBN 978-1-009-25416-8 Gallagher et al

He emphasised two elements when describing this syndrome.

- It is non-specific, meaning it is the same irrespective of the type of stressor the organism is exposed to.
- It is identical within all members of a species, in this case rats.

Selye also noted three stages of the GAS:

- Stage 1 – **alarm reaction**
- Stage 2 – resistance
- Stage 3 – exhaustion.

Figure 4C–3 Hans Selye experimented on rats, which are often used as human models in psychological research.

Alarm reaction stage the first stage of the general adaptation syndrome, in which we become aware of the stressor; it consists of two phases – shock and countershock

Shock the first phase of the alarm reaction stage of the general adaptation syndrome, in which the body's ability to deal with the stressor falls below normal

Countershock the second phase of the alarm reaction stage of the general adaptation syndrome, in which the body's ability to deal with the stressor rises above normal

Resistance stage the second stage of the general adaptation syndrome, in which the stressor persists, and the body's resources are maximised to cope and adapt over time

Exhaustion stage the third stage of the general adaptation syndrome, in which the continued depletion of energy stores and high levels of hormones such as cortisol decrease resistance to the stressor and impair the immune system

Stage 1: Alarm reaction

This stage of the GAS occurs when we first become aware of the stressor and the body responds to the immediate threat or challenge. It consists of two phases: shock and counter shock. In the **shock** phase, an acute stress response occurs, whereby the body experiences a drop in its resistance, and the ability to deal with the stressor falls below normal. This phase is also associated with a decrease in muscle tone, body temperature and blood sugar levels.

In the **countershock** phase, the body attempts to compensate for the acute stress response in the shock phase. This is helped by the release of the stress hormones adrenaline and cortisol, as well as the activation of the flight-or-fight-or-freeze response in order to deal with the stressor. Physiological changes associated with this phase include increases in muscle tension, heart rate, breathing rate, blood glucose and temperature. The alarm reaction stage does not usually last very long; sometimes just a few seconds, sometimes longer.

Stage 2: Resistance

When the stressor persists over a prolonged period and the individual has to adapt to its ongoing presence, the **resistance stage** occurs. In this stage, the body is actively dealing with the stressor. The body's ability to deal with the stressor, and its level of resistance to it, continues to rise above normal. Cortisol levels are at their highest, which helps repair any damage to the body and maximises the body's resources to cope and adapt to the stressor over time. For example, increased glucose and fat levels provide us with extra energy to deal with the stressor, and increased protein concentration in the blood improves the body's ability to repair any damage.

The body can adapt to the strains or demands of the environment for some time, but not indefinitely. In particular, the continuing high levels of stress hormones such as cortisol interferes with the body's ability to fight disease by supressing the immune system. Thus, problems occur and eventually the body begins to show physiological signs of wear and tear; for example, cold and flu symptoms, sore throat, lethargy and headaches. In addition, we cannot effectively resist the threat or deal with it properly, which can result in social withdrawal or absence from work or school, moodiness and irritability.

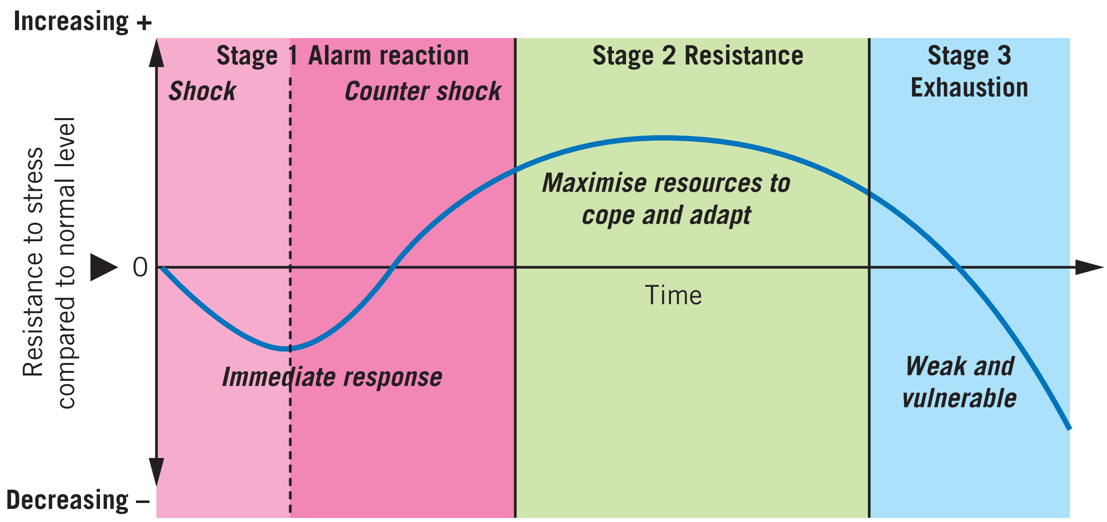
Stage 3: Exhaustion

During the **exhaustion stage**, the body runs out of reserves because it has been fighting the stressor for a long time. It may become weak, and have a low resistance to physical and psychological illnesses. Energy stores become depleted and excess cortisol in the

ISBN 978-1-009-25416-8 Gallagher et al

bloodstream over a long time impairs the immune system and gut function. Ultimately, we become more susceptible to a variety of physical and psychological conditions such as infection, stomach ulcers, sleep disturbances, irritability, fatigue, anxiety and depression.

The three stages of GAS are represented in Figure 4C–4.



		Biological symptoms	Resistance to the stressor
Stage 1	**Shock**	• Acute stress response • Loss of muscular tone, lowering of body temperature and blood pressure	• Below normal
	Counter shock	• Flight-or-fight-or-freeze response occurs to deal with the stressor • Adrenaline and cortisol initially released • Muscles tense, heart rate and breathing rate increase, pupils dilate	• Initially below, but rises above normal
Stage 2		• Cortisol levels are at their highest • Increased energy because of higher blood sugar levels • Immune system functioning impaired • Physical signs of wear and tear begin to appear, such as colds and flu symptoms, headaches and lethargy	• Well above normal • Beginning to drop
Stage 3		• Energy stores depleted • Increased susceptibility to several physical conditions such as infection, stomach ulcers, sleep disturbances and fatigue	• Well below normal

To remember the order of stages in the general adaptation syndrome, use the acronym **'SCARE'**:

Shock
Countershock
Alarm reaction (Both are a part of)
Resistance
Exhaustion

Figure 4C–4 The three stages of the general adaptation syndrome, as well as the acronym SCARE to help you remember them

Explanatory power of the general adaptation syndrome

Selye was nominated for the Nobel Prize in Physiology or Medicine 17 times between 1949 and 1953, in recognition of his work in relation to the biological stress response. In the middle of the twentieth century, Selye's notion of biological stress and its impact on health was adopted by researchers in a variety of fields, including veterinary medicine, clinical allergy and psychiatry. This is because he provided an important method and structure for scientists interested in understanding the relationship between stressful modern lives and disease.

However, Selye's research was predominantly conducted on rats, which limits its application to the human stress response. Also, it does not consider the psychological or intellectual aspects of stress that have been found to directly influence the physiological symptoms we experience.

Table 4C–1 A summary of the explanatory power of Selye's general adaptation syndrome model

Strengths	Limitations
• The model suggests a predictable pattern of responses that can easily be tested in a laboratory. • It identifies various biological processes that occur as a part of the stress response, such as hormone secretion and immune system depletion. • It is one of the first theories to suggest that stress can weaken the body's resistance to illness. • There is research and evidence to suggest that the three stages of GAS exist and that the body's non-specific response to a stressor is a physiological reality (at least in rats).	• Humans and rats are physiologically different. For example, human stress responses tend to be more complex and variable. Therefore, Selye's GAS model cannot be simply generalised to humans. • It does not acknowledge the psychological or cognitive processing involved in the human stress response, which can affect how much an individual experiences the stress response. • It does not account for individual differences in stress responses. For example, many different types of disorders are associated with high stress levels, such as hypertension (high blood pressure), post-traumatic stress disorder and major depression.

Check-in questions – Set 1

1 What did Selye mean when he described the GAS as being non-specific?
2 Describe what occurs in the alarm reaction stage of the GAS, including the distinction between the shock and countershock phases.
3 Describe what occurs in the resistance stage of the GAS.
4 Describe the circumstances under which someone would enter the resistance stage of the GAS.
5 With reference to cortisol, explain why the body begins to show signs of wear and tear in the resistance stage.
6 Describe they key features of the exhaustion stage of the GAS.
7 Explain one strength and one limitation of the GAS as a biological model of stress.

ISBN 978-1-009-25416-8 Gallagher et al

4C SKILLS

Applying your understanding of the GAS

A key skill in assessment questions on the GAS is to correctly identify the stage of the GAS that an individual is in, and justify why from the information provided in the scenario. It is particularly important to be able to distinguish between the resistance and exhaustion stages because some of the symptoms can be similar or overlap. While reading a scenario, make sure you establish whether the person is still coping and only has minor ailments such as cold and flu symptoms. If this is the case, they are probably still in resistance. If they can no longer manage their daily tasks, are seriously ill and are no longer coping, then they have probably moved into the exhaustion phase.

Scenario:

Rishani is in her first year of university. She is a first-generation migrant, having arrived in Australia from Pakistan when she was 9 years old. Her parents have high expectations of her because she is the first female member of her family to attend university. In addition to this family pressure, Rishani has been trying to balance her academic demands, part-time work and the usual day-to-day irritations. However, at the end of Semester 1, her first relationship breaks up, which is challenging because she finds that her usual supports are not enough. She talks it through with her girlfriends and works out at the gym to help her refocus. Rishani develops a cold after the break-up but still manages to stay on top of things.

Question:

Explain whether Rishani is in the resistance or exhaustion stage of the GAS at the end of Semester 1.

Suggested answer:

At the end of Semester 1, Rishani is still in the resistance stage rather than exhaustion. This is because despite finding her break-up challenging and finding her usual supports are not enough, she is still able to stay on top of things and cope, whereas if she was in the exhaustion stage, she would struggle to cope and would withdraw from some of her commitments, such as her part-time job or university classes. In addition, she only has minor physiological symptoms of a cold, which would indicate the beginning of the wear and tear that can occur in the resistance stage, whereas had she been in the exhaustion stage, she would have a more serious physical or mental condition such as an infection or mental disorder like anxiety.

Marking comments:

This answer required an elaborated response, which demonstrated the ability to differentiate between the two stages of the GAS. To ensure that it was clear, there was a comparative term included. The answer also incorporated specific evidence from the scenario to further support the correct understanding of the two stages.

VIDEO 4C–1 SKILLS: APPLYING UNDER-STANDING OF THE GAS

WORKSHEET 4C–1 GAS APPLICATION SCENARIOS

ISBN 978-1-009-25416-8 Gallagher et al

Section 4C questions

1 Richard is preparing for his starring role in the upcoming school play, which has been causing him stress for a few weeks. He has been juggling his schoolwork, rehearsals for the play and learning his lines.

  a How would cortisol benefit Richard in this situation?

  b In terms of Richard's flight-or-fight-or-freeze response, identify two adaptive changes that would occur when Richard is nervously performing on stage, and explain how each would benefit him.

  c After the school play is finished, Richard becomes ill with tonsillitis and has to take a week off school to rest, falling behind with his schoolwork. What stage of the GAS is Richard in when he gets tonsillitis?

  d With reference to cortisol and the GAS stage you identified in part **c**, explain why Richard has become ill with tonsillitis.

  e Why might the GAS be a limited explanation for why Richard has become ill with tonsillitis?

ISBN 978-1-009-25416-8 Gallagher et al

4D A psychological model of stress

Study Design:
The explanatory power of Lazarus and Folkman's transactional model of stress and coping to explain stress as a psychological process (primary and secondary appraisal)

Glossary:
Appraisal
Benign/positive
Challenge
Harm/loss
Irrelevant
Primary appraisal
Secondary appraisal
Transactional model of stress and coping
Threat

ENGAGE

Our relationship to stress

How we think about the stress in our lives can shape the experience we have with it. Kelly McGonigal, a US health psychologist, challenges us to reframe how we view stress. She says that if our relationship with stress is more positive, we can reduce its impact on us. A large study from the University of Wisconsin–Madison involved researchers asking almost 29 000 people to rate their levels of stress and how much they believed this stress influenced their health. A follow-up survey eight years later showed that participants who had reported high stress and believed that the stress had a large impact on their health had a 43% increased risk of death compared to those who did not have this belief. McGonigal explains that if people are placed in a stressful situation and told that the stress response is not harmful, and that symptoms such as a strong heartbeat mean more oxygen is being pumped around the body, then they experience less stress.

Figure 4D–1 Stress can have a profoundly negative impact on the body.

Appraisal the process of categorising an event on the basis of its perceived significance and how it may affect our wellbeing

Transactional model of stress and coping a model that suggests a stress response is only elicited if an event is perceived to exceed our ability to cope and is based on our appraisal of the situation

EXPLAIN

Transactional model of stress and coping

LINK 4C A BIOLOGICAL MODEL OF STRESS

A major limitation of Selye's GAS as described in the previous section is its insistence on a single common response to any stressor. In contrast, we know that two people can respond very differently to the same stressor and that its effects vary widely. One of the key determinants of these varied responses is the individual's perception of the stressor. Whether something produces stress depends on the individual's **appraisal** of the situation and their coping skills. The stress response is only elicited if the individual believes that the stressor may exceed their available resources. This has been termed the **transactional model of stress and coping** where the transaction is between an event (stressor) and the individual. The person will assess the significance of an event and whether they can cope with it. This model was developed and has been refined by US psychologists Richard Lazarus and Susan Folkman (1984).

ISBN 978-1-009-25416-8 Gallagher et al

Primary appraisal when an individual determines whether a situation or event is significant to them and stressful or not

Irrelevant describes a situation or event that has no implications for an individual's wellbeing because nothing will be gained or lost, or they are not invested in the situation

Benign/positive describes a situation or event that is perceived as having a positive outcome for an individual, i.e. it either maintains (benign) or enhances their wellbeing (positive)

Threat the anticipated harm/loss in the future because of an event

Harm/loss the damage to the individual that has already occurred as a result of a stressor

Challenge the perceived potential for personal gain or growth from an event

Secondary appraisal when an individual considers the available resources and their own coping strategies, to decide the best way of dealing with a stressor

Primary appraisal

The model proposes that we go through two forms of appraisal of the situation or event, represented as a flow chart in Figure 4D–2. Initially, in **primary appraisal** the individual determines whether the situation or event is significant to them. Based on this, the event is categorised as either stressful or not stressful. If deemed not to be stressful, it will be further categorised as either benign/positive or irrelevant:

- **Irrelevant** – the situation or event has no implications for the individual's wellbeing; that is, nothing is to be gained or lost by them and they are not invested in the situation; for example, a SAC gets changed to an earlier date for a subject that you do not do at school, so it does not affect you.
- **Benign/positive** – the outcome of a situation or event is perceived as positive; that is, it either maintains (benign) or enhances their wellbeing (positive). It is characterised by pleasurable emotions such as joy, love and happiness; for example, you are happy that you have moved to a new house because you are closer to school and your commute is shorter.

If the individual has deemed the event to fit into one of these categories, they will not need to perform any further appraisal. This is because they do not need to assess their coping resources to deal with the stressor.

If the event is deemed to be stressful, it will be categorised as a threat, harm/loss or challenge:

- **Threat** – anticipated harm/loss in the future because of the event. This is characterised by fear, anxiety and apprehension; for example, you failed your Psychology SAC and now you do not know whether you will get the study score you need.
- **Harm/loss** – damage to the individual that has already occurred. This is characterised by sadness, despair or anger; for example, failing your SAC means that you have lost valuable marks that could have gone towards your study score.
- **Challenge** – perceived to have the potential for personal gain or growth. This is characterised by eagerness, excitement and exhilaration; for example, you see failing your SAC as an opportunity to improve your study skills.

If an event has been established as stressful, something must be done to manage the situation and so **secondary appraisal** occurs.

Secondary appraisal

Secondary appraisal is where the individual considers the available resources, as well as their own coping strategies, to decide the best way of dealing with the stressor. The individual then enacts a coping strategy or effort, which results in an outcome. They can reappraise the outcome to determine its success or otherwise, and modify their coping strategy if needed. By improving an individual's coping skills or getting them to reappraise the stressor in a more positive light, the transactional model makes it possible to avoid negative stress responses and the person can better cope with the challenge.

Explanatory power of the transactional model

Lazarus and Folkman's model was one of the first to explain stress as a psychological process. Its strengths lie in its acknowledgement of the role cognitive processes play in our experience of stress and how we cope with it. It can give us a more positive view of stress because it suggests that we can control and manage it on our own terms.

ISBN 978-1-009-25416-8 Gallagher et al

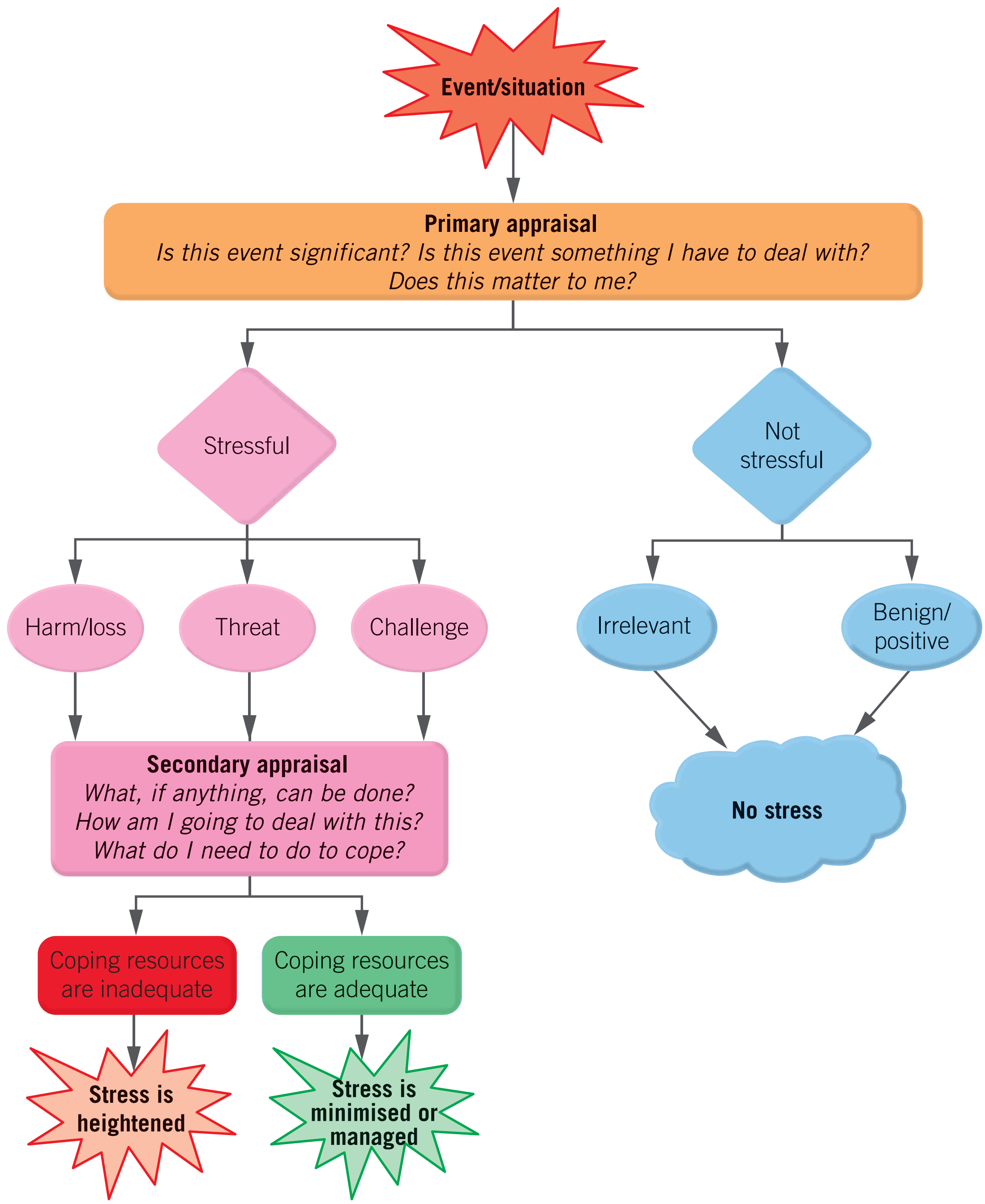


Figure 4D–2 The two forms of appraisal that occur within the transactional model of stress and coping: primary and secondary

However, several criticisms have also been made of the model. These mostly centre on the individual and subjective nature of stress as a psychological process. Given that a person's perception of a 'stressful experience' can vary significantly, it can make it difficult to design experiments or stress management interventions that would apply to larger groups or populations. Similarly to Selye's GAS model, it also does not account for any external factors that may influence a person's stress response, such as race, socio-economic status or education.

ISBN 978-1-009-25416-8 Gallagher et al

Table 4D–1 A summary of the explanatory power of the transactional model of stress and coping

Strengths	Limitations
• The model acknowledges the psychological determinants or causes of the stress response. • It emphasises the personal nature and individuality of the stress response, accounting for why individual responses to an event vary widely. • It suggests that because stress involves an interaction with the environment, the individual has an active role in their own stress response and can therefore learn to respond and manage it. • The model allows for the fact that stressors and the circumstances under which they occur can change over time and that our thinking about a stressor and our response to it can also change.	• It is difficult to test through experimental research because of the subjective nature of individual responses to stress. • Individuals may not always be consciously aware of all the factors causing them stress or the thought processes that take place internally when experiencing stress. • It is narrowly focused on cognitive processes, and therefore does not account for physiological variations in individual responses to stress and external, sociocultural factors that may influence stress such as race, socio-economic status or education. • It does not allow for individual variation in progression through its stages, as primary and secondary appraisals have been found to interact with one another and often occur simultaneously.

Check-in questions – Set 1

1 What does appraisal involve?
2 What is involved in primary appraisal?
3 Using examples other than those in the text, distinguish between a benign/positive and irrelevant primary appraisal.
4 Using the example of breaking up with your partner, distinguish between the three different primary appraisals of threat, harm/loss or challenge.
5 How does secondary appraisal differ from primary appraisal in the transactional model of stress and coping?
6 You find out that you failed your recent Psychology SAC and you establish in primary appraisal that it is a threat to you doing well in this subject. Explain what would then occur in secondary appraisal.
7 Outline one strength and one limitation of the transactional model of stress and coping.

VIDEO 4D–1 SKILLS: TRANSACTIONAL MODEL APPRAISAL

WORKSHEET 4D–1 TRANSACTIONAL MODEL APPLICATION SCENARIOS

4D SKILLS

Using a flow chart to represent the process of appraisal in the transactional model of stress and coping

Because the steps in secondary and primary appraisal are complex, it can be useful to represent the process or at least follow the process as it progresses in a flow chart, similar to that in Figure 4D–2.

Scenario:

Anna is a 40-year-old woman who was married for 15 years. Her husband was the CEO of a large company while Anna was a stay-at-home mother. Anna's husband liked to spoil her with gifts, and she enjoyed living an extravagant lifestyle. Last year, Anna

ISBN 978-1-009-25416-8 Gallagher et al

found out that her husband was having an affair and they are now going through a divorce. In her psychologist appointments, Anna describes her divorce as the worst thing that has ever happened to her. She is worried about the long-term effect it will have on her children, her chances of securing a job, and dating again. When Anna bumps into her friends, she pretends that she is still happily married, because it is easier than admitting the truth.

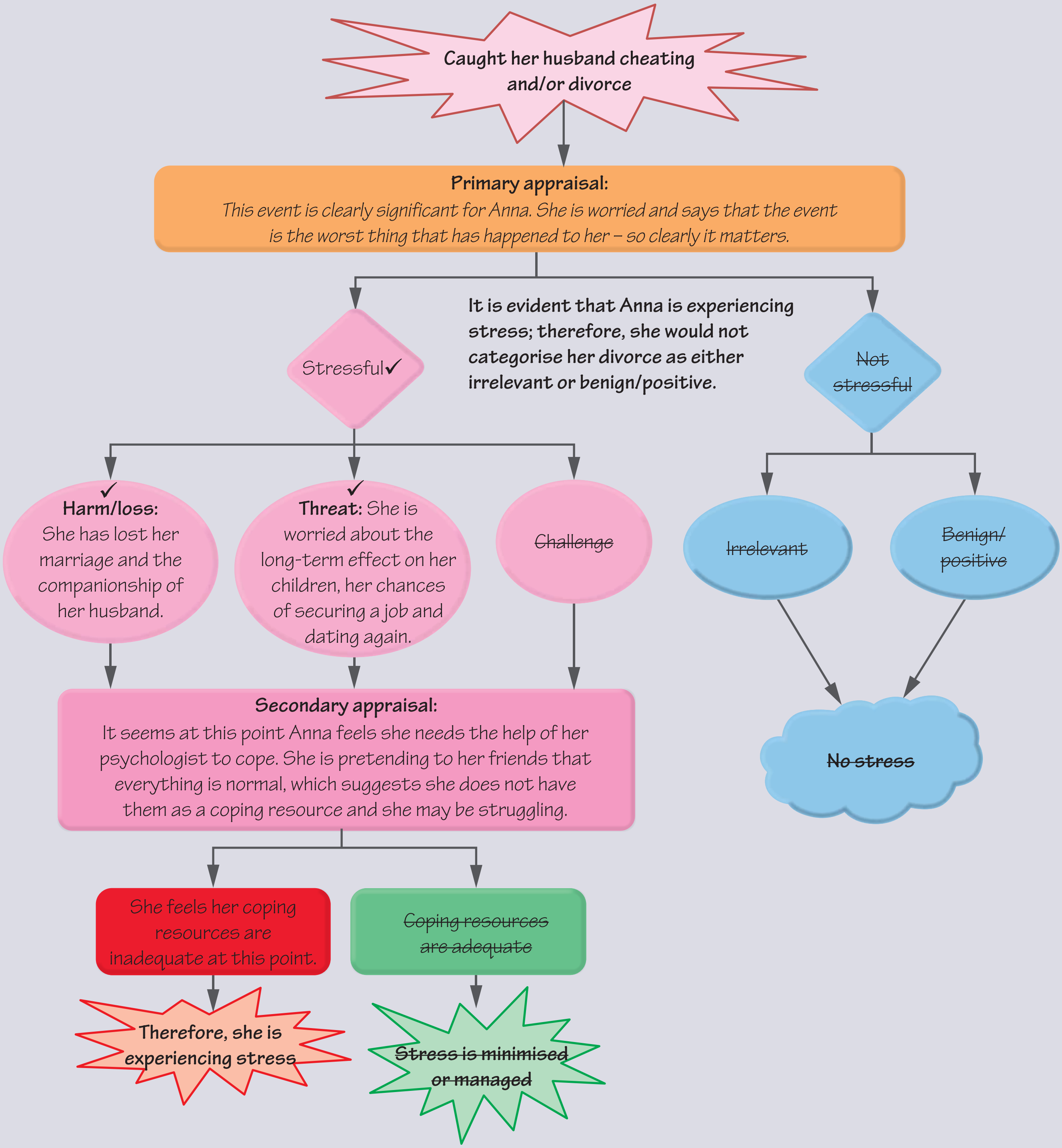


Figure 4D–3 Anna's two forms of appraisal

First, the flow chart in Figure 4D–3 indicates that the event that has occurred for Anna is her divorce/catching her husband cheating on her. In primary appraisal, where Anna assesses whether this is significant to her, she clearly deems it to be significant and stressful for her.

ISBN 978-1-009-25416-8 Gallagher et al

Therefore, she moves down the left side of the flow chart, further categorising her divorce as both a harm/loss because she has lost her marriage and relationship with her husband (so damage has already occurred), and she deems it to be a potential for further harm/loss and therefore a threat, because she is worried about the long-term effects on her children.

In secondary appraisal, Anna assesses her coping resources and whether she feels they are adequate. It seems that she is not really coping. She is seeing a psychologist but is also lying to her friends about what has happened, depriving herself of support. At this point, it seems that her coping resources are inadequate, and she is therefore experiencing stress.

4D KEY SCIENCE SKILLS

VIDEO 4D–2 KEY SCIENCE SKILLS: INVESTIGATION METHODOLOGIES

CHAPTER 1 LINK

Determining appropriate investigation methodologies

In VCE Psychology, when you are asked to design an investigation, many options are available. Often, you need to choose the most appropriate of these options in certain contexts. Here is a quick refresher on these investigation methodology options (which are discussed in detail in Chapter 1):

- A **controlled experiment** tests the cause-and-effect relationship between one or more independent variable(s) and a dependent variable under controlled conditions.
- A **case study** is an in-depth investigation into an individual or small group of people.
- **Classification and identification** involves arranging phenomena, objects or events into manageable sets, and recognising phenomena as belonging to a particular set.
- A **correlational study** involves observing and recording behaviour to understand the relationship between variables that have not been manipulated or controlled.
- **Fieldwork** is the collection of information through observation and interaction with a selected environment.
- A **literature review** involves collating and analysing secondary data and viewpoints.
- **Modelling** involves constructing a physical or conceptual model that can be used to simulate a system.
- **Simulation** is the use of a model to replicate and study the behaviour of a system.
- **Product, process or system development** involves the design of an artefact, process or system to meet a human need.

Each of these methods can be used in relation to Selye's GAS and Lazarus and Folkman's transactional model of stress and coping. Some examples are shown in Table 4D–2 which follows.

Table 4D–2 Examples of investigation methods related to Selye's GAS and Lazarus and Folkman's transactional model of stress and coping

Investigation methodology	General adaptation syndrome	Transactional model of stress and coping
Controlled experiment	Design an investigation to determine whether those with higher blood cortisol levels are more likely to get sick than those with lower blood cortisol levels.	Design an investigation to determine whether thinking about stress in a more positive way influences a person's coping ability.
Case study	Interview an individual or small group about a time that they were stressed and got sick as a result. For the interview, develop a script of questions you would ask to determine what symptoms they experienced at each stage of the GAS.	Interview an individual or small group about a stressful event in their life. For the interview, develop a script of questions you would ask to gain insight into their primary and secondary appraisals of the event.
Classification and identification	Collate data on people's physiological responses to stressful events. Design criteria to categorise these symptoms as either acute or chronic. Then calculate the proportion of people who suffered acute or chronic symptoms.	Collate data on people's primary appraisals of stressful events. Design criteria to categorise these appraisals as benign/positive, irrelevant, harm/loss, threat or challenge. Then calculate the proportion of people who used each type of primary appraisal.
Correlational study	Determine the relationship between chronic stress (in the resistance stage) and illness or disease (in either the resistance or exhaustion stage).	Determine the relationship between a more positive primary appraisal, such as seeing something as a challenge, and a person's perceived ability to cope in secondary appraisal.
Fieldwork	Conduct a study in a school setting on the relationship between stress and illness in VCE students.	Conduct a study in a school setting on the effects of different stressors and their appraisal of them on the performance of VCE students.
Literature review	Determine the explanatory power of the GAS model by finding any secondary data that supports or contradicts it.	Determine the explanatory power of the transactional model of stress and coping by finding any secondary data that supports or contradicts it.
Modelling and simulation	Design a replication of the stages of the GAS using 10 rat models.	Create a simulated stressful event using virtual reality with human participants, to investigate the subjective nature of appraisal.
Product, process or system development	Develop an idea of how wearable technology such as a Fitbit or smartwatch could be used to reduce physiological stress-related symptoms during the resistance stage of the GAS, in order to reduce the likelihood of people entering the exhaustion stage. This could include heart rate, breathing exercises, step counting and sleep quality.	Develop an idea of how an online chatbot function or phone app could be used to alter people's cognitive perceptions of a stressful event in their lives, assisting them in re-appraising an event in order to cope more successfully with their stress.

ISBN 978-1-009-25416-8 Gallagher et al

ACTIVITY 4D–1 APPLYING INVESTIGATION METHDOLOGIES

Working independently or collaboratively with a few classmates, choose one of the applied examples of the investigation methodologies in 4D Science Skills.

- Plan and design the methodology.
- If possible, collect and interpret some data using this methodology.
- Could you adapt or extend this investigation by making any modifications?

Section 4D questions

1 Identify the correct type of primary appraisal for each example.

Example	Stressful			Not stressful	
	Harm/loss	Threat	Challenge	Irrelevant	Benign/ positive
You lost your job but you feel that it's an opportunity for you to find one you love.					
You broke up with your partner and you miss their company.					
You found out your friend got a scholarship to the university they dreamed of going to. You are happy for them.					
You have a headache and feel as though you will not be able to perform well on the test you have later today.					
The AFL grand final is not being held in Melbourne, but you do not mind because you do not really watch football anyway.					
You lost your part-time job and are now worried that you will not be able to afford the formal outfit you picked out.					
Someone you have never met in person stopped following you on Instagram, but you are not bothered about it.					
You are feeling excited about your upcoming Psychology test because you are looking forward to impressing your teacher with your knowledge.					
You found out your cousin got engaged and is planning a wedding, which will be fun.					
You wear your favourite white outfit to a party and someone spills their drink on it, staining it permanently.					

ISBN 978-1-009-25416-8 Gallagher et al

2 Why is the word 'transactional' used in the title of Lazarus and Folkman's model?

3 Year 12 graduation is coming up in a few weeks and Hazel is feeling anxious about it. She feels that she is going to miss school and her friends and is worried she will not be able to make new ones at university. By contrast, Tilly is somewhat nervous but cannot wait for graduation to come because she is excited about heading to university and meeting new people.

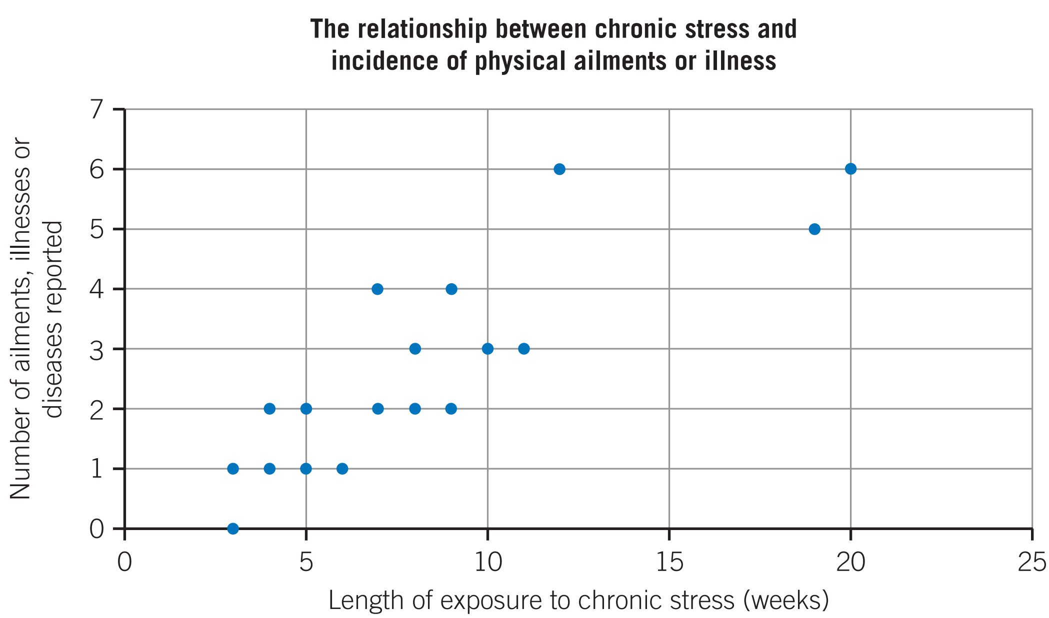
In terms of primary appraisal, explain why Tilly and Hazel feel differently about graduation.

4 Describe the secondary appraisal Tilly and Hazel are likely to go through.

5 Hazel decides to seek help from a psychologist for her anxiety about graduating. Provide an example of how the psychologist might help her reappraise her situation.

6 A teacher wants to investigate the effect of stressful events for VCE students and how their appraisal of them affects their ability to cope and perform. Outline how the teacher could use fieldwork questionnaires and interviews to source data on stressful events for students and how they appraise them.

7 A researcher is studying the link between the length of exposure to chronic stress and the number of reported physical ailments such as headaches and other illnesses. They use a questionnaire to gather data from 20 participants who have been recently exposed to chronic stress. They plot the data on the following graph.



a Identify and explain the investigation methodology used in this study.
b Describe the relationship the researcher establishes between these two variables.
c Suggest a modification that the researcher could implement to extend this investigation and gain further insight into this relationship.

8 Using a Venn diagram or other comparison tool, compare the similarities and differences between the biological GAS, and the psychological transactional model of stress and coping.

ISBN 978-1-009-25416-8 Gallagher et al

4E Strategies for coping with stress and improving mental wellbeing

Study Design:
Use of strategies (approach and avoidance) for coping with stress and improving mental wellbeing, including context-specific effectiveness and coping flexibility.

Glossary:
Approach strategy
Avoidance strategy
Context-specific effectiveness
Coping
Coping flexibility
Coping strategy

ENGAGE

Ways of coping

Are there healthy and unhealthy ways of coping?

You might have heard someone say, 'Swearing gets me through the day'. But is that a healthy way of coping? As this section will outline, we all manage the stressors of everyday life in different ways, some of which are more helpful than others. Think about how you cope with stress. Do you seek out friends and family to share your concerns, do you go for a walk or run, or do you turn to a favourite TV show to escape? As you will soon learn, some of these strategies are more helpful than others.

EXPLAIN

Coping with stress

Coping all the things we do to manage and reduce the stress we experience

Coping strategy a method that we use to manage or reduce the stress produced by a stressor

Coping flexibility the ability to modify our coping strategies to adapt and meet the demands of different stressful situations

Coping is the term used to describe all the things we do to manage and reduce the stress we experience because of problems in our lives. It is an attempt to manage the demands of a stressor in an effective way. These attempts usually involve one or more coping strategies. A **coping strategy** is a method that people use to manage or reduce the stress produced by a stressor. Whether the strategy works or not is influenced by two factors:

- coping flexibility
- context-specific effectiveness.

Coping flexibility

Coping flexibility is our ability to modify our coping strategies to meet the demands of different stressful situations. Hence, when we psychologically and physically respond to stressors, a richer coping flexibility tends to produce more adaptive outcomes. It is our ability to relinquish an ineffective coping strategy and to devise and implement an alternative, more effective strategy. For example, if you are training for a half marathon and you notice that you are not showing enough improvement with two practice runs a week, you adjust your training plan and add in a sprint session each week to improve your fitness more rapidly.

The coping flexibility hypothesis dictates that richer coping flexibility produces more adaptive outcomes caused by stress responses, such as reduced psychological and physical dysfunction.

ISBN 978-1-009-25416-8 Gallagher et al

Coping flexibility includes being able to:

- recognise whether the use of a coping strategy is appropriate for a specific situation
- select a coping strategy that suits the circumstances of the situation
- recognise when the coping strategy being used is ineffective
- discontinue using an ineffective coping strategy and implement an alternative, more effective coping strategy.

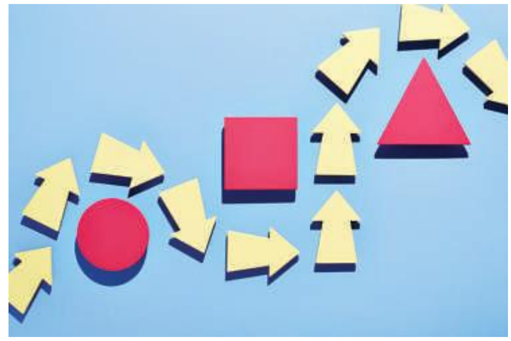
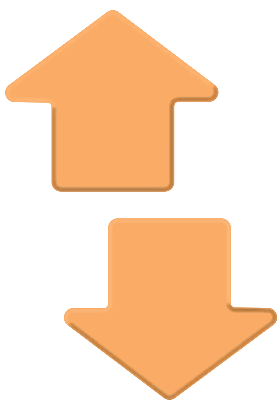


Figure 4E–1 Coping flexibility relates to modifying strategies to meet the needs of the situation.

Coping flexibility is a personality attribute that is adaptive and enables us to adjust our thoughts, feelings or behaviour according to changing situational circumstances.



Individuals with high coping flexibility: quickly recognise and adjust their coping strategies if they are ineffective. These individuals tend to use a wider variety of coping strategies across situations, and match the strategies to the demands of the situation.

Individuals with low coping flexibility: tend to rely on the same, limited coping strategies across different situations, and persist with them, even if they are ineffective. Essentially, these individuals are not flexible and are predictable when dealing with stress.

Figure 4E–2 The differences between individuals with high coping flexibility and those with low coping flexibility

Context-specific effectiveness

A coping strategy is considered to have **context-specific effectiveness** when it matches or is appropriate to the stressful situation. For example, if you are training for a half marathon, but all you are doing is sprint training, this is probably not a good match for running 21.5 kilometres. A more appropriate training regimen would include running longer distances a couple of times a week to increase endurance and cardiovascular fitness.

Context-specific effectiveness also considers whether a coping strategy is effective from aspects of the situation such as the physical environment, the stressor itself

Context-specific effectiveness when a coping strategy matches or is appropriate to the stressful situation

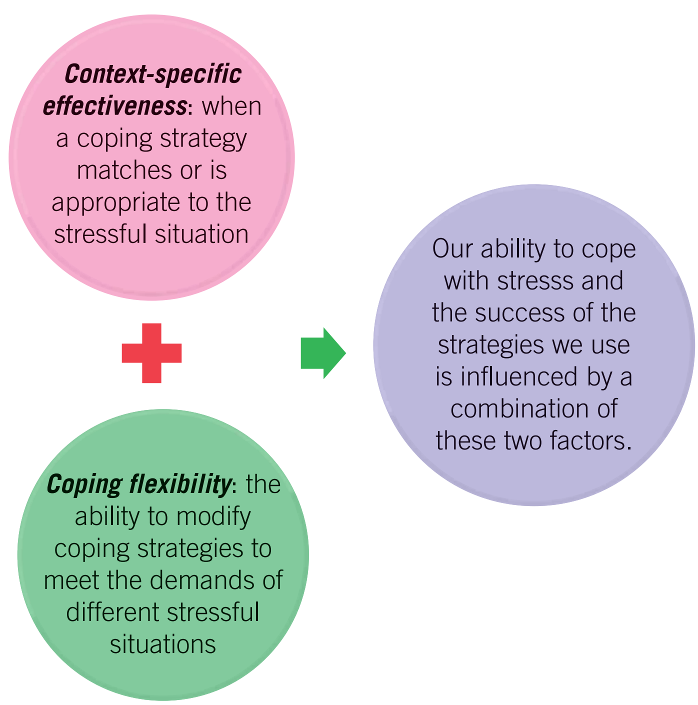


Figure 4E–3 Context-specific effectiveness and coping flexibility come together to influence our ability to cope with stress.

ISBN 978-1-009-25416-8 Gallagher et al

and the individual involved. In any given situation, for a coping strategy to be successful, it must match the specific demands of the stressor and be suited to the relevant personal characteristics of the individual involved, such as their personality, knowledge or skills.

Check-in questions – Set 1

1 a Define 'coping'.
  b What is a coping strategy?
2 What two things affect whether a coping strategy works or not?
3 Using examples, distinguish between context-specific effectiveness and coping flexibility.

Strategies for coping with stress

Approach and avoidance strategies

The 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' refer to the orientation or focus of an individual's activity either towards or away from the stressor. The aim of both approach and avoidance strategies is to reduce stress levels and increase the ability to cope, but the method by which this is achieved differs.

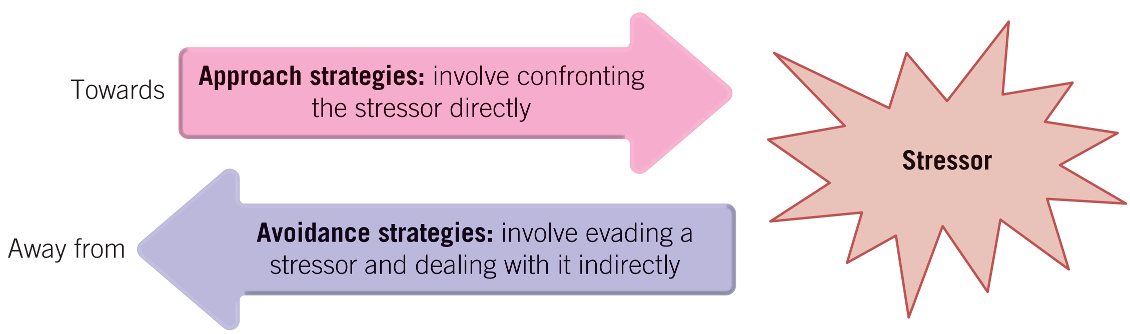


Figure 4E–4 A visual representation of approach and avoidance strategies

Approach strategy an effort to confront a stressor and deal directly with it and its effects

Approach strategies are 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. These include strategies that involve engagement with the stressor. For example, if you are stressed about your workload at school, you might develop a study schedule, cut back your hours at your part-time job or seek advice from a teacher or counsellor.

Figure 4E–5 An approach strategy for coping with stress is to seek advice from a counsellor.

ISBN 978-1-009-25416-8 Gallagher et al

Examples of approach strategies are:
- seeking advice from an expert such as a counsellor or psychologist
- talking through your problems with a friend or family member for a different perspective
- accepting responsibility for a problem or reframing a situation to recognise the positive aspects rather than focusing on the negative aspects
- developing a plan to increase your sense of control around an issue.

Table 4E–1 A summary of the benefits and limitations of using approach strategies when coping with stress

Benefits	Limitations
• Approach strategies are generally considered to be more adaptive and effective than avoidance strategies. • People who rely more on approach strategies to cope with a stressor tend to experience fewer psychological symptoms and can function more effectively than people who rely more on avoidance strategies.	• Initially or in the short term, approach strategies may increase stress levels while the individual is directly engaged with the stressor and its causes. • An approach strategy may require a lot of the individual's energy and focus to deal with the stressor, which means they might neglect other aspects of their lives.

Avoidance strategies are used to avoid the stressor rather than deal with it directly. They are maladaptive because they involve changing your behaviour to avoid thinking about, feeling or doing difficult things. They tend to take your focus away from the stressor, and you do not confront the stressor and its causes. Avoidance strategies are usually temporarily beneficial because they relieve stress in the short term. However, in the long term the source of the stress will still be there, and using avoidance may make your situation worse.

Avoidance strategy an effort to avoid a stressor and not deal directly with it and its effects

For example, instead of developing a study schedule to deal with your stressful workload at school you might take a nap or binge watch your favourite show on Netflix to relieve your stress. This would make you feel better in the short term but would put you more behind with your work, making your stress worse in the long term.

Some examples of avoidance strategies are:
- procrastination
- napping or oversleeping
- substance use or abuse
- denial
- use of distractions such as television or computer games.

Figure 4E–6 Binge-watching your favourite streaming series is an example of an avoidance strategy.

ISBN 978-1-009-25416-8 Gallagher et al

Table 4E–2 A summary of the benefits and limitations of using avoidance strategies to cope with stress

Benefits	Limitations
• Selectively avoiding dealing with unchangeable aspects of a stressor by 'switching off' may be considered an adaptive strategy. • It allows you to conserve energy to focus on other stressors that can be changed. • Disengagement might be appropriate in a situation where nothing can be done. • It can be more effective in coping with stress in the short term. • Ignoring a stressor for a couple of days while focusing on other things can provide 'time out' from a stressor while minimising potential stress from another source.	• Avoidance strategies tend to be maladaptive. • Excessive reliance on avoidance strategies tends to be associated with several negative consequences, e.g. increased 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, e.g. delinquency, socially inappropriate behaviours and substance use. • The strategies tend to only be helpful in the short term, and their long-term use can prevent people from responding to stressors in constructive ways. • Delaying actually dealing with a stressor can also have negative consequences and might be detrimental when action is needed.

Exercise as an avoidance coping strategy

Exercise is any physical activity that is usually planned and performed to improve or maintain your physical condition. Any form of exercise, from yoga to boxing, can relieve stress. Being physically active can reduce the risk of serious diseases or illnesses, including those associated with chronic stress, such as cardiovascular disease, stroke and cancer. The benefits are wide ranging – physical health and mental wellbeing improve, as does our overall sense of wellbeing.

Exercise has many benefits:

- It increases demands on the body for energy and in the process uses up stress hormones. This helps the body return to normal functioning sooner.
- It can also help 'work out' tension that has built up in the muscles.
- It increases the efficiency of the cardiovascular system and increases strength, flexibility and stamina for encountering future stressors.
- There are short-term psychological benefits during or immediately after exercising. For example, exercise can promote relaxation, thereby providing relief from stress symptoms.
- Strenuous physical activity produces 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.
- It can provide an opportunity for distraction or 'time out' from a stressor. For example, exercise can divert a person's attention away from a stressor and the negative emotional states associated with stress. Exercise can also benefit by removing the person 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.

ISBN 978-1-009-25416-8 Gallagher et al

Despite these benefits, in most cases exercise would be considered an avoidance strategy because it does not directly deal with the stressor you may be facing, unless the stressor is something such as needing to get fit and lose weight, or training for an event like a fun run. In these cases, it would of course be an approach strategy. But if you were to rely heavily on exercise as an avoidance strategy, this could lead to the previously mentioned limitations – it is only helpful in the short term and delays dealing with the stressor.

Check-in questions – Set 2

1 a What are approach strategies? Provide an example in your answer.
  b What are avoidance strategies? Provide an example in your answer.
2 a Outline one benefit and one limitation of using approach strategies to cope with stress.
  b Outline one benefit and one limitation of using avoidance strategies to cope with stress.

4E SKILLS

VIDEO 4E–1 SKILLS: QUESTIONS ON COPING

Questions on coping flexibility, approach strategies or avoidance strategies

In VCE Psychology, you may be provided with a scenario where you are required to identify and justify why you think someone demonstrates either coping flexibility, an approach strategy or an avoidance strategy. Ask your teacher for scenarios that allow you to practise this important skill.

Scenario:

Miguel has his university exams in a week and he is highly stressed. Throughout the semester, he has not been attending all of his lectures and tutorials, and is therefore feeling underprepared for his exams. To manage his stress, Miguel contacts his best friend Jake and asks him to play online games.

Question:

Explain whether Miguel is demonstrating an approach strategy or an avoidance strategy.

Attempted answer:

Miguel is demonstrating an approach strategy because the online games will help him forget about his stress.

Suggested answer:

Miguel is demonstrating an avoidance strategy. Choosing to play online games with his friend Jake will not relieve the stress of the approaching university exams. It may provide some short-term relief, but once the gaming is over, the exams and the associated stress will still be present.

Key points to remember:

- Start by stating whether you have identified an approach or avoidance strategy.
- Then, use an example from the case study to demonstrate your choice.
- Explain why your example is either an approach or an avoidance strategy, using your content knowledge as a basis for your explanation.

ISBN 978-1-009-25416-8 Gallagher et al

ACTIVITY 4E–1 EXERCISE AND ME

For many reasons, exercise is an effective coping strategy. Exercising releases built-up tension and increases the flow of endorphins or 'feel-good' hormones in the body. Think back over the past week and make a note of each time you exercised. Then go to the Australian Department of Health webpage 'Physical activity and exercise guidelines for all Australians' at the following link: http://cambridge.edu.au/redirect/9727.

Read about the daily exercise guidelines for your age group. Consider whether you are meeting the current recommendations and, if not, make a plan to meet them over the next week.

Section 4E questions

1 What does the coping flexibility hypothesis suggest?

2 A coping strategy has context-specific effectiveness when it matches or is appropriate to the stressful situation. Match the following strategies with the appropriate context.

Strategy		Context	
1	Daily cycling with longer cycling on weekends	A	An upcoming Psychology exam
2	Reading the Psychology textbook	B	A recent breakdown of an intimate relationship
3	Speaking with a counsellor about managing your feelings	C	An upcoming 'round the bay in a day' cycling event

3 'In the long term, an avoidance strategy is better than an approach strategy for dealing with a stressor.' Evaluate this statement.

ISBN 978-1-009-25416-8 Gallagher et al

Chapter 4 review

Summary

Create your own set of summary notes for this chapter on paper or in a digital document. A model summary is provided in the Teacher Resources, which can be used to compare with yours.

Checklist

In the Interactive Textbook, the success criteria are linked from the review questions and will be automatically ticked when answers are correct. Alternatively, print or photocopy this page and tick the boxes when you have answered the corresponding questions correctly.

Success criteria – I am now able to:		Linked questions
4A.1	Understand that internal and external stressors cause psychological and physiological stress responses, including the flight-or-fight-or-freeze response, and understand the role of cortisol in chronic stress	1☐, 2☐, 4☐
4A.2	Define ‘stress’, ‘stressor’ and ‘stress response’	1☐
4A.3	Distinguish between internal and external stressors and provide examples of each	2☐
4A.4	Explain what is meant by acute stress	14a☐
4A.5	Explain the features of the flight-or-fight-or-freeze response as an example of an acute stress response	3☐, 4☐
4A.6	Apply my understanding of the flight-or-fight-or-freeze response	3☐, 4☐
4A.7	Explain what is meant by chronic stress	14a☐
4A.8	Describe the role of the hormone cortisol in chronic stress responses	14b☐
4A.9	Apply my understanding of the role of cortisol to examples of chronic stress	14b☐
4B.1	Understand the GBA, and how stress can interact with gut microbiota and the nervous system, affecting our psychological processes and behaviour	10☐, 15☐
4B.2	Explain the structure and role of the GBA	8☐
4B.3	Understand the relationship between gut microbiota and the nervous system	15☐
4B.4	Explain how stress can influence the relationship between gut microbiota and the nervous system and how this affects our psychological processes and behaviours	9☐, 15☐
4B.5	Apply the relationship between stress, gut microbiota and the nervous system to psychological processes and behaviours	15☐
4C.1	Understand the explanatory power of Selye’s GAS as a biological model of stress	6☐
4C.2	Describe the key features of Selye’s GAS, including the stages of alarm reaction (shock/counter shock), resistance and exhaustion	5☐
4C.3	Apply my understanding of the GAS to explain real-world examples of responses to stressful events	5☐
4C.4	Evaluate the explanatory power of the GAS as a biological model of stress, by outlining its strengths and limitations	6☐

ISBN 978-1-009-25416-8

Success criteria – I am now able to:		Linked questions
4D.1	Describe Lazarus and Folkman's transactional model of stress and coping, including the stages of primary and secondary appraisal	14c☐, d☐
4D.2	Understand how Lazarus and Folkman's transactional model of stress and coping explains stress as a psychological process	14e☐
4D.3	Outline why Richard Lazarus and Susan Folkman propose that stress is a psychological process that is unique to the individual	7☐
4D.4	Apply my understanding of the transactional model of stress and coping to explain real-world examples of responses to stressful events	14c☐,d☐
4D.5	Evaluate the explanatory power of the transactional model of stress and coping, as a model used to explain stress as a psychological process	6☐
4D.6	Compare and contrast the GAS and the transactional model of stress and coping, as models used to explain stress	6☐
4E.1	Identify and describe strategies for coping with stress and improving mental wellbeing	12☐, 16a☐
4E.2	Explain and apply strategies for coping with stress and improving mental wellbeing	13☐, 16b☐
4E.3	Explain the importance of context-specific effectiveness and coping flexibility in relation to the successful use of coping strategies	11☐, 16c☐

Key Science Skills

Skills	Questions and Skills boxes
Determine appropriate investigation methodology: case study; classification and identification; controlled experiment; correlational study; fieldwork; literature review; modelling; product, process or system development; simulation	4D Key Science Skills 4D Section questions – 4, 5a, b
Work independently and collaboratively as appropriate and within identified research constraints, adapting or extending processes as required and recording such modifications	4D Key Science Skills 4D Section questions – 5c Activity 4D–1

Multiple-choice questions

1 Stress and a stressor refer to

	Stress	Stressor
A	a state of psychological tension that is interpreted in the same way by all individuals	an event that is perceived to threaten us and challenge our ability to cope
B	a state of psychological tension that can be subjective, and produces different physiological responses in all individuals	an event that is not perceived to threaten us and with which we can cope
C	a state of physiological tension only, which is the same for all individuals	an event that causes us stress, but with which we can cope
D	a state of psychological tension that can be subjective, and produces different physiological responses in all individuals	an event that is perceived to threaten us and challenge our ability to cope

ISBN 978-1-009-25416-8

The following information relates to Questions 2–5.

Merinda is feeling stressed and overwhelmed about her workload in her new job. She is putting pressure on herself to succeed as this is a promotion for her and she wants to do well. In addition, she has also been asked to make a presentation to the team she manages and was asked by her boss to make sure she impresses everyone and gets them on side. Merinda has been putting in a lot of extra hours in the lead-up to the presentation, which has also put a strain on her relationship with her boyfriend, as he complains he not seen her enough recently.

2 For Merinda, an example of an internal and external stressor is

	Internal	External
A	being asked by her boss to make sure she impresses everyone in the team presentation	putting pressure on herself to succeed
B	putting pressure on herself to succeed	strain on her relationship with her boyfriend
C	strain on her relationship with her boyfriend	being asked by her boss to make sure she impresses everyone in the team presentation
D	being asked by her boss to make sure she impresses everyone in the team presentation	feeling stressed and overwhelmed

3 Merinda's boss brings forward the team meeting at short notice. She begins to feel significantly more stressed. In terms of the flight-or-fight-or-freeze response it is likely that Merinda will experience

A constricted pupils and a decrease in her rate of digestion.
B increased sweating and an increased rate of digestion.
C dilated pupils and increased sweating.
D decreased heart rate and decreased breathing rate.

4 Merinda's flight-or-fight-or-freeze response will be activated by her

A somatic nervous system, which is consciously regulated.
B parasympathetic nervous system, which is unconsciously regulated.
C sympathetic nervous system, which is unconsciously regulated.
D central nervous system, which is consciously regulated.

5 When Merinda's flight-or-fight-or-freeze response occurs, she will be in which stage of the general adaptation syndrome?

A shock
B countershock
C resistance
D alarm reaction

6 Which of the following statements is correct when comparing the GAS and the transactional model of stress and coping?

A The GAS model does not explain biological contributors to stress, whereas the transactional model does.
B The transactional model explains the influence of individual perceptions on the stress response, whereas the GAS does not.
C The transactional model explains the role of the flight-or-fight-or-freeze response in the stress response, whereas the GAS does not.
D The GAS model accounts for both biological and psychological or cognitive aspects of stress, whereas the transactional model only accounts for psychological or cognitive aspects.

ISBN 978-1-009-25416-8

7 Richard Lazarus and Susan Folkman proposed that stress is unique to the individual because

- **A** it depends on the person's perception of the stressor and whether they believe they can cope with it.
- **B** stress involves a set of biological responses that differ from person to person.
- **C** the stress response is only elicited if the individual believes that the stressor does not exceed their available resources.
- **D** stress is an interaction between biological and psychological responses.

8 The enteric nervous system is a further subdivision of which main division of the nervous system?

- **A** central nervous system
- **B** autonomic nervous system
- **C** peripheral nervous system
- **D** parasympathetic nervous system

9 Which of the following statements about the relationship between gut microbiota and stress is not true?

- **A** Stress causes changes in gut microbiota and deficiencies in certain bacteria, which have been linked to anxiety and depression.
- **B** Specific gut microbiota associated with stress have been shown to increase anxiety-related behaviours.
- **C** Stress exposure early in life or in adulthood can change an organism's microbiota composition.
- **D** Treatment with unhealthy microbiota can reduce anxiety-like behaviour and reduce stress responsiveness.

10 The difference between germ-free and normal mice used in research relating to the gut–brain axis is that

- **A** germ-free mice are delivered surgically and raised under sterile conditions with no microbial exposure, whereas normal mice are delivered non-surgically and are raised under non-sterile conditions.
- **B** normal mice are particularly useful because they have minimal gut microbiota, which can be manipulated/controlled by scientists.
- **C** normal mice are delivered surgically and raised under sterile conditions with no microbial exposure, whereas germ-free mice are delivered non-surgically and are raised under non-sterile conditions.
- **D** the effects of changes to specific gut microbes on behaviours can be determined when using normal mice, not germ-free mice.

11 Whether a coping strategy works or not is influenced by two factors. They are

- **A** coping-specific effectiveness and coping flexibility.
- **B** the plateau effect and resilience.
- **C** desensitisation and the plateau effect.
- **D** coping-specific flexibility and coping effectiveness.

12 Which of the following is a limitation of avoidance strategies?

- **A** Long-term use of these strategies can lead to other problems.
- **B** They tend to be maladaptive.
- **C** They tend to only be useful in the short term.
- **D** All of the above

ISBN 978-1-009-25416-8 Gallagher et al

13 Which of the following is an approach strategy?
- **A** procrastination
- **B** seeking advice from a counsellor
- **C** napping or oversleeping
- **D** substance use or abuse

Short-answer questions

14 Abby is stressed about an upcoming History assignment that is due on Friday. For the last few months, her friend Peta has been struggling to deal with the stress associated with her parents' ongoing divorce. Peta has been feeling run down and overwhelmed by her workload. She finds it hard to concentrate and has been worried that she may get sick and fall further behind with her schoolwork. Normally she would talk to her mother when she is feeling stressed, but her mother has been very busy with work and organising the divorce, so Peta has not wanted to bother her.

- **a** Using your understanding of the difference between chronic and acute stress, discuss the likelihood of Abby and Peta developing a physical or mental illness. (4 marks)
- **b** Explain how the stress hormone cortisol would help Peta deal with the stress associated with her parents' ongoing divorce. (2 marks)
- **c** With reference to the transactional model of stress and coping, describe a primary appraisal that Peta is having about her situation. (2 marks)
- **d** With reference to the transactional model of stress and coping, describe Peta's secondary appraisal of her situation. (2 marks)
- **e** Why are both primary and secondary appraisal considered to be a psychological process for Peta? (1 mark)

15 Richard has been dealing with ongoing chronic stress in his life and has been suffering from anxiety-related symptoms. His doctor ordered a blood test because he has been complaining of feeling run down and extremely stressed. The test revealed that he has particularly high cortisol levels and Richard's doctor suggested that he begin to consume probiotics to assist with his anxiety-related symptoms.
- **a** What does emerging research suggest about the effects of chronic stress and high levels of cortisol on Richard's gut microbiota? (3 marks)
- **b** Why would the doctor have suggested Richard take a probiotic containing healthy gut bacteria to help treat his anxiety and exaggerated stress-related symptoms? (2 marks)
- **c** Use your understanding of the gut–brain axis to explain how communication between Richard's central and enteric nervous systems could exaggerate his stress and anxiety-related symptoms. (5 marks)

16
- **a** Explain two ways exercise could be used as an effective avoidance strategy to reduce an individual's stress levels. (2 marks)
- **b** List two possible limitations of using exercise as a coping strategy. (2 marks)
- **c** Describe an example of when exercise would be a successful approach coping strategy with context-specific effectiveness. (2 marks)

ISBN 978-1-009-25416-8 Gallagher et al

UNIT 3 HOW DOES EXPERIENCE AFFECT BEHAVIOUR AND MENTAL PROCESSES?

CHAPTER 5 APPROACHES TO UNDERSTAND LEARNING

Aboriginal and Torres Strait Islander readers should be aware that this chapter contains images of people who have, or may have, passed away.

Introduction

Learning through experience is fundamental in life in order to develop and function. Learning can be intentional (an active process) or unintentional (a passive process). For example, when playing basketball, you may intentionally learn to block a person taking a shot, or you may already have unintentionally learned to put your hands out when falling over on the court, after years of falling over as a child. Learning can be a self-driven process, or it may happen when you are part of a community growing and learning from each other, as covered in Section 5D, which has a particular focus on First Nation peoples' systems of knowledge.

In Chapter 3, we discussed the neural basis of memory as the biological process of learning. In this chapter you will begin to see that learning is the acquisition of a skill or knowledge through experience, while memory is the retention of that knowledge. In this chapter, we also explore how learning can be discussed at a behavioural level; for example, explaining the following experiences in life:

- hearing the school bell ring for the first time and wondering why everyone suddenly changed what they were doing
- walking into an elevator and facing the door rather than the wall
- yarning with an Elder about why painting with rocks from the land is important
- feeling anxious as a driver when a police officer pulls you over
- becoming stressed when you are late to class or work
- watching someone get in trouble with authority (e.g. police, teacher, parent, coach) and then changing your own behaviour.

ISBN 978-1-009-25416-8 Gallagher et al

Curriculum

Area of Study 2 Outcome 2
Approaches to understand learning

Study Design	Learning intentions – at the end of this chapter I will be able to:
• Behaviourist approaches to learning, as illustrated by 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, and operant conditioning as a three-phase process (antecedent, behaviour and consequence) involving reinforcement (positive and negative) and punishment (positive and negative)	**5A Classical conditioning** **5A.1** Describe the key features of classical conditioning as an approach to explaining learning, including its involuntary nature and the association formed **5A.2** Explain the three-phase process of classical conditioning (before, during and after conditioning) using key terminology (neutral stimulus, unconditioned stimulus, unconditioned response, conditioned stimulus and conditioned response) **5A.3** Apply my understanding of the three-phase process (before, during and after conditioning) and use key terminology to identify the neutral stimulus, unconditioned stimulus, unconditioned response, conditioned stimulus and conditioned response in real-life examples of classical conditioning
• Behaviourist approaches to learning, as illustrated by 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, and operant conditioning as a three-phase process (antecedent, behaviour and consequence) involving reinforcement (positive and negative) and punishment (positive and negative)	**5B Operant conditioning** **5B.1** Describe the key features of operant conditioning as an approach to explaining learning, including its voluntary nature **5B.2** Explain the three-phase process of operant conditioning (antecedent, behaviour and consequence) **5B.3** Apply my understanding of the three-phase process by identifying the antecedent, behaviour and consequence in real-life examples of operant conditioning **5B.4** Explain the effect of different consequences in operant conditioning on behaviour, including reinforcers (positive and negative) and punishment (including response cost) **5B.5** Apply my understanding of the different consequences by correctly identifying the use of positive and negative reinforcements in real-life examples of operant conditioning **5B.6** Apply my understanding of the different consequences by correctly identifying the use of positive and negative punishments in real-life examples of operant conditioning **5B.7** Compare and contrast classical and operant conditioning as approaches used to explain learning

ISBN 978-1-009-25416-8

Study Design	Learning intentions – at the end of this chapter I will be able to:
• Social-cognitive approaches to learning, as illustrated by observational learning as a process involving attention, retention, reproduction, motivation and reinforcement	**5C Observational learning** **5C.1** Describe the key features of observational learning and explain why it is considered to be a social-cognitive approach to explaining learning **5C.2** Describe attention, retention, reproduction, motivation and reinforcement as the key processes involved in observational learning **5C.3** Apply my understanding of the processes involved in observational learning (attention, retention, reproduction, motivation and reinforcement) to real-life examples **5C.4** Compare and contrast observational learning with classical and operant conditioning, as approaches used to explain learning
• Approaches to learning that situate the learner within a system, as illustrated by Aboriginal and Torres Strait Islander ways of knowing where learning is viewed as being embedded in relationships where the learner is part of a multimodal system of knowledge patterned on Country	**5D Aboriginal and Torres Strait Islander ways of knowing** **5D.1** Understand that learning can occur when the learner is a part of a system, as illustrated in Indigenous cultures where learning is viewed as being embedded in relationships **5D.2** Explain what is meant by 'Aboriginal and Torres Strait Islander ways of knowing' and provide examples **5D.3** Explain how Indigenous learners are viewed as being part of a multimodal system of knowledges patterned on Country

Key Science Skills

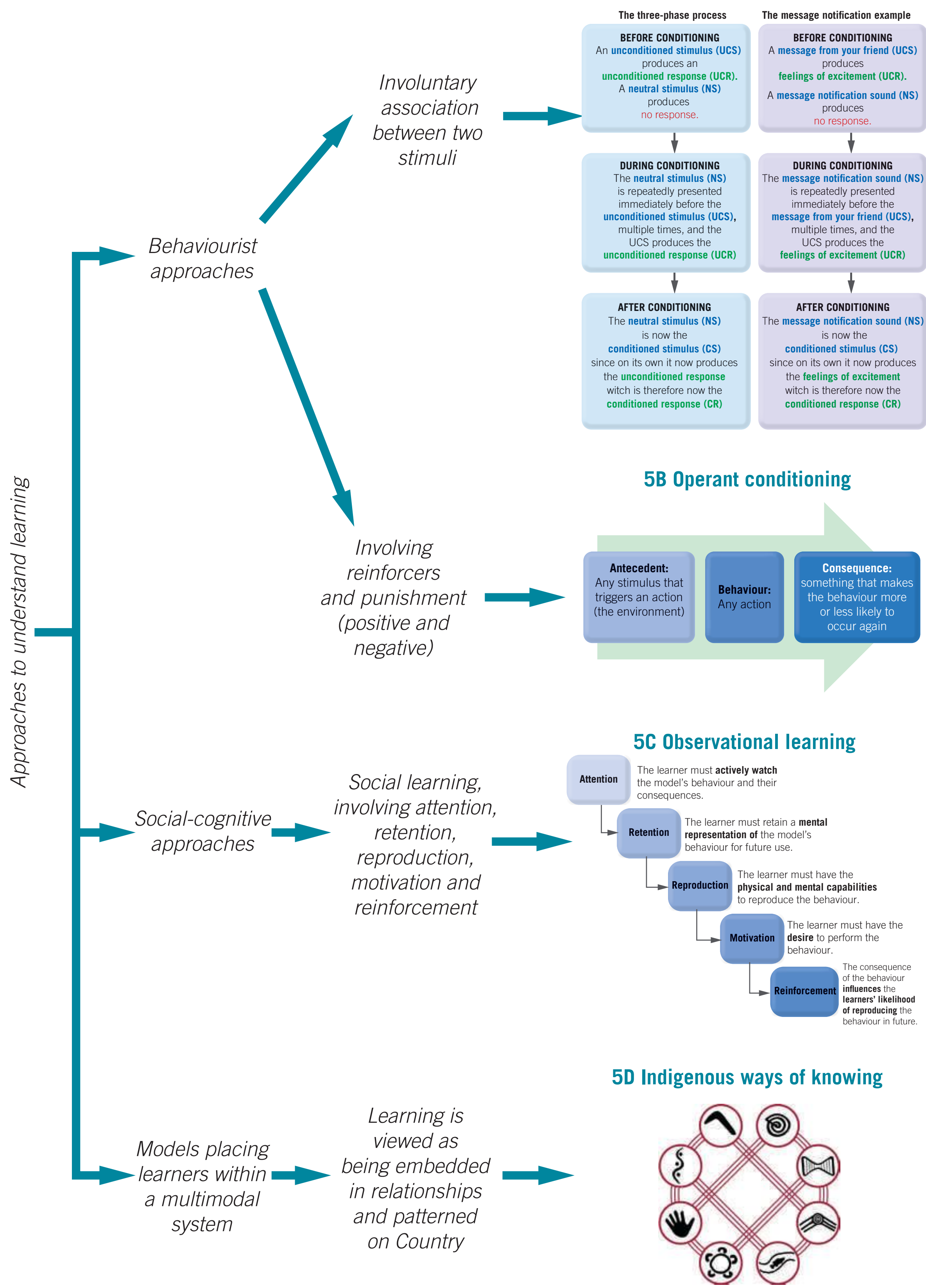
- Demonstrate safe laboratory practices when planning and conducting investigations by using risk assessments that are informed by safety data sheets (SDS), and accounting for risks
- Apply relevant occupational health and safety guidelines while undertaking practical investigations
- Demonstrate ethical conduct and apply ethical guidelines when undertaking and reporting investigations

Glossary

Aboriginal and Torres Strait Islander peoples
Acquisition
After conditioning
Antecedent
Attention
Before conditioning
Behaviour
Behaviourist approach
Classical conditioning
Community
Conditioned response (CR)
Conditioned stimulus (CS)
Conditioning
Connection to Country
Consequence
During conditioning
First Nations
Indigenous
Kinaesthetic
Learner
Learning
Learning map
Model
Motivation
Narrative
Negative punishment
Negative reinforcement
Neutral stimulus (NS)
Observational learning
Operant conditioning
Place-based learning
Positive punishment
Positive reinforcement
Punishment
Reinforcement
Reproduction
Response
Retention
Social-cognitive approach
Stimulus
Unconditioned response (UCR)
Unconditioned stimulus (UCS)
Ways of knowing
Yarn

ISBN 978-1-009-25416-8

Concept map



See the Interactive Textbook for an interactive version of this concept map interlinked with all concept maps for the course.

ISBN 978-1-009-25416-8 Gallagher et al

5A Classical conditioning

Study Design:
Behaviourist approaches to learning, as illustrated by 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, and operant conditioning as a three-phase process (antecedent, behaviour and consequence) involving reinforcement (positive and negative) and punishment (positive and negative)

Glossary:
Acquisition
After conditioning
Before conditioning
Behaviourist approach
Conditioning
Classical conditioning
Conditioned response (CR)
Conditioned stimulus (CS)
During conditioning
Learning
Neutral stimulus (NS)
Response
Stimulus
Unconditioned response (UCR)
Unconditioned stimulus (UCS)

ENGAGE

How social media influencers change your behaviour

In 2019, a study was conducted in India that suggested that 97% of adolescents aged 15–17 own a smartphone and use it regularly to access social media. Furthermore, the teenagers said that they mostly used Instagram, TikTok and Snapchat every day. The growth of social media has opened up opportunities for careers as micro-celebrities in blogging or vlogging. These people have gained fame on social media through self-branding and online exposure. They are known as influencers, and they can be paid to endorse particular products in their content to their millions of followers.

For example, Dwayne Johnson, commonly known as 'The Rock', has recorded 230 million followers and earns on average $US1.1 million for each Instagram advertising post. Similarly, Kim Kardashian has more than 220 million followers and earns on average $US1.1 million for each advertising post. Influencers such as Kim Kardashian and Dwayne 'The Rock' Johnson change consumer behaviour through social media, for which they derive income.

This new form of advertising technique changes the behaviour and attitudes of consumers without them actively being involved in the behaviour change. Furthermore, the consumers of social media information are involuntarily learning to change their behaviour purely because of its association to a desirable post or video from a social media influencer. Adolescents perceive online influencers as more credible than traditional celebrities and therefore the advertising cues in influencer messages are more likely to be effective.

Marketing agencies now depend on social media influencers more than traditional Hollywood figures to promote their brands. This is because influencers can use persuasion techniques such as repetition of association between products and the influencer, product demonstration and popularity among peers. Influencers are also able to build ongoing relationships with adolescents through social media networking sites that makes it easier to connect and learn their desires so that they can plan their next promotion.

Overall, research confirms that adolescents are more likely to copy the behaviours of online influencers because of the connection that is created between the behaviour and the influencer they admire. Do you notice that your behaviour changes due to followers online? If so, you're not alone. People don't notice their behaviour changing; it happens involuntarily and passively. You will learn more about this in this section.

ISBN 978-1-009-25416-8 Gallagher et al

EXPLAIN

Overview of classical conditioning

Learning is the process of acquiring knowledge or skills resulting from experience. There are many approaches to understanding how learning occurs. Classical conditioning, along with operant conditioning (discussed in Section 5B), are both considered to be **behaviourist approaches** to understanding learning. This is because they both state that behaviours are learned through interactions with the environment as a result of the process of **conditioning**. This is a learning process by which the behaviour of an organism becomes dependent on an event or **stimulus** occurring in its environment. In the case of classical conditioning, the **response** involved is an involuntary or reflexive one that occurs automatically and unconsciously; for example, blinking in response to dust blowing in your eye on a windy day or salivating in response to your favourite freshly baked cookies. Let's look more closely at how the classical conditioning process was first discovered.

Figure 5A–1 Top: An example of an involuntary action is flinching when someone throws a water balloon at you. Centre: If students repeatedly attend a certain class and feel bored, as soon as they walk into that class again they will feel bored by association. Bottom: If you have a positive view of Kim Kardashian, you may associate that good feeling with a product she promotes.

Pavlov's pioneering classical conditioning research

Around 1900, physiologist Ivan Pavlov was studying digestion in dogs, particularly the role of saliva in dogs' digestion. He developed equipment to measure the amount of saliva that dogs produced in response to food being placed in front of them. He noticed that the dogs started to salivate as soon as the technician who fed them entered the room, before the food even appeared. He therefore experimented with other stimuli to see if they also produced salivation, using the experimental set-up shown in Figure 5A–2. His best-known experiment involved multiple trials of starting a metronome (a device that produces a steady beat) ticking just before the dogs were fed. Originally the dogs had no natural response to the metronome, but eventually they started to unconsciously salivate at the sound of the metronome alone because of repeated associations between this stimulus and the stimulus of the food. This led Pavlov to develop the three-phase process of **classical conditioning**.

VIDEO 5A–1 CLASSICAL AND OPERANT CONDITIONING

Learning the process of acquiring knowledge or skills resulting from experience; there are many approaches

Behaviourist approach an approach to learning that states that behaviours are learned through interactions with the environment

Conditioning the learning process by which the behaviour of an organism becomes dependent on an event occurring in its environment

Stimulus an environmental event that triggers a response in an organism

Response a behavioural reaction to a stimulus

Classical conditioning a simple form of learning that occurs through repeated associations between two stimuli to produce a conditioned response

ISBN 978-1-009-25416-8 Gallagher et al

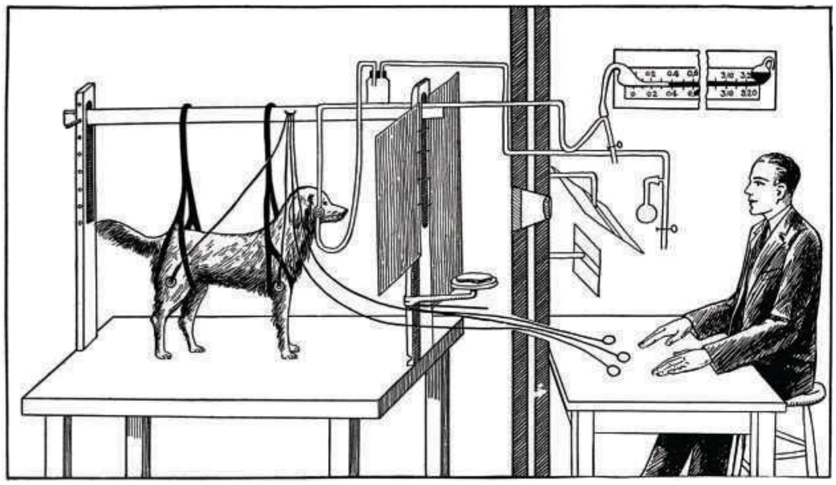


Figure 5A–2 A drawing representing one of Pavlov's experimental set-ups for his classical conditioning experiments on dogs. The pipe connected to the dog's head is collecting the dog's saliva. There were many variations both of the saliva collection apparatus and of the stimuli. In this version, the food is presented from behind a screen and, instead of a metronome, there is equipment to deliver a (hopefully mild) electric shock. Note that according to a 2014 biography of Pavlov, he didn't actually use a ringing bell as a stimulus in the experiments.

Classical conditioning can be described as a simple form of involuntary learning, which occurs through repeated associations of two different stimuli to produce a conditioned response.

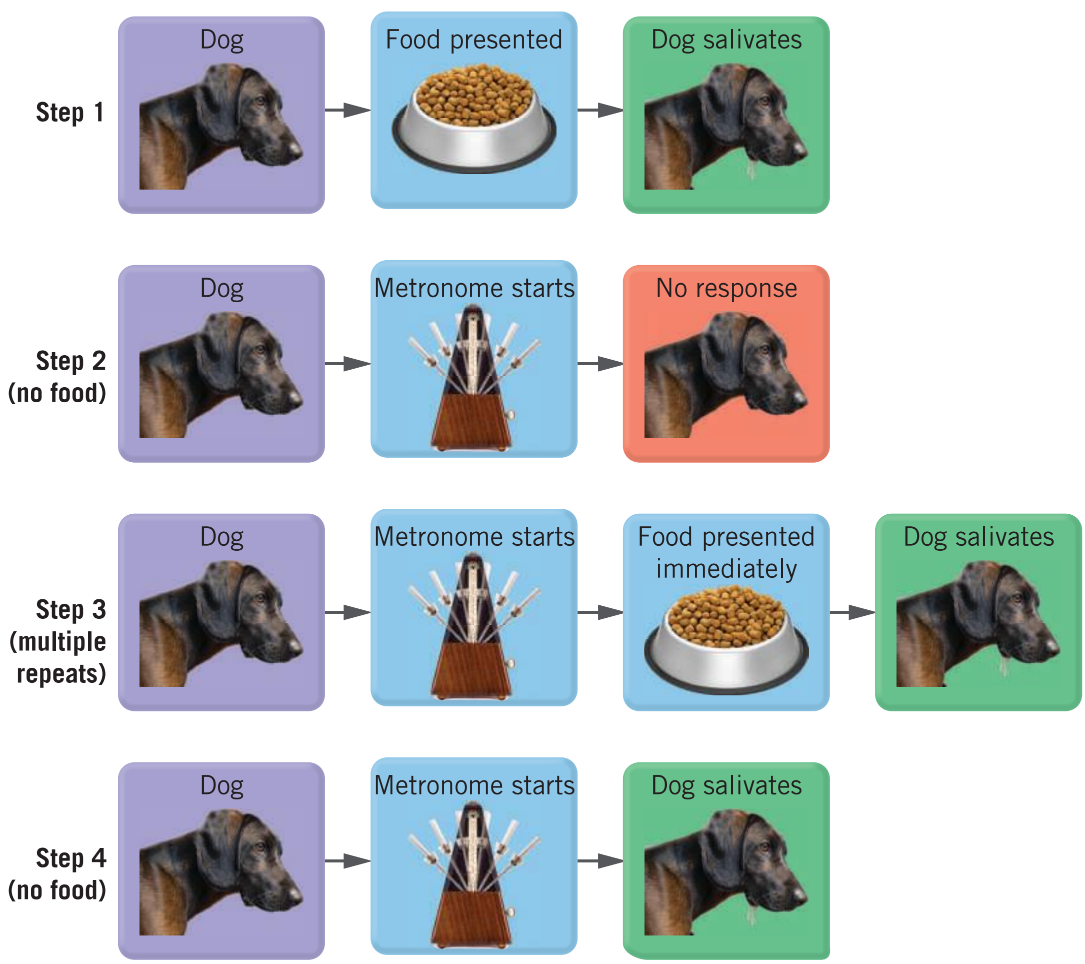


Figure 5A–3 Simplified steps in Pavlov's dog experiment. Blue panels are stimuli, green and red panels are responses. The dog salivates naturally (response) when it sees or smells food (stimulus). At first the sound of the metronome alone produces no response. But after repeating step 3 several times, at step 4 the dog salivates to the metronome on its own.

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 1

1 What is classical conditioning?
2 Identify what a stimulus is.
3 Use an example to distinguish between a stimulus and a response.
4 Outline Pavlov's dog experiment that demonstrated classical conditioning.

The three-phase process of classical conditioning

The three phases of classical conditioning are *before conditioning*, *during conditioning* and *after conditioning*. In the discussion below, the phases and terminology are related to Figure 5A–3.

Before conditioning

Before conditioning is the phase when no learning has taken place yet. In this phase, there is an **unconditioned stimulus (UCS)**, which consistently produces a naturally occurring, automatic response, shown in **step 1** in Figure 5A–3. The UCS is the presentation of food. The word *unconditioned* here is used in the sense of 'not depending on any conditions' or 'unconditional.'

The response to the unconditioned stimulus is called the **unconditioned response (UCR)**, for the same reason – it doesn't depend on any conditions. It is the naturally occurring, automatic response to the UCS. When a dog sees or smells food, it begins to salivate; this is a reflexive response. The UCR is the dog salivating in **step 1** of Figure 5A–3.

In this before conditioning phase, there is also a **neutral stimulus (NS)**, shown in **step 2** as the sound of the ticking metronome. The dog does not have a natural response to it. The word *neutral* here is used in the sense of 'not doing anything.'

During conditioning

During conditioning is the phase in which the two stimuli are associated or paired. The neutral stimulus is usually presented and immediately followed by the unconditioned stimulus, or they are presented simultaneously. This is shown in **step 3** of Figure 5A–3, where the metronome is started (NS) and food is presented (UCS). The salivating response (UCR) is due to the food being presented (UCS).

This step is repeated multiple times, so that the two stimuli, the NS and UCS, become associated or paired. This is called **acquisition**, the association of the NS with the UCS. It is at the heart of this learning process.

After conditioning

After conditioning is the final stage of classical conditioning, shown in **step 4** of Figure 5A–3, in which the neutral stimulus becomes the **conditioned stimulus (CS)**. Through repeated association in the previous phase, the neutral stimulus (the ticking metronome) on its own now triggers the same unconditioned response (salivation) as the unconditioned stimulus. The unconditioned response is now called the **conditioned response (CR)** when it is a response to the CS. The word *conditioned* here is used to mean that the stimulus or response depends on a condition, namely that acquisition has occurred.

Before conditioning the first stage of classical conditioning; at this stage no learning has occurred

Unconditioned stimulus (UCS) a stimulus that consistently produces a naturally occurring, automatic response

Unconditioned response (UCR) a response that occurs automatically/involuntarily when the unconditioned stimulus is presented

Neutral stimulus (NS) a stimulus (prior to conditioning) that doesn't produce a response

During conditioning the second stage of classical conditioning, in which learning occurs through association

Acquisition the process during which an organism learns to associate two events (the neutral stimulus and the unconditioned stimulus)

After conditioning the final stage of classical conditioning

Conditioned stimulus (CS) a stimulus that was previously neutral but now, as a result of repeated associations with the unconditioned stimulus, produces a conditioned response

Conditioned response (CR) a learned behaviour that is similar to the unconditioned response and is now triggered by the conditioned stimulus as a result of conditioning

ISBN 978-1-009-25416-8 Gallagher et al

So, the CS (ticking metronome) now produces the CR (salivation).

The CR is a learned and involuntary behaviour that is similar to (but not necessarily exactly the same as) the unconditioned response. In Pavlov's dog experiments, they are the same, namely salivating in anticipation of food. However, imagine a scenario in which the neutral stimulus is seeing a bee, the unconditioned stimulus is being stung by the bee and the unconditioned response is pain from the sting. Then the conditioned stimulus will be seeing the bee and the conditioned response will be fear of the pain of a sting, not an actual sting.

WORKSHEET 5A–1 APPLYING CLASSICAL CONDITIONING TO SCENARIOS

Let's look more closely at an everyday example of classical conditioning. Figure 5A–4 summarises the three-phase process of classical conditioning as it applies to the everyday example of feeling excited upon getting a message notification on your phone from a friend. After conditioning, the sound of the notification alone elicits feelings of excitement.

The three-phase process	The message notification example
BEFORE CONDITIONING An **unconditioned stimulus (UCS)** produces an **unconditioned response (UCR).** A **neutral stimulus (NS)** produces **no response.**	**BEFORE CONDITIONING** A **message from your friend (UCS)** produces **feelings of excitement (UCR).** A **message notification sound (NS)** produces **no response.**
DURING CONDITIONING The **neutral stimulus (NS)** is repeatedly presented immediately before the **unconditioned stimulus (UCS)**, multiple times, and the UCS produces the **unconditioned response (UCR)**	**DURING CONDITIONING** The **message notification sound (NS)** is repeatedly presented immediately before the **message from your friend (UCS)**, multiple times, and the UCS produces the **feelings of excitement (UCR)**
AFTER CONDITIONING The **neutral stimulus (NS)** is now the **conditioned stimulus (CS)** since on its own it now produces the **unconditioned response** witch is therefore now the **conditioned response (CR)**	**AFTER CONDITIONING** The **message notification sound (NS)** is now the **conditioned stimulus (CS)** since on its own it now produces the **feelings of excitement** witch is therefore now the **conditioned response (CR)**

Figure 5A–4 Left: a flow chart summarising the three-phase process of classical conditioning. Right: the process applied to the everyday example of receiving a message from a friend and feeling excitement. (Blue represents stimulus, green response, and red neutral.)

ISBN 978-1-009-25416-8 Gallagher et al

The three-phase model

BEFORE CONDITIONING

A ______________________________ (UCS)

produces ______________________________ (UCR).

A ______________________________ (NS)

produces no response

↓

DURING CONDITIONING

The ______________________________ (NS)

is presented immediately before

the ______________________________ (UCS)

multiple times, and the UCS produces the

______________________________ (UCR)

↓

AFTER CONDITIONING

The NS ______________________________

is now the CS since on its own it now produces

the UCR ______________________________

which is therefore now the (CR).

Figure 5A–5 This template can be used to apply the three-phase model of classical conditioning to examples you analyse and create. Make a copy of it and fill in the blanks when needed.

NOTE

- The neutral stimulus must be presented before the unconditioned stimulus for the association to be most effective.
- No more than half a second should elapse between the presentation of the neutral stimulus and the unconditioned stimulus.
- Acquisition is complete when the conditioned stimulus alone produces the conditioned response.

Check-in questions – Set 2

1 Make a copy of Figure 5A–3 and label it with the three phases of classical conditioning and all instances of the UCS, UCR, NS, CS and CR.

2 Create a flow chart similar to Figure 5A–4 that shows the classical conditioning that might occur if your messaging app has a particular notification sound for a message from someone who is usually annoyed with you or critical of you.

3 Explain and give an example of the use of these words in classical conditioning:

a conditioned

b unconditioned

c involuntary

d pairing

e association

f acquisition

ISBN 978-1-009-25416-8 Gallagher et al

VIDEO 5A–2
SKILLS: APPPLYING YOUR UNDERSTANDING OF CLASSICAL CONDITIONING TO SCENARIOS

5A SKILLS

Applying your understanding of classical conditioning to scenarios
Commonly, in questions based on classical conditioning scenarios, you will have to use the correct terminology to explain how someone has learned a behaviour through the process of classical conditioning. In particular, you will need to reference the three phases (before, during and after) as well as the key elements (NS, UCS, UCR, CS and CR). It can therefore be useful to signpost or subhead your response when summarising each stage, and use brackets when referring to each element. Let's look at an example of a question.

Question:

Celeste goes to the beach every day over a hot summer and has to park her car in the sun. As she is putting her seatbelt on, the hot metal tongue of the buckle brushes against her skin; Celeste feels pain as a result. This happens several days in a row. Before experiencing multiple seatbelt burns, she has never flinched while putting the seatbelt on; now every time she puts her seatbelt on, she flinches. Use the three-phase process of classical conditioning to explain why Celeste now flinches when putting her seatbelt on.

Answer:

Before conditioning

The seatbelt (NS) does not cause Celeste a response. The burn (UCS) from the hot seatbelt causes Celeste pain (UCR) in response to the burn.

During conditioning

The seatbelt (NS) is repeatedly presented just before the burn (UCS) from the seatbelt, causing Celeste pain (UCR) in response to the burn.

After conditioning

Now the seatbelt (CS) alone causes Celeste to flinch in response to the seatbelt (CR) when putting it on.

Finally, know that VCAA accepts answers with abbreviations for classical conditioning; for example, UCR for unconditioned response and CS for conditioned stimulus.

Key points to remember:
- The neutral stimulus and the conditioned stimulus are often the same, if not similar. For example: neutral stimulus – seatbelt; conditioned stimulus – seatbelt.
- The unconditioned response and the conditioned response are similar, but you must write what the response is 'at/to ....'
  For example: unconditioned response – pain in response to the burn of the seatbelt; conditioned response – flinching in response to the seatbelt on.
- Be sure to name each stage clearly in your answer, and always identify the elements of the classical conditioning and apply them to the scenario by using brackets. You can use the template in Figure 5A–5.

ACTIVITY 5A–1 CLASSICAL CONDITIONING TASK

To learn how to involuntarily salivate at the sound of a knock, collect your favourite snack and something to knock on (for example, a classroom table).

1 Work in pairs. Your partner is the experimenter in this task and is to randomly knock on the table 20 times, at any time they desire, over a period of 10 minutes. Immediately after each knock, you, the participant, will eat a small amount of your favourite snack (just enough to taste the flavour and produce a salivation response).
2 Next, do not eat, hold the snack or look at the snack at any time; however, take note of how you respond after each knock. The experimenter will now randomly knock another 10 times, at any time they desire, over the next five minutes.
3 Continue to not eat, hold the snack or look at the snack at any time; however, take note of how you respond after the knock. The experimenter will then knock again after 3 minutes.

Questions:

- Did you salivate or respond in a similar way to the favourite snack as you did to the knocking when the favourite snack was taken away?
- In relation to the acquisition stage of classical conditioning, what are the two stimuli being associated together?
- Apply the three-phase model of classical conditioning to this experiment.

Section 5A questions

1 In the following scenarios, identify the neutral stimulus, unconditioned stimulus, unconditioned response, conditioned stimulus and conditioned response.
   a A dog getting excited each time its owner grabs its leash.
   b A baby salivates when being placed in its highchair ready for dinner.
   c A cat purrs each time it hears its owner use a can opener to open its food.
   d A young child is bitten by a barking dog. Now, every time they hear a dog bark, they whimper in fear.
2 Using the three-phase model of classical conditioning, explain why a baby may cry and scream when put to bed each night to sleep, knowing that the first time the baby was put to bed, they didn't protest.
3 Jackson drives his motorbike to work every morning. Three days in a row the motorbike has problems starting, which causes him to rev the engine making a loud obnoxious noise just as his neighbour's baby, Olivia, is passing by in her stroller being pushed to day care. This causes her to startle and cry excessively. Now, whenever Olivia sees a motorbike, she cries excessively.

   Using classical conditioning terminology, outline why Olivia learned to cry every time she saw a motorbike.

ISBN 978-1-009-25416-8 Gallagher et al

5B Operant conditioning

Study Design:
Behaviourist approaches to learning, as illustrated by 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, and operant conditioning as a three-phase process (antecedent, behaviour and consequence) involving reinforcement (positive and negative) and punishment (positive and negative)

Glossary:
Antecedent
Behaviour
Consequence
Negative punishment
Negative reinforcement
Operant conditioning
Positive punishment
Positive reinforcement
Punishment
Reinforcement

ENGAGE

Training animals to be full-time carers for humans

Service dogs have been trained with treats to identify when people need assistance for various disabilities and chronic health conditions such as diabetes and post-traumatic stress disorder (PTSD). These service dogs give cost-effective support and increase people's independence, ability to stay employed, and general wellbeing.

Figure 5B–1 Service dogs are trained by reinforcement.

For example, a diabetes service dog is trained to identify when its owner's blood sugar is abnormally low or high and then alert them to adjust their levels of insulin before they become too unwell. PTSD service dogs are trained to disrupt their owner's nightmares, improving the owner's sleep quality; and reduce the owner's anxiety at people getting too close by alerting and creating boundaries with other people.

The relationship between the service dog and their owner is very important; so, generally, the service dogs should not be patted or rewarded outside of their duties. The process of matching a service dog and a client takes a long time, to be sure both the dog and the person feel safe, trusted and cared for. The training of a service dog includes giving instructions and then either rewarding or punishing the behavioural response the dog gives.

In the United States, similar service training has occurred with monkeys, and monkeys have been used to support people with disabilities. They are trained to complete tasks such as turning on the TV, getting the person a drink or even scratching their body for them.

ISBN 978-1-009-25416-8 Gallagher et al

It isn't just animals who actively learn behaviours from consequence; humans also learn this. For example:

- Youngest siblings in large families might do their siblings' chores in order to gain attention.
- If it is your responsibility to put the rubbish bin out and you are too late for the rubbish truck, there would be a consequence.
- If you tell a joke during a speech but no one laughs, you might not talk publicly again.

Figure 5B–2 Humans learn from consequences.

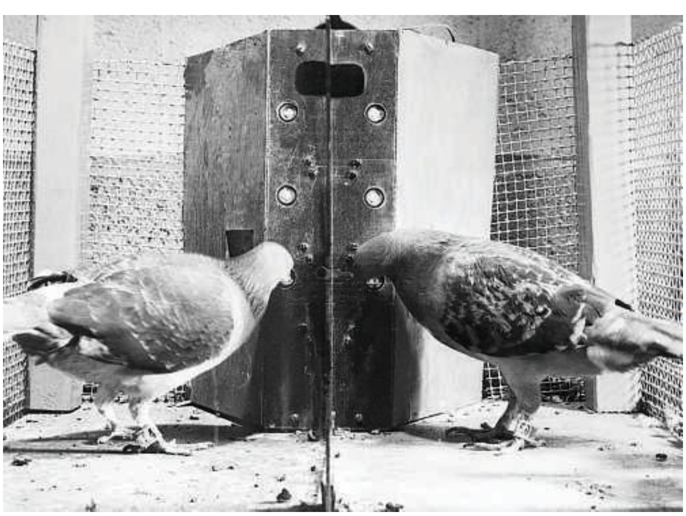
In all these situations we will either volunteer to demonstrate the behaviour again or not, depending on the consequence that follows.

As you read further into this section, you will begin to understand the conscious relationship between the behaviour and the consequence.

EXPLAIN

Overview of operant conditioning

Interestingly, it was animals again that were used to initially discover and understand the theory of operant conditioning. In 1948, psychologist B.F. Skinner trained mice and pigeons to perform certain behaviours (pressing a lever or matching a coloured panel and coloured light) by rewarding them with food each time they carried out the correct behaviour (Figure 5B–3). Through the connection with the desired food, the animals actively learned to voluntarily change their behaviour.



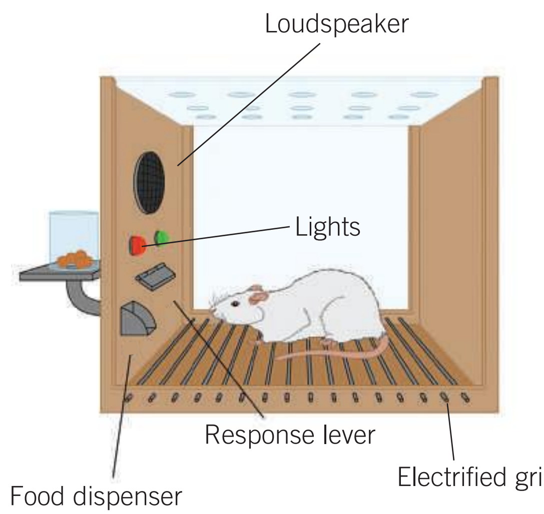


Figure 5B–3 Left: In Skinner's operant conditioning experiments, he trained pigeons to match a coloured light with a corresponding coloured panel in order to receive food. Right: His learning box for rats was known as the Skinner box. Each time a particular light went on, the rat had to press the lever to receive a reward. In some boxes, an electric shock could be given as punishment through a metal grid in the floor.

ISBN 978-1-009-25416-8 Gallagher et al

Operant conditioning a learning process in which the likelihood of a voluntary behaviour occurring is determined by its consequences

Antecedent an environmental stimulus that triggers an action

Behaviour any observable action by an organism

Consequence something that makes a behaviour more or less likely to occur again

Operant conditioning is a learning process in which the likelihood of a voluntary behaviour occurring is determined by its consequences. Compared to classical conditioning, which is a passive learning process, operant conditioning requires the learner to be active – they are voluntarily aware of the behaviour they are exhibiting in response to stimuli. The word 'operant' is used to mean 'operating to produce an effect'.

ACTIVITY 5B–1 MANAGING A CAFE

Imagine you are setting up a cafe and are taking on the role of cafe manager. Your aim is to build a focused work ethic in your team of kitchen and wait staff and build a positive team culture. Design and create an employment policy that could help encourage this behaviour using incentives and disciplinary actions.

The three-phase model of operant conditioning

Operant conditioning can be explained as a three-phase process: **antecedent**, **behaviour** and **consequence** (Figure 5B–4).

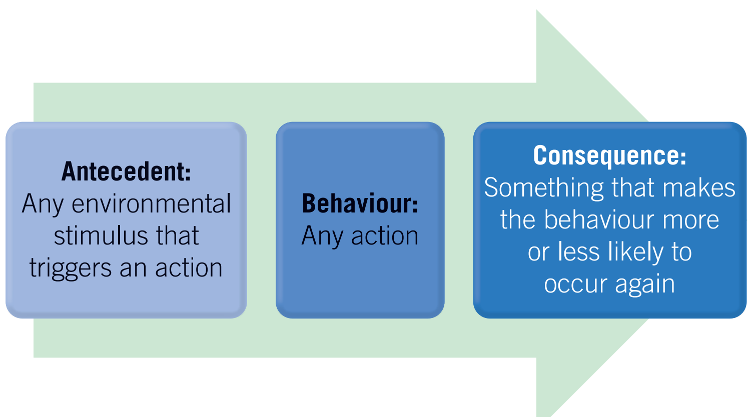


Figure 5B–4 The three-phase model of operant conditioning

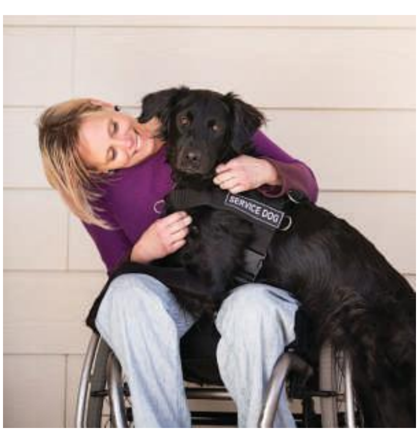


Figure 5B–5 A service dog and its owner, whom it is trained to assist

For example, when a service dog is in training to support a person with diabetes, they will detect the abnormal smell of the person's body (antecedent). This will trigger them to run towards the person and alert them (behaviour). Then the dog will be rewarded with a treat (consequence). This will make the service dog more likely to alert the person again when their smell (due to sugar levels) is abnormal.

The process of acquisition occurs when an association is made between the behaviour and its consequence. This association can either strengthen or weaken the likelihood of the behaviour occurring again, depending on the consequence. During acquisition in operant conditioning, the voluntary behaviour is strengthened by association with a reinforcement or weakened by an association with a punishment, which will be explained next.

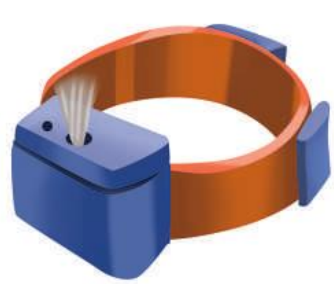
ISBN 978-1-009-25416-8 Gallagher et al

Consequences in operant conditioning

There are two main consequences in operant conditioning: reinforcement and punishment. **Reinforcement** increases the likelihood of a behaviour reoccurring in the future. **Positive reinforcement** occurs when a behaviour is followed by adding a desirable or pleasant stimulus, increasing the likelihood of the behaviour occurring again. For example, a service dog is given a treat to eat immediately after their alerting behaviour. **Negative reinforcement** occurs when a behaviour is followed by the removal of an undesirable stimulus, increasing the likelihood of the behaviour occurring again. For example, an uncomfortable face harness is removed from the service dog after it performs the alerting behaviour. Both types of reinforcement increase the likelihood of the service dog's alerting behaviour reoccurring.

Punishment, on the other hand, decreases the likelihood of a behaviour reoccurring. **Positive punishment** occurs when a behaviour is followed by adding an undesirable or unpleasant stimulus, decreasing the likelihood of the behaviour occurring again. For example, an unpleasant odour is emitted from the service dogs' collar when it jumps up on people unnecessarily. **Negative punishment** occurs when a behaviour is followed by the removal of a desirable or pleasant stimulus, decreasing the likelihood of the behaviour occurring again. For example, the service dog has a desirable toy taken off them after jumping up on its owner. Both types of punishment decrease the likelihood of the service dog's unwanted jumping behaviour reoccurring.

Table 5B–1 Consequences in operant conditioning

Influence on the service dogs' behaviour	POSITIVE Adding a stimulus +	NEGATIVE Removing a stimulus −
REINFORCEMENT **Increases** the likelihood of it being performed again.	 Dog is given a treat.	 Unpleasant face harness is removed.
PUNISHMENT **Decreases** the likelihood of it being performed again.	 Unpleasant odour is emitted from the dog's collar.	 Dogs' favourite toy or ball is taken away.

Reinforcement a stimulus from the environment that increases the likelihood of a response occurring in the future

Positive reinforcement when a behaviour is followed by adding a desirable stimulus, increasing the likelihood of the behaviour occurring again

Negative reinforcement when a behaviour is followed by the removal of an undesirable stimulus, increasing the likelihood of the behaviour occurring again

Punishment a stimulus from the environment that decreases the likelihood of a behaviour occurring again

Positive punishment when a behaviour is followed by adding an undesirable stimulus, decreasing the likelihood of the behaviour occurring again

Negative punishment when a behaviour is followed by the removal of a desirable stimulus, decreasing the likelihood of the behaviour occurring again

ISBN 978-1-009-25416-8 Gallagher et al

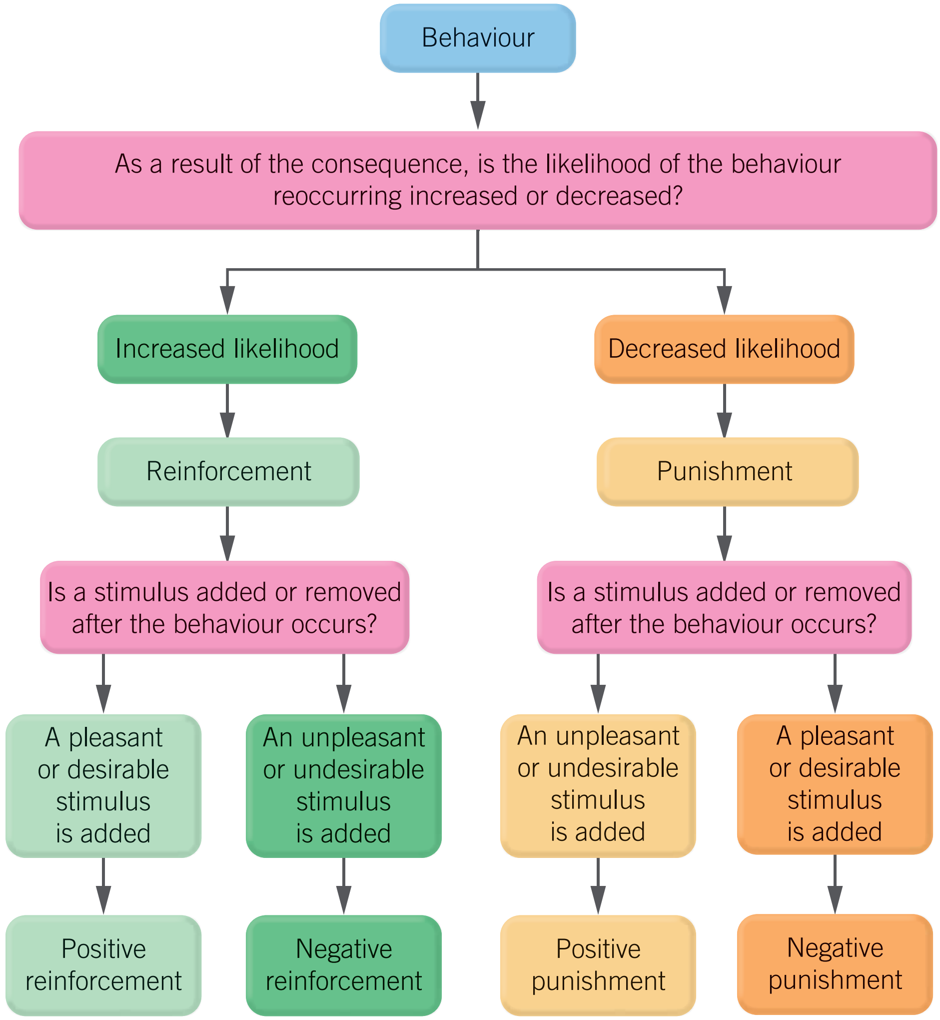


Figure 5B–6 A summary of the four consequences in operant conditioning

WORKSHEET 5B–1 APPLYING OPERANT CONDITIONING

Application of operant conditioning

Lets look at an everyday example of operant conditioning such as using your travel card when boarding a public bus. You are expected to tap your travel card each time you board, in order to pay for your ride. In this example, the:

- antecedent is boarding the bus
- behaviour is tapping or not tapping your card
- consequence is avoiding a fine if you tap, making you more likely to tap in future, or getting a fine if you don't tap, making you less likely to not tap in the future.

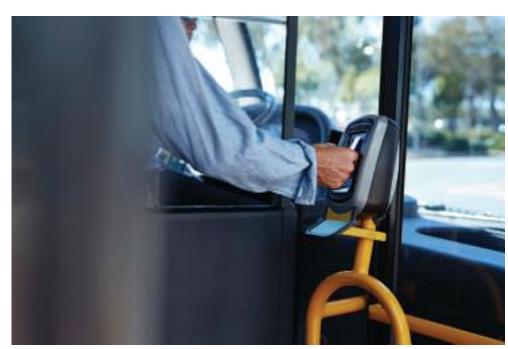


Figure 5B–7 Tapping on your travel card is an example of operant conditioning

ISBN 978-1-009-25416-8 Gallagher et al

Figure 5B–8 applies each type of consequence to this example.

Positive reinforcement	Negative reinforcement	Positive punishment	Negative punishment
Antecedent Passenger boards bus	**Antecedent** Passenger boards bus	**Antecedent** Passenger boards bus	**Antecedent** Passenger boards bus
Behaviour Passenger taps travel card	**Behaviour** Passenger taps travel card	**Behaviour** Passenger doesn't tap travel card	**Behaviour** Passenger doesn't tap travel card
Consequence Bus driver says thanks with a smile, increasing likelihood of behaviour reoccurring	**Consequence** Passenger is not fined, increasing likelihood of behaviour reoccurring	**Consequence** Passenger is fined, decreasing likelihood of behaviour reoccurring	**Consequence** Passenger is not allowed to get on the bus, decreasing likelihood of behaviour reoccurring

Figure 5B–8 The three-phase model of operant conditioning applied to the example of using a travel card on a bus

Figure 5B–9 Left: A treat is positive reinforcement. Right: Playing with a favourite toy could be positive reinforcement, taking it away would be a negative punishment.

NOTE

- Whether the consequence is a reinforcement or a punishment, the consequence should always occur immediately after the behaviour.
- In order for the learning to be effective, the consequence should be consistently delivered.

ISBN 978-1-009-25416-8 Gallagher et al

ACTIVITY 5B–2 TYPES OF CONSEQUENCES

Working with a partner, discuss a time when you or your partner have experienced each of the four consequences. Take turns to explain to one another a time when your behaviour changed as a result of each consequence. Ask each other: if you could experience the situation again, what would stay the same or what would you do differently? Discuss together how relevant or not relevant operant conditioning is in your life and if so, how it could be used to help you succeed in VCE Psychology.

Check-in questions – Set 1

1 Define 'reinforcement' and 'punishment'.
2 Identify the antecedent, behaviour and consequence in the following scenarios:
   a Jackson's teacher asked him to do homework. He was given chocolate when he completed his homework.
   b The traffic light changes to green and the driver begins to drive towards their destination.
   c An elderly woman drops her wallet in front of you and you proudly give it back to her.
   d Your brother gets into the Nationals Soccer Team after training hard for months before the trial day.
3 Compare and contrast two consequences you could use to decrease the likelihood of a child doing something socially unacceptable (e.g. picking their nose) in public.
4 Use an example to describe negative reinforcement.

VIDEO 5B–1 SKILLS: ANSWERING OPERANT CONDITIONING QUESTIONS

5B SKILLS

Answering operant conditioning questions

The ability to apply operant conditioning to an example or scenario is a key skill. The command term *apply* suggests using a theory or idea to analyse a given problem or issue, then to describe how the theory would explain a given psychological phenomenon or solve a problem. It is important to be familiar with each of the elements of operant conditioning and to be able to identify them accurately, so you can apply the theory comprehensively.

Question:

Every afternoon Theo spends time skateboarding at the local shopping centre with his friends. Today he was given a final warning for skateboarding too close to the entrance. Using the three-phase model of operant conditioning, explain why Theo is likely to stop skateboarding too close to the entrance.

Attempted answer:

When Theo was at the shopping centre with friends, he decided to voluntarily skateboard too close to the entrance and therefore was given a final warning.

Comments:

Although this answer has provided examples from the scenario accurately, the student has failed to identify the three phases of learning. Therefore, the answer does not address the first instruction in the question, which is 'using the three-phase model'. As a result, this answer would not obtain any marks.

ISBN 978-1-009-25416-8 Gallagher et al

Suggested answer:

Antecedent: The trigger for Theo's behaviour is being at the shopping centre with his friends.

Behaviour: Theo skateboarding outside the entrance of the shopping centre is the behaviour that is being conditioned.

Consequence: Theo's consequence in response to him skateboarding is a positive punishment. This is due to the addition of an undesirable stimulus, a warning, in order to decrease the likelihood of the skateboarding outside the entrance reoccurring.

Comments:

When applying the operant conditioning phases:
- explicitly name each stage of the three-phase operant conditioning model – antecedent, behaviour and consequence
- name the type of consequence (e.g. positive punishment)
- explain what is involved (e.g. the addition of an undesirable stimulus) indicate whether it will increase or decrease the likelihood of the behaviour reoccurring; and explain why, with reference to the scenario (e.g. Theo receiving a warning at the shopping centre).

Section 5B questions

1 Define 'operant conditioning'.

2 Copy and complete the table on the consequences involved in operant conditioning:

Consequence	Description	Example
Negative reinforcement		
Negative punishment		
Positive reinforcement		
Positive punishment		

3 Provide three differences between classical and operant conditioning.

4 Explain the process of acquisition when learning to use a credit card to purchase food for the first time.

5 Using an example, explain how negative punishment may inadvertently increase the likelihood of a behaviour reoccurring.

6 Every evening after school, Tahlia's father pestered her to do her homework. After a lot of pestering, Tahlia did her homework to make her father's pestering stop. Name the learning principle associated with Tahlia eventually choosing to complete her homework and state how this learning principle encouraged Tahlia to do her homework.

7 Apply the three-phase model of operant conditioning to the following scenarios.

a One of your classmates failed to submit their homework on time. Outline how your teacher could ensure that they complete their work on time in the future.

b Outline how a boss could reduce the likelihood of their staff coming to work late.

c Outline how coaches could increase the likelihood of their players training more outside of the scheduled practice sessions.

d Outline how allowing teenagers to have a sip of alcohol can increase the likelihood of them drinking alcohol in the future.

ISBN 978-1-009-25416-8 Gallagher et al

5C Observational learning

Study Design:
Social-cognitive approaches to learning, as illustrated by observational learning as a process involving attention, retention, reproduction, motivation and reinforcement

Glossary:
Attention
Learner
Model
Motivation
Observational learning
Reproduction
Retention
Social-cognitive approach

ENGAGE

Learning new skills from around the world

In 2008, the online website YouTube's main purpose was for home movies and random clips. Then people started uploading commentated videos of themselves playing games. Online bloggers would commentate while playing video games, discussing their strategies, their motives and their tips and having general conversation. People from all over the world watched these videos to learn new skills and behaviours in their own gaming style.

Figure 5C–1 We learn from watching other people's behaviours.

By 2020, gaming videos were one of YouTube's main resources. At the same time, competitors including the TikTok social media app and Twitch, went viral. TikTok is a video-sharing network where people can learn by watching others dance, cook, do make-up or even just chat. Twitch is a website dedicated to live streaming video games. This ability to learn from watching other people's behaviours and their consequences is not a new phenomenon; children have been learning behaviours by watching the adults around them for much of human history. However, the accessibility to the different models of behaviour and the worldwide network of skill sharing has evolved with technology, becoming a multibillion-dollar industry and a new form of employment.

ISBN 978-1-009-25416-8 Gallagher et al

EXPLAIN

The Bobo doll experiments

In 1965, psychologist Albert Bandura was interested to know what a child, the **learner**, would do if they observed an adult, the **model**, aggressively interact with a Bobo doll, a large blow-up doll (Figure 5C–2). Bandura set out to prove that children's behaviour can be learned indirectly through observing an adult's behaviour and its consequence. He found that children who saw the adult model being rewarded for their behaviour or receiving no consequence were more likely to display the aggressive behaviours than the children who saw the model being punished. He summarised his research to say that the consequences for the aggressive behaviour had an effect on the behaviour displayed by the children, and in real-life settings and, furthermore, that children had learned the model's behaviour, even if they didn't imitate the model until a later time. Bandura was the first in his time to identify this type of learning – observational learning.

Learner
the individual who observes, remembers and initiates the actions of the model

Model
the live, pre-recorded or symbolic person being observed

VIDEO 5C–1
OBSERVATIONAL LEARNING

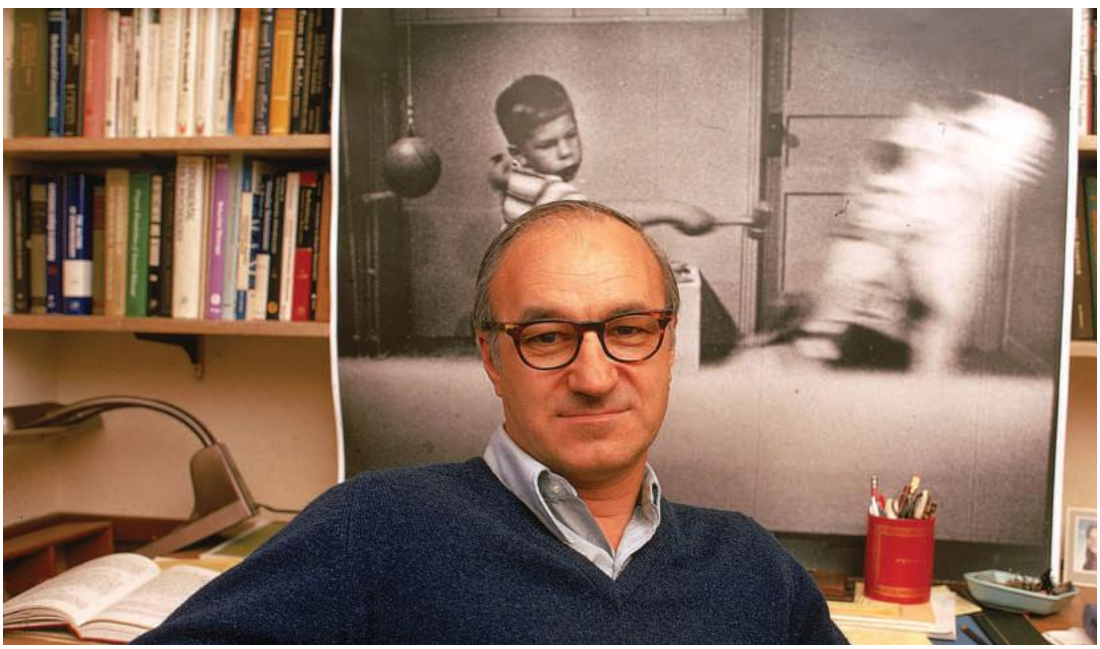


Figure 5C–2 Psychologist Albert Bandura, who became famous for his early 1960s experiments on the behaviour of children towards a Bobo doll after they had witnessed an adult model acting aggressively towards it. This 1973 photo shows Bandura in his office, with a largo photo behind him of one of the children in the experiment hitting the Bobo doll.

Overview of observational conditioning

Observational learning is a **social-cognitive approach** to learning that occurs when a learner observes a model's actions and their consequences to guide their future actions. It is defined as an active type of learning compared to other types of learning, such as classical conditioning. It is further considered to be a more efficient type of learning than other types of learning, such as operant conditioning, because there isn't a need to wait for a specific consequence.

Observational learning emphasises the importance of the environment, or 'social context' in which learning occurs. In other words, people learn from those around them.

Let's take a closer look at each of the stages of observational learning, while considering a teenager (learner) who watches an online gamer (model) to pick up on their skills and imitate them.

Observational learning
a type of social learning that occurs when a learner observes a model's actions and their consequences to guide their future actions

Social-cognitive approach
when individuals process, remember and learn information in social contexts to explain and predict their behaviour and that of others

ISBN 978-1-009-25416-8 Gallagher et al

Attention

In this first stage, the learner must *actively watch* the model's behaviour and the consequences. For example, the teenager must be sure to actively watch the gamer's moves and tricks and how this benefits them in the game. The learner is more likely to focus on the model if they are attractive, credible, well respected and/or an authority figure. The learner's **attention** may be influenced further by their own level of motivation and interest level. Generally, the greater the similarities between the model and the learner, the more likely the learner is to pay attention to the model.

Attention
the first step in observational learning, when the learner actively watches the model's behaviour and the consequences

Retention
the second stage in observational learning, when the learner stores (retains) a mental representation of the model's behaviour

Reproduction
the third stage in observational learning, when the learner's physical and mental capabilities enable them to perform the model's behaviour

Motivation
in observational learning, the learner's desire to perform the model's behaviour

Reinforcement
receiving a reward or desirable factor that increases the likelihood that the learner will reproduce the behaviour in future

Retention

In this next stage, called **retention**, the learner must store a *mental representation* of the model's behaviour (retain it in their long-term memory) for future use. For example, the teenager must use their cognitive skills to store and retain a memory of the move or trick and how it benefited the model in the game. The more meaningful the learner's memory is, the more accurately the learner will be able to replicate the model's behaviour later.

Reproduction

In order to perform the behaviour of the model, the learner must have the necessary physical and mental capabilities. This stage is referred to as **reproduction**. For example, the teenager must have the physical and mental capabilities to reproduce the behaviour of the online gamer, such as being able to use their hands in a similar way to the online gamer in order to reproduce the skills with the controller. The behaviour must be within the learner's competency levels.

Motivation

In this stage, the learner's desire or **motivation** to imitate the model's behaviour influences whether they will perform it or not. In other words, they have to want to do it in order to gain something, achieve a goal or receive a reinforcer. For example, the teenager must want to perform the tip or trick in order to get further in the game or collect more points.

Reinforcement

In this last stage of observational learning, the **reinforcement** on offer *influences* the learner's desire and the *likelihood that the learner will reproduce* the behaviour in the *future*. For example, the teenager will be more likely to reproduce the behaviour of the online gamer, the model, in the future if there is a positive outcome, such as feeling proud, being able to join a desirable online gaming group, or avoiding being removed from an online gaming group. The expectation of reinforcement or punishment influences the cognitive process of the learner.

The consequence the model receives could also either increase or decrease the likelihood of the learner repeating the behaviour. For example, if the online gamer performs a movement (behaviour) during the game that many people watching cheer on, a learner may be more inclined to reproduce that movement in the future. Alternatively, if the online gamer performs a movement (behaviour) during the game that makes them lose the game, a learner may be less likely to reproduce that movement in the future.

ISBN 978-1-009-25416-8 Gallagher et al

Summary of stages of observational learning

Figure 5C–3 summarises the key terminology used to describe each stage of observational learning.

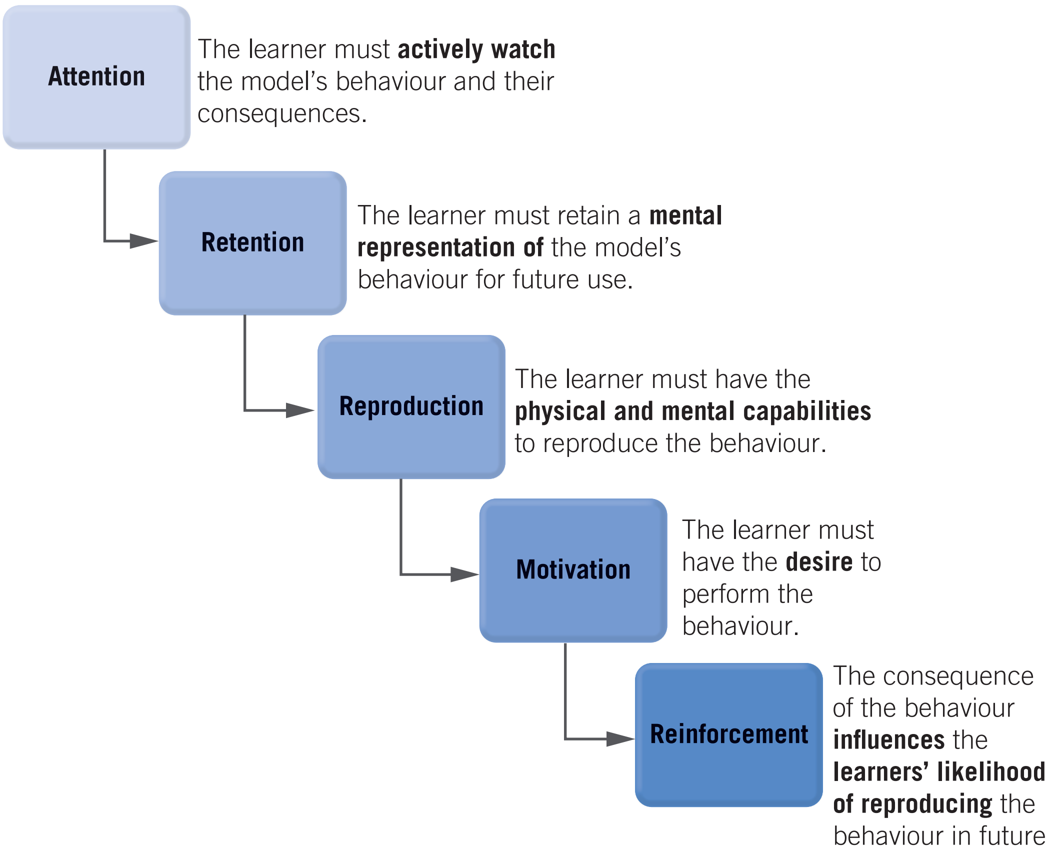


Figure 5C–3 The stages of observational learning

ACTIVITY 5C–1 KEY SCIENCE SKILLS IN THE BOBO DOLL EXPERIMENT

Watch the Bobo doll video (available at: http://cambridge.edu.au/redirect/9728) and explore the weblink (available here: http://cambridge.edu.au/redirect/9729), or carry out your own internet search, to further understand the foundations of Bandura's social learning theory of observational learning. Take notes as you watch, so that you can practise your Key Science Skills by identifying the following from Bandura's Bobo doll research:

- aim
- hypothesis
- independent variable and dependent variable
- participants
- method
- results
- conclusion.

Check-in questions – Set 1

1 What are the stages of observational learning?
2 Explain why observational learning is identified as a method of social learning.
3 Why is the attention stage of observational learning considered to involve a cognitive process?

ISBN 978-1-009-25416-8 Gallagher et al

VIDEO 5C–2 SKILLS: OBSERVATIONAL LEARNING

5C SKILLS

Application of observational learning to scenarios

The order of the stages is vitally important for learning to occur through observation. For example, a learner cannot reproduce a behaviour if they have not created a mental representation of the behaviour in their memory to retrieve. Additionally, someone will not be able to store a mental representation of a behaviour to learn if they had not paid attention to the observable behaviour.

For example, Roberto is a well-known chef in Spain. Roberto uploads a video to TikTok of him cooking paella, a traditional Spanish rice dish. John is of similar age to Roberto and wants to learn how to cook paella in Australia for his family, so he watches Roberto's video. In Figure 5C–4, each stage of learning is applied to show you how to use the psychological language to demonstrate your understanding of observational learning.

Attention – 'John must **actively watch** Roberto cooking paella and successfully complete the cooking.'

Retention – 'John must store a **mental representation** of Roberto cooking paella for future use.'

Reproduction – 'John must have the **physical and mental capabilities** to cook paella like Roberto. For example, he must have the hand coordination to chop the ingredients and mental capabilities to focus on the video until it is finished.'

Motivation – 'John must have the **desire** to want to cook paella like Roberto.'

Reinforcement

'Watching Roberto successfully finish the paella and eat happily **influences** John's desire and the **likelihood that he will cook paella** in the future.'

OR

'John's self-motivation to cook his family paella for dinner **reinforces** his desire and the **likelihood that he will cook paella** in the future.'

Figure 5C–4 An example of how to apply the stages of observational learning to a real-life scenario

WORKSHEET 5C–1 APPLYING OBSERVATIONAL LEARNING

ISBN 978-1-009-25416-8 Gallagher et al

In the VCE Psychology exam, you may be asked to apply observational learning to a real-life scenario. In constructing a response, you must signpost each part of the application with the key psychological terms: the name of the stage; the specific behaviour within that scenario; the specific model with that scenario; the key words relevant to that stage; and the specific learner within that scenario.

For example, when applying the reproduction stage to the example in Figure 5C–4, each of these key terms has been clearly signposted:

During the *reproduction stage* of observational learning, *John* must have the *physical and mental capabilities* to *cook paella* like *Roberto*. For example, he must have coordination in his hands to be able to *chop the ingredients* and the mental capability to *focus on the video* until it is finished.

Section 5C questions

1 Define 'observational learning'.
2 In observational learning, why is it important to follow the order of the stages?
3 Identify and describe features of a model that would influence a learner who is actively watching the model's behaviour.
4 Using an example, describe each of the key processes of observational learning.
5 Risa watches her teacher do a mathematical algebra calculation and is then required to do one on her own in her book in order to pass the subject. Explain the process of observational learning for Risa.
6 Using psychology terminology, explain how parents could use observational learning to increase the likelihood of their child routinely making their bed in the morning.

ISBN 978-1-009-25416-8 Gallagher et al

5D Aboriginal and Torres Strait Islander ways of knowing

Study Design:
Approaches to learning that situate the learner within a system, as illustrated by Aboriginal and Torres Strait Islander ways of knowing where learning is viewed as being embedded in relationships where the learner is part of a multimodal system of knowledge patterned on Country

Glossary:
Aboriginal and Torres Strait Islander peoples
Community
Connection to Country
First Nations
Indigenous
Kinaesthetic
Learning map
Narrative
Place-based learning
Ways of knowing
Yarn

ENGAGE

Engagement between 'Western' and Indigenous knowledge

In this extract from his book *Sand Talk: How Indigenous Thinking Can Save the World,* Tyson Yunkaporta comments on engagement between 'Western' (for want of a better word) and Indigenous knowledge. Note that this a very complex area and there are many views, of which this is just one, presented here as an example of the difficulties rather than an endorsement of what is expressed.

> I have been to many conferences and talks about Indigenous knowledge and sustainability and have read numerous papers on the topic. Most carry the same simplistic message: First Peoples have been here for x-thousand years, they know how to live in balance with this place and we should learn from them to find solutions to sustainability issues today. (I often wonder whom 'we' refers to in this statement.) They then offer some isolated examples of sustainable practices pre-colonisation, and that's it. The audience is left wondering, 'Yes, but how? What insight does this offer today, for the problems we are experiencing now?' … There's a welcome ceremony at the start and a dance at the end, and everybody goes home happy but none the wiser. We rarely see global sustainability issues addressed using Indigenous perspectives and thought processes. Instead we are shown a dot painting and implored to make sure we include Indigenous employment in our plans … Any discussion of Indigenous Knowledge systems is always a polite acknowledgment of connection to the land rather than true engagement. It is always about the what, and never about the how.

Figure 5D–1 Tyson Yunkaporta is an academic, an arts critic and a researcher who is a member of the Apalech Clan in far north Queensland. He carves traditional tools and weapons and works as a senior research fellow in Indigenous Knowledges at Deakin University in Melbourne.

ISBN 978-1-009-25416-8 Gallagher et al

EXPLAIN

Overview of general Indigenous community systems

Refer to the Overview (page xi) for the terminology used here and additional resources. **Indigenous** communities exist in 90 countries around the world and these are similar to those in Australia in that they all have their own systematic way of knowing and learning. The worldviews of **Indigenous** peoples throughout the world are highly integrated: each aspect of culture, history and society connects with all other aspects. This is the same for Australia's First Peoples or the **Aboriginal and Torres Strait Islander peoples** community in terms of their 'knowledge framework'. Each **community** has their own personalised system of thinking, doing and knowing based on years of sharing, community and life with the environment around them. To gain an understanding of each system, Indigenous or not, requires time and effort. Learners should choose to be part of the learning journey and to grow with the knowledge system, not simply want to have a piece of knowledge from the system.

LINK OVERVIEW: ABORIGINAL AND TORRES STRAIT ISLANDER KNOWLEDGE, CULTURES AND HISTORY

Indigenous First Australians and First Peoples of any country

Aboriginal and Torres Strait Islander peoples the Australian Indigenous population, which includes Aboriginal peoples, Torres Strait Islander peoples and people who have both Aboriginal and Torres Strait Islander heritage; the term 'Aboriginal and Torres Strait Islander' encompasses all three

Community a group of people who live in the same location or who share an interest or characteristic in common, and who interact or have the potential to interact

Ways of knowing methods through which knowledge becomes apparent to us

Local, national and global community systems

Indigenous community systems are generally very old and can be considered on local, national and global scales. Global communities include the Indigenous people of each country – the first people of any country. National community systems include the first people of specific countries; for example, the Maya people in Guatemala, Lakota people in the United States and the Māori of New Zealand.

It is also important to note that within the national community are smaller local communities that have their own systems for learning, as highlighted in the AIATSIS Map of Indigenous Australia (pages xii – xiii). Local communities' systems include their own language, historical stories, decision-making and skills.

Indigenous cultures are different from non-Indigenous cultures. For example, traditional non-Indigenous schools teach students how to learn in a way that is mostly separate from how to live day to day. By contrast, Indigenous Australian culture combines both aspects in its teaching for knowing. Western culture tends to compartmentalise its **ways of knowing**. For example, Western culture usually regards scientific culture as separate from arts culture; or a plumber's job is completely separate to a teacher's job. Indigenous cultures tend to integrate them and treat them as aspects of one culture. For example, Indigenous artwork often communicates scientific knowledge passed on through the generations. Furthermore, each member of the local Indigenous community is responsible for both aspects of daily life and teaching the next generation skills and knowledge.

As Tyson Yunkaporta has said, Indigenous Australian peoples and non-Indigenous peoples have different ways of thinking and learning systems. If they worked more closely together, they may develop innovative solutions to problems such as sustainability issues that might otherwise be missed. When there is respectful dialogue based on reciprocity rather than competition, there is an opportunity to learn and produce new knowledge. It will give all people an impression of 'the pattern of creation and how we might follow that pattern in our lives and systems'.

The starting point for any discussion of Indigenous ways of knowing is the local Aboriginal and Torres Strait Islander community. In this chapter, examples are given but these may be restricted to one community or group of communities only. There is great variety and generalisations have to be avoided. Understanding should always be checked against the local community's cultural practices.

ISBN 978-1-009-25416-8 Gallagher et al

ACTIVITY 5D–1 RESEARCH AN INDIGENOUS LANGUAGE IN YOUR LOCAL COMMUNITY

If you are a member of an Aboriginal and Torres Strait Islander community and know the language of your community, and you feel comfortable completing this activity, either make a presentation for the rest of the class on that language or join with other members of your community in a discussion of what the language means to you. If you are non-Indigenous then use the internet to research your local area and identify the Aboriginal language of the area and examine the systems of knowing for that local community. If possible, connect with local Elders and ask them to guide your understanding of the local Aboriginal community's system of knowledge and learning. Use your findings to write a story explaining the past, present and future knowledge of the local area that can then be presented to your class.

Check-in questions – Set 1

1 Define 'Indigenous' and 'Aboriginal'.
2 What is meant by 'knowledge systems' when referring to Indigenous communities?
3 Give an example of a difference between non-Indigenous and Indigenous systems of knowledge in terms of separation or integration of different areas of knowledge.
4 Identify three community groups Indigenous to Victoria.
5 Identify and discuss a key factor that is good for the learning relationship between non-Indigenous community groups and Indigenous community groups.

Sharing knowledge historically

There is the potential for much knowledge transfer from Indigenous communities to Western communities. However, historic barriers dating back to colonisation and exploitation have eroded trust between communities. Trust needs to be rebuilt to enable this exchange of knowledge to occur. Historically, research involving Indigenous communities has been inappropriate because the researchers rarely obtained informed consent. The power differences between participants and researchers meant that participants were readily exploited, and the aims of the research often served the purposes of colonial control.

Figure 5D–2 An Aboriginal painting of an emu in a cave at Mount Borradaile, Arnhem Land, Northern Territory painted between 1000 and 3000 years ago. Emus feature in many Dreaming stories.

ISBN 978-1-009-25416-8 Gallagher et al

Furthermore, in the establishing years of Australian colonisation, people in charge of learning about the Australian Indigenous communities focused more on 'classifying and labelling' in an attempt to manage the communities. And, unfortunately, similar inappropriate systems of finding knowledge have continued, largely by culturally insensitive research designs and methodologies that have not recognised and catered to the systems of knowing and learning that are part of Indigenous people and communities.

Figure 5D–3 Artwork by Donna Hensen, a Wailwan/Wiradjuri woman, illustrating the trauma felt by members of the Stolen Generations

There is a perpetuating belief that Indigenous peoples embody a 'problem' to be solved and that they are 'passive objects that require assistance from external experts.' Non-Indigenous leaders used to believe that their understanding of community integration was superior and took to removing **First Nations** children from their communities and placing them in non-Indigenous communities, leading to psychological harm. They became known as the Stolen Generations. This practice illustrates that research based on culturally insensitive knowledge systems is damaging. In order for non-Indigenous Australians to learn and appreciate ways of knowing, they need to build on the relationships and complexity of Indigenous ways of knowing.

First Nations Indigenous people of Australia; or First Peoples

Connection to Country

'Indigenous ways of knowing' is a useful term that displays the beautiful intricacies and diversity of Indigenous ways of learning and teaching. As discussed earlier, many researchers and communities continue to assume and generalise Indigenous experience and lived realities. The intent of the phrase 'Indigenous ways of knowing' is to guide people in how to explore the abundance of knowledge in Indigenous communities. It also reminds the Indigenous communities that learning is in human connections and relationships but also in all of the objects of creation: the plants, animals, land and its sources.

Figure 5D–4 Indigenous peoples' connection to Country means that they respect and treasure the land.

Indigenous ways of knowing are incredibly intricate and sophisticated. The practice of learning and knowing concepts and constructs for each Indigenous community is heavily based on the specific location of the land. With the importance of the land is also the language, the protocols and the culture surrounding each way of knowing. Hence, the concepts and constructs may look very different from one First Nations community to another. Nevertheless, Indigenous ways of knowing are rooted in a deep respect for the ecology and an understanding of the importance of the connected relationship with the land. This is known as **connection to Country**.

Connection to Country Indigenous ways of knowing are known to be rooted with deep respect for the ecology and the importance of the connected relationship with the land

First Nations peoples believe that their connection and use of the land today will have a significant impact on the next generations, so they are respectful of how they walk on the earth and interact with all living things. They believe that when there is an offering of respect, then learning can move forward.

Check-in questions – Set 2

1 Historically, why have Australian Indigenous communities questioned their involvement with research and investigatory measures?
2 Indigenous peoples require voluntary participation in any new research. What would this mean for the research?
3 With reference to the phrase 'connection to Country', explain why the Australian land is so important to Indigenous ways of knowing.

An example of an Indigenous framework of learning: 8 Ways

It is important to remember that this is an example that comes out of a particular Indigenous community. While some of its principles may be shared with other Indigenous ways of knowing, it would be a mistake to assume it has broad acceptance and usage. The project itself stresses that it is a framework, with the need to identify local Indigenous cultural systems to provide the detailed content to go into the framework.

8 Ways is a framework for using Indigenous learning techniques, created by a NSW Department of Education project on the website 8ways.online. The initiative contends that Indigenous perspectives are not found in Indigenous content, but in the way they transmit the knowledge. These learning processes were identified as:

> Aboriginal learning is more about 'how' rather than 'what' in ways of knowing systems, skills and constructs. The 8 Ways of knowing framework is expressed as eight interconnected ideas involving: telling a story; planning; thinking and doing; drawing it; taking it outside; trying a new way; watching first and then doing; and sharing it with others . . . these ideas . . . work together in the learning process.
>
> *8ways.online*

Figure 5D–5 shows the interconnected eight ways.

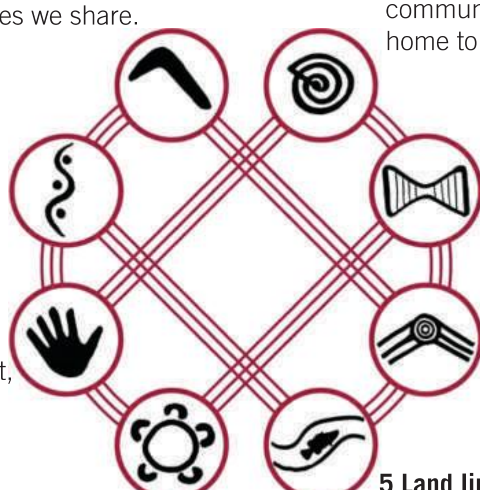


Figure 5D–5 A learning map of the 8 Ways framework, which is about identifying local Indigenous values, systems, protocols and processes, then integrating these into the mainstream schooling system. Used with permission from 8ways.online.

ISBN 978-1-009-25416-8 Gallagher et al

1 Story sharing: learning/knowing through narrative

This system of learning takes place by continually sharing stories (including stories told in song) and connecting through shared personal stories of the past, present and future. This is commonly known as '**yarning**' within First Nations culture and community and is expressed as a way to gain knowledge or to learn. Yarning allows for learning to be built upon real-world experience rather than through print-based text and screens. Stories from a yarning session should be repeatedly used, expressed and incorporated into everyday conversation to encourage learning. Storytelling isn't only about yarning; it is more importantly about listening – to Elders past, present and future, to each other within the community and to individual stories.

Figure 5D–6 The sharing of learning and knowledge can be done through yarning within the community.

2 Learning maps: visualising and mapping processes

This system of learning takes place by creating **learning maps** – a process of picturing a pathway and creating a deliberate visual plan for learners to follow. It usually follows a story and will be a discussion-based procedure to create the map, to indicate the direction to take in that learning sequence. Images are at the forefront of these plans and make up most of the maps. For example, maps could be created for curriculum plans at schools, directions to a location, plans for a family's future or even to tell a story.

Narrative
a story which in a cultural context may be delivered in a variety of ways including performance, song and dance

Yarn
an Indigenous system of learning that involves continually sharing stories

Learning map
images or visuals used to map out processes for learners

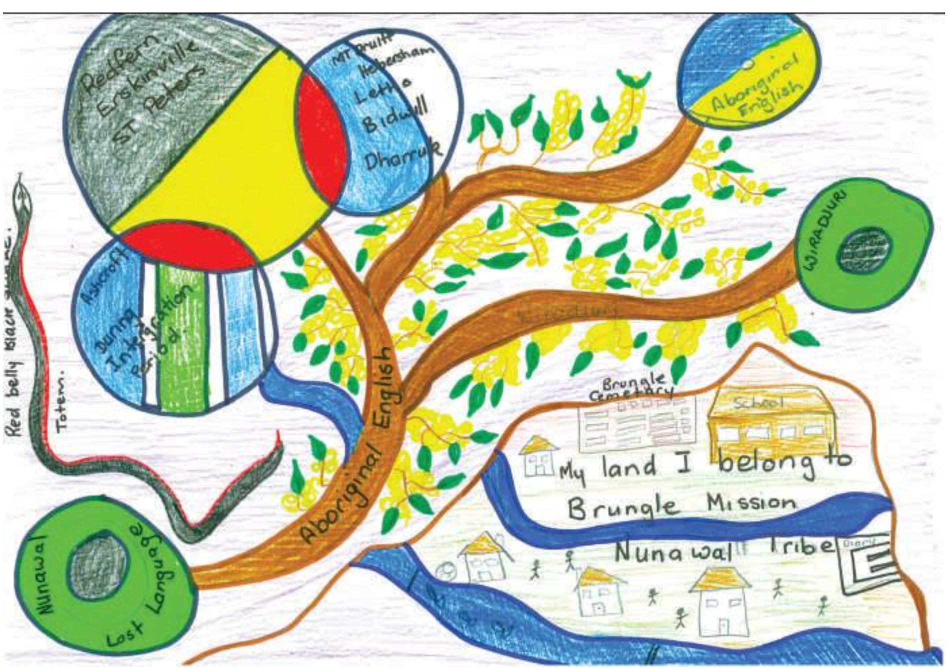


Figure 5D–7 A learning map drawn by Sandra Hickey, who comes from Brungle, a mission in Ngunawal Country near Tumut. The leaves on the tree are her family members; her family in Sydney are on the highest branch.

ISBN 978-1-009-25416-8 Gallagher et al

Figure 5D–8 Dance is an example of a kinaesthetic approach to learning.

3 Non-verbal: see, think, act, create, move without words

This system of learning is said to take place by using non-verbal **kinaesthetic** approaches; people see, think, act, mime, make and share without words. Instead, they use dance, facial expressions, gestures and kinaesthetic skills to help them to think and learn. It is important for learning that these skills are used repeatedly, to frequently use similar rhythms, tones or movements. For example, a dance could be created and performed to help learn about the way in which animals grow and develop in the wild.

4 Symbols and images: understanding concepts through art and metaphor

This system of learning is said to be kept and shared through symbols and images in the form of art and drawings. The images and drawings are central to the learning and can be a way of communicating without drawing too. Some drawings can take moments to create; others can take days. Some drawings can be simple, others complex. Some drawings only exist for a few moments, before being rubbed out and never drawn again; these drawing are only for those people at that time to understand and know. For example, drawings might be made in the sand to have a conversation with someone and share their experience on a recent exploration.

Kinaesthetic to do with body movement or sensation

Place-based learning learning drawn from the landscape with profound connections to ancestral and personal relationships with place

5 Land links: place-based learning

This system of learning is said to take place when land links are made with nature. Ecological and **place-based learning** is drawn from the living landscape within a framework of profound ancestral and personal relationships with place.

Figure 5D–9 Symbols and images are central to learning and communication.

6 Non-linear: indirect, innovative and interdisciplinary approaches

In non-linear learning, there are different phases of learning that can be learned in the order that best suits that moment. The learner puts different ideas together and creates new knowledge – producing original thoughts and understanding by lateral cognitive processing. For example, when learning about grammar in an English class, the learners may share jokes about grammar, practise writing grammar, sing a song about grammar, discuss the complexities about grammar, discuss the history

ISBN 978-1-009-25416-8 Gallagher et al

of the grammar, then share some more jokes about the culture of grammar, before the deeper discussion around the meaning of grammar. The grammar lesson has an indirect, innovative and interdisciplinary approach to learning.

7 Deconstruct/reconstruct: modelling and scaffolding

This way of learning takes place when the learner looks at a whole process of a concept before looking at parts in detail. Learners may watch a complete process to understand its purpose and what it produces, and only then learn individual steps or skills that make it up.

8 Community links: connecting learning to local values and needs

This system of learning is said to take place when the learner brings new knowledge to help their mob, otherwise known as their community. The knowledge that is being learned is based on local viewpoints and will benefit the community. This connection to community benefits not only the community but also the learner because their learning experience is given real-life purpose. Growing the community helps to build teams to continue to learn from in the future. For example, a class could do a research project on the local lake and its significance to the land and area and then share this at their school assembly with the school community. Furthermore, the class could learn a song about the lake and perform this at the local festival to continue to share the knowledge and build community.

WORKSHEET 5D–1 AN INDIGENOUS VIEW OF THE WORLD: CASE STUDY

ACTIVITY 5D–2 PRESENTATION ON WAYS OF KNOWING

Individually or in small groups, research one of the ways of knowing in the 8 Ways example. Devise an example of applying that process and present it in a style of your choosing, to the rest of the class.

VIDEO 5D–1 SKILLS: USING KNOWLEDGE OF THEORY

5D SKILLS

Using knowledge of theory

In VCE Psychology exams, to answer a question *in reference to* or *in terms of* suggests that you are using your knowledge of a concept or theory to explain something. Responses should use the relevant psychological terminology.

Question:

An Indigenous Elder is teaching a child within their community how to fish, by using some of the ways of knowing. The Elder starts with a story about the importance of fish to the land and draws a picture in the sand that their ancestors drew for them as they share the story. During this yarning session, the Elder jumps to their feet and starts dancing around as they act out how to carve a fishing spear and how to use a fishing spear. The Elder and the child then sit and listen to the weather in silence for a while. The Elder then starts singing a song related to their fishing expedition as they pick up a spear and begin throwing it into the shallows of the water. The pair then sit and yarn a little longer about the type of fish in that particular water and its significance to that area of land. The young child then picks up the spear to practise his fishing.

ISBN 978-1-009-25416-8 Gallagher et al

In reference to 'Indigenous ways of knowing' explain how the child is being viewed as part of the system with particular knowledge by the Elder in their community.

Attempted answer:

Indigenous communities use their bodies to help them to think and learn about fishing. For example, a dance could be created and performed to help learn about the way in which to throw a fishing line or net into the water.

Comments:

This answer is incorrect because it does not reference the concept of ways of knowing, despite the content of the response being accurate.

Suggested answer for full marks:

Non-verbal ways of learning use body movements (kinaesthetic skills), facial expressions, gestures and dance to help Indigenous people to think and learn about fishing. Repetition of the same movements reinforces memory and learning. For example, the Elder's dance could be created and performed to help the child learn about the way in which to throw a spear into the water.

Section 5D questions

1 Copy and complete this table by listing the names of the 8 Ways of Indigenous learning and writing a short description of what is done to learn in that way. The sentence should start with 'We …' followed by a verb for performing an action.

Way of knowing in 8 Ways framework	What we do to learn in that way

2 What does it mean to yarn?

3 Give an example for each of the identified eight ways of knowing when learning a particular skill of your choice.

4 With reference to Indigenous peoples, define integrity in research.

5 Unfortunately, in the past scientific research involving Indigenous peoples has not respected the people. Describe how respect was not demonstrated.

6 Identify the ethical guideline a researcher would be following in each scenario.

   a They were not to share any personal details of the participants outside of the agreed study.

   b They were to consider the value of Indigenous communities and the capacity to make their own decisions.

   c They were to ensure participants are free to discontinue their involvement in a study at any point during or after conclusion of the study, without receiving a penalty.

ISBN 978-1-009-25416-8 Gallagher et al

Chapter 5 review

Summary

Create your own set of summary notes for this chapter on paper or in a digital document. A model summary is provided in the Teacher Resources which can be used to compare with yours.

Checklist

In the Interactive Textbook, the success criteria are linked from the review questions and will be automatically ticked when answers are correct. Alternatively, print or photocopy this page and tick the boxes when you have answered the corresponding questions correctly.

Success criteria – I am now able to:		Linked questions
5A.1	Describe the key features of classical conditioning as an approach to explaining learning, including its involuntary nature and the association formed	4☐, 5☐
5A.2	Explain the three-phase process of classical conditioning (before, during and after conditioning) using key terminology (neutral stimulus, unconditioned stimulus, unconditioned response, conditioned stimulus and conditioned response)	11☐, 12b☐
5A.3	Apply my understanding of the three-phase process (before, during and after conditioning) and use key terminology to identify the neutral stimulus, unconditioned stimulus, unconditioned response, conditioned stimulus and conditioned response in real-life examples of classical conditioning	13☐
5B.1	Describe the key features of operant conditioning as an approach to explaining learning, including its voluntary nature	5☐
5B.2	Explain the three-phase process of operant conditioning (antecedent, behaviour and consequence)	12a☐
5B.3	Apply my understanding of the three-phase process by identifying the antecedent, behaviour and consequence in real-life examples of operant conditioning	14☐
5B.4	Explain the effect of different consequences in operant conditioning on behaviour, including reinforcers (positive and negative) and punishment (including response cost)	12d☐
5B.5	Apply my understanding of the different consequences by correctly identifying the use of positive and negative reinforcements in real-life examples of operant conditioning	7☐
5B.6	Apply my understanding of the different consequences by correctly identifying the use of positive and negative punishments in real-life examples of operant conditioning	6☐
5B.7	Compare and contrast classical and operant conditioning as approaches used to explain learning	17☐
5C.1	Describe the key features of observational learning and explain why it is considered to be a social-cognitive approach to explaining learning	8☐
5C.2	Describe attention, retention, reproduction, motivation and reinforcement as the key processes involved in observational learning	16☐

ISBN 978-1-009-25416-8

Success criteria – I am now able to:		Linked questions
5C.3	Apply my understanding of the processes involved in observational learning (attention, retention, reproduction, motivation and reinforcement) to real-life examples	9☐, 15☐
5C.4	Compare and contrast observational learning with classical and operant conditioning, as approaches used to explain learning	10☐, 17☐
5D.1	Understand that learning can occur when the learner is a part of a system, as illustrated in Indigenous cultures where learning is viewed as being embedded in relationships	2☐, 19☐, 21☐
5D.2	Explain what is meant by 'Aboriginal and Torres Strait Islander ways of knowing' and provide examples	1☐, 20☐, 21☐
5D.3	Explain how Indigenous learners are viewed as being part of a multimodal system of knowledges patterned on Country	20☐

Key Science Skills

Skills	Questions and Skills boxes
Demonstrate safe laboratory practices when planning and conducting investigations by using risk assessments that are informed by safety data sheets (SDS), and accounting for risks	Chapter review – 3, 12c
Apply relevant occupational health and safety guidelines while undertaking practical investigations	Chapter review – 18
Demonstrate ethical conduct and apply ethical guidelines when undertaking and reporting investigations	5D Check-in questions – Set 2 5D Section questions – 4, 5, 6

Multiple-choice questions

1 Which of the following is not one of the '8 Ways' example of Indigenous learning?
- **A** rumination
- **B** story sharing
- **C** land links
- **D** learning maps

2 In Indigenous cultures, the most accurate overall view of learning is that it is embedded in
- **A** Country.
- **B** folklore.
- **C** cognition.
- **D** secret business.

3 Before starting any new research of learning, which of the following should occur to consider, identify and reduce the physical and psychological risks?
- **A** occupational health and safety
- **B** safety data sheet
- **C** risk assessment
- **D** debriefing

ISBN 978-1-009-25416-8 Gallagher et al

4 Jessica is constantly criticised by her mum for not studying hard enough at school. Eventually, every time she sees her mum after school, she starts to feel anxious. What sort of learning has occurred?
 A operant conditioning
 B classical conditioning
 C observational learning
 D reflex learning

5 In classical conditioning, the learning is ______, while in operant conditioning the learner is ________.
 A involuntary, active
 B voluntary, passive
 C voluntary, involuntary
 D involuntary, passive

The following information relates to Questions 6–8.

A group of friends were practising their beach volleyball skills by counting how many passes they could get together. The aim of the game was to get as many passes as possible in a row before the ball hit the ground or became uncontrolled. If one of the friends dropped the ball or made a bad pass, someone would throw sand in their face.

6 According to operant conditioning, what type of consequence was used when the ball was uncontrolled?
 A positive reinforcement
 B negative reinforcement
 C positive punishment
 D negative punishment

7 One of the friends suggested that, instead of throwing sand, they should all encourage each other for every 10 consecutive passes. This would change the type of consequence to
 A positive reinforcement.
 B negative reinforcement.
 C positive punishment.
 D negative punishment.

8 The team decided to video call their coach to get some practical tips on how to keep the ball in the air. The coach then demonstrated to them the best technique for the game they played. If the group of friends were to use their cognitive skills to pay attention, what stage of learning are they in?
 A reproduction
 B before learning
 C attention
 D consequence

9 Shernaali's mum makes delicious curries, and Shernaali has been watching her cooking. After several weeks of observing her mum make curries, Shernaali decides to make one herself. She chops all the ingredients and then begins to cook, but it all burns and gets ruined. According to observational learning, the stage that Shernaali has not achieved is
 A attention.
 B retention.
 C reproduction.
 D motivation.

ISBN 978-1-009-25416-8 Gallagher et al

10 Dorian has always wanted to study jazz ballet but is concerned that he may not have the talent to be successful. He practises at home by imitating the dance moves from the movie *Black Swan*. Dorian's strategy for studying jazz ballet relies on the principle of

A operant conditioning.
B classical conditioning.
C unlearned behaviour.
D observational learning.

Short-answer questions

11 Compare and contrast a neutral stimulus and an unconditioned stimulus. (1 mark)

12 State whether the following statements are true or false and, if false, explain what the true statement should be.

a The three-phase model of operant conditioning suggests that the consequence will either increase or decrease the likelihood of the behaviour happening again. (1 mark)
b A conditioned stimulus alone gives a conditioned response. (1 mark)
c Occupational health and safety is defined as an ethical concept involving the commitment to maximising benefits and minimising the risks and harms. (1 mark)
d Positive punishment includes the removal of an undesirable stimulus. (1 mark)

13 For the past 10 years, Crosbie has created a party while putting up the Christmas tree every year on 1 December. His party includes eating his favourite chocolate, drinking a hot chocolate, playing his favourite Christmas carols and dancing around the lounge room. Now, every year as 1 December approaches, Crosbie feels very happy and excited. Explain, using the three phases of classical conditioning, why this may occur. (3 marks)

14 Takumi's partner does not agree to spend as much time with him as he would like. He wonders how he might influence his partner to want to spend more time together. With reference to the three-phase model of operant conditioning, explain how Takumi could change his partner's behaviour to increase the time they spend with him. (3 marks)

15 Using an example, describe what would increase the likelihood of the learner paying attention to the model's behaviour and consequence when demonstrating observational learning. (2 marks)

16 Suhail was in Biology watching his teacher demonstrate how to use the microscope successfully to inspect cells for an upcoming SAC. Using psychological language, explain the reproduction, motivation and reinforcement stages of observational learning. (3 marks)

17 Distinguish between observational learning and operant conditioning. (2 marks)

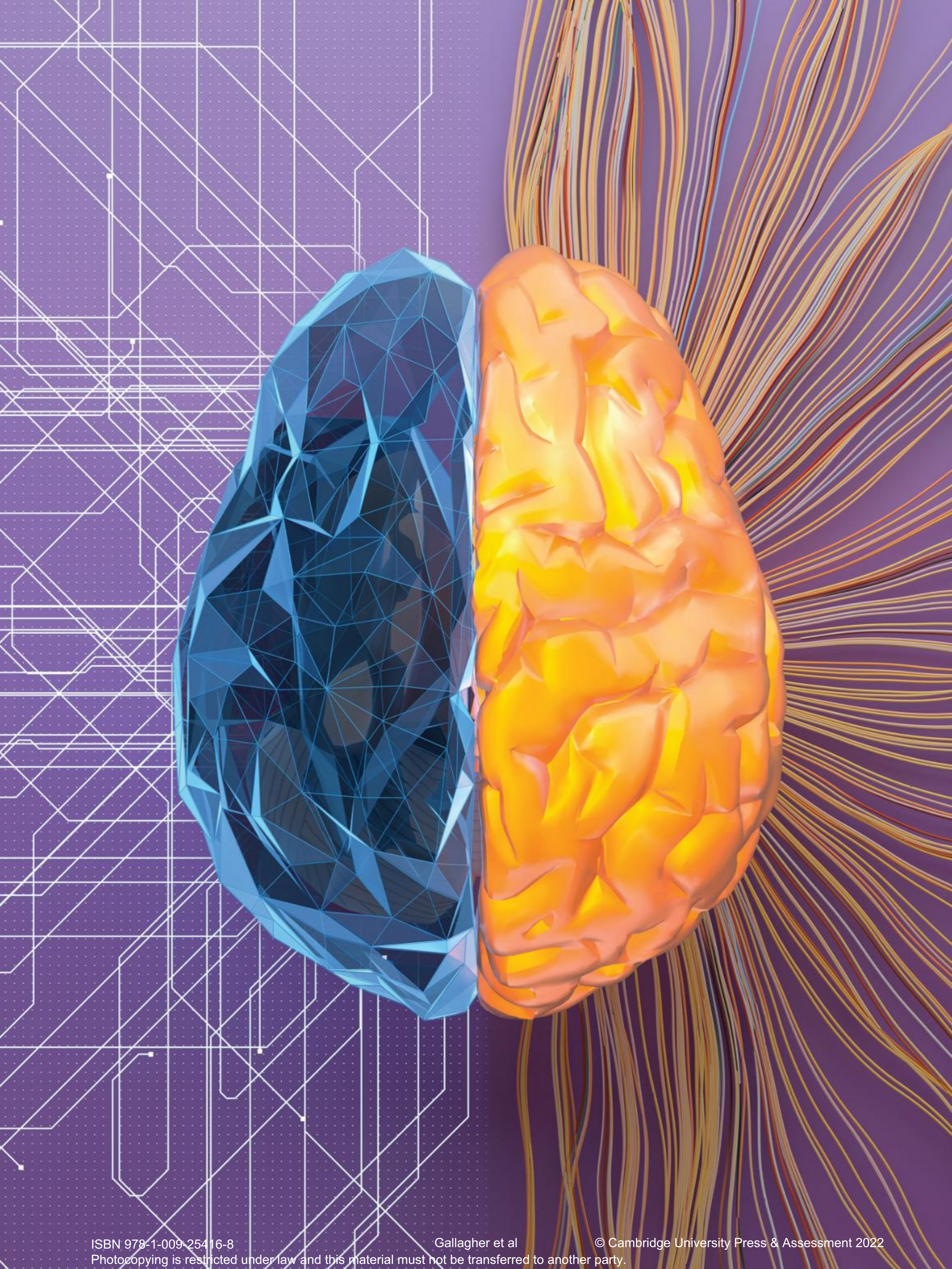
18 Compete a detailed risk assessment for research on operant conditioning with students from a local high school as the participants during their VCE Psychology timetabled class. Within the experiment, participants will be learning to complete their work by being given the punishment of water being squirted in their face, every time they don't do their work. (3 marks)

19 What is connection to Country and why is it important to First Nations peoples? (2 marks)

20 Give an example of how deconstruct/reconstruct ways of learning can look whenlearning how to play the didgeridoo. (2 marks)

21 Describe a difference between the focus in Indigenous ways of learning and the focus in non-Indigenous ways of learning. (2 marks)

ISBN 978-1-009-25416-8 Gallagher et al



ISBN 978-1-009-25416-8 Gallagher et al

UNIT 3 HOW DOES EXPERIENCE AFFECT BEHAVIOUR AND MENTAL PROCESSES?

CHAPTER 6 THE PSYCHOBIOLOGICAL PROCESS OF MEMORY

Aboriginal and Torres Strait Islander readers should be aware that this chapter contains images of people who have, or may have, passed away.

Introduction

In the popular media, you can read about people who have lost their memory. These people face many obstacles in their day-to-day life, such as not being able to recognise loved ones, not being able to remember the things they have learned or the places they have been, and even not being able to complete basic skills such as cooking dinner. These examples demonstrate why memory is so important. Without memory there is no way to connect our past to our present. In effect, we could not live our everyday lives without a set of memory systems that are in working order.

But what is memory? In Chapter 5, you learned about various theories that explain how humans and animals learn. Essentially, memory is evidence that we have learned a piece of information or a skill. For example, if you go to a dance class you might learn how to waltz. When you have created a mental representation of the steps of the waltz, you will store it for a length of time until it is needed. When you next go dancing, you might recover the initial mental representation of the waltz steps so that you can recreate them on the dance floor. This is memory.

As with learning, there are many theories that explore how memory is encoded, stored and retrieved. In this chapter, you will explore the process of memory and uncover the many factors that can influence how effective our memory is at any given time.

Curriculum

Area of Study 2 Outcome 2
How do people learn and remember?

Study Design	Learning intentions – at the end of this chapter I will be able to:
• The explanatory power of Atkinson–Shiffrin multi-store model of memory in the encoding, storage and retrieval of stored information in sensory, short-term and long-term memory stores	**6A** **The explanatory power of the Atkinson–Shiffrin multi-store model of memory** **6A.1** Define 'encoding', 'storage' and 'retrieval' **6A.2** Outline the role, capacity and duration of sensory memory, short-term memory and long-term memory **6A.3** Explain how sensory, short-term and long-term memory interact when processing sensory information, according to the multi-store model of memory **6A.4** Apply my understanding of how sensory memory, short-term memory and long-term memory allow us to interact with the world with reference to examples

ISBN 978-1-009-25416-8

Study Design	Learning intentions – at the end of this chapter I will be able to:
• The roles of the hippocampus, amygdala, neocortex, basal ganglia and cerebellum in long-term implicit and explicit memories	**6B The roles of specific regions of the brain in long-term memory** **6B.1** Define 'implicit memory' and 'explicit memory' and provide examples of each **6B.2** Compare and contrast implicit and explicit memories **6B.3** Outline the roles of and discuss how the hippocampus, amygdala, neocortex, basal ganglia and cerebellum encode, store and retrieve explicit and implicit memories **6B.4** Apply my understanding of how the hippocampus, amygdala, neocortex, basal ganglia and cerebellum interact with reference to examples
• The role of episodic and semantic memory in retrieving autobiographical events from the past and in constructing possible imagined futures, including evidence from brain imaging and post-mortem studies of brain lesions in people with Alzheimer's disease and aphantasia as an example of individual differences in the experience of mental imagery	**6C The role of episodic and semantic memory** **6C.1** Explain what is meant by episodic and semantic memory and provide relevant examples of each **6C.2** Explain what is meant by autobiographical memory and episodic imagined futures and provide relevant examples of each **6C.3** Explain the roles of episodic and semantic memory in the construction of autobiographical memory and episodic imagined futures **6C.4** Apply my understanding of the roles of episodic and semantic memory in the construction of autobiographical memory and episodic imagined futures to a real-world scenario **6C.5** Explain what is meant by Alzheimer's disease and how it acts as a lesion model for episodic and semantic memory **6C.6** Outline the symptoms associated with the early, middle and later stages of Alzheimer's disease with reference to the changes to the brain **6C.7** Explain what is meant by aphantasia and outline its symptoms, causes and treatments
• The use of mnemonics (acronyms, acrostics and the method of loci) by written cultures to increase the encoding, storage and retrieval of information as compared to the use of mnemonics such as sung narrative used by oral cultures, including Aboriginal people's use of songlines	**6D Mnemonic devices to increase encoding, storage and retrieval** **6D.1** Explain what is meant by a mnemonic device and how it increases the encoding, storage and retrieval of information **6D.2** Explain what is meant by the method of loci, acronyms and acrostics and provide relevant examples of each **6D.3** Explain how written cultures use method of loci, acronyms and acrostics to each increase encoding, storage and retrieval of information **6D.4** Explain what is meant by sung narrative used by oral cultures, including Aboriginal people's use of songlines **6D.5** Apply my understanding of sung narrative used by oral cultures, including Aboriginal people's use of songlines to a real-world scenario **6D.6** Compare the use of mnemonics used by written and oral cultures to increase the encoding, storage and retrieval of information

Key Science Skills

- Systematically generate and record primary data, and collate secondary data, appropriate to the investigation
- Record and summarise both qualitative and quantitative data, including use of a logbook as an authentication of generated or collated data
- Organise and present data in useful and meaningful ways, including tables, bar charts and line graphs

Glossary

Acquired
Acronym
Acrostic
Alzheimer's disease
Amnesia
Amygdala
Amyloid plaque
Anterograde amnesia
Aphantasia
Autobiographical memory
Basal ganglia
Brain atrophy
Brain scan
Capacity
Cerebellum
Cerebral cortex
Congenital
Consolidation
Decay
Declarative memory
Dementia
Displacement
Dreaming
Dreamtime
Duration
Encoding
Episodic memory
Episodic future thinking
Explicit memory
Hippocampus
Implicit memory
Lesion
Long-term memory (LTM)
Memory
Mental time travel
Method of loci
Mnemonic
Neocortex
Neurofibrillary tangle
Oral culture
Reconstruction
Rehearsal
Retrieval
Retrograde amnesia
Role
Semantic
Semantic memory
Sensory memory
Short-term memory (STM)
Songline
Storage
Sung narrative
Visual cortex
Written culture

ISBN 978-1-009-25416-8

Concept map

6D Mnemonic devices to increase encoding, storage and retrieval

The use of acronyms, acrostics and the method of loci by written cultures, in comparison to the use of sung narrative by oral cultures including Aboriginal people's use of songlines

MEMORY

6A The explanatory power of the Atkinson–Shiffrin multistore model of memory

Sensory memory → Attention → Short-term memory (STM) → Encoding → Long-term memory (LTM)

Long-term memory (LTM) → Retrieval → Short-term memory (STM)

Implicit and explicit memory

6B The roles of specific regions of the brain in long-term memory

The neurodegenerative disease Alzheimer's as a lesion model and aphantasia as an example of the lack of mental imagery

6C The role of episodic and semantic memory

Semantic memories provide the context of the imagined event: where Paris is located, the language that is spoken, the weather at the time of travel.

Episodic memories provide the specific details of what might occur in the imagined event: who you meet there and what you will do.

See the Interactive Textbook for an interactive version of this concept map interlinked with all concept maps for the course.

ISBN 978-1-009-25416-8 Gallagher et al

6A The explanatory power of the Atkinson–Shiffrin multi-store model of memory

Study Design:
The explanatory power of Atkinson–Shiffrin multi-store model of memory in the encoding, storage and retrieval of stored information in sensory, short-term and long-term memory stores

Glossary:
Capacity
Decay
Displacement
Duration
Encoding
Long-term memory (LTM)
Memory
Rehearsal
Retrieval
Role
Semantic
Sensory memory
Short-term memory (STM)
Storage

ENGAGE

Are memories like a photograph?

Have you ever tried to recall an event, such as a birthday party, and couldn't remember some of the key details such as what was said or who attended? Or have you ever sat down to study for a test and realised that you couldn't remember anything of what your teacher had said about a concept, even though you were in class at the time? Most people conceptualise their memories as being like a photograph – an exact replica of an experienced event. However, memories are much more like a painting –an impression of an event that is influenced by several internal and external factors.

Experiments on implanting false memories in people reveal the true nature of memory; it is prone to distortion. One such experiment, conducted by Roediger and McDermott, found that when a participant studied a list of words (for example, shoe, hand, toe, kick) with a common but not present associate (for example, foot), the participants often falsely reported the not present associate as having been in the original list.

The study of human memory is evolving and what we know about memory increases year to year. In this section, we will explore the basic building blocks of the memory process – the information processing model – and discuss one of the most enduring models of memory – the Atkinson–Shiffrin multi-store model.

Figure 6A–1 Many people consider memory to be similar to a photo. But memory is more like a painting.

ISBN 978-1-009-25416-8
Gallagher et al

EXPLAIN

Encoding, storage and retrieval

Memory is an information processing system that actively receives, organises, stores and recovers information. Memory is not a passive system because it involves purposeful coding, storage and recall of sensory information.

VIDEO 6A–1
MEMORY

Memory
an information processing system that actively receives, organises, stores and recovers information

Encoding
converting sensory information into a useable from that can be processed by the brain

For memory to work effectively, information must go through a sequential process. This three-stage process, called the information processing model, can be likened to using a computer.

Figure 6A–2 The process of memory can be compared to using a computer.

The first stage involves **encoding** sensory information or converting it into a useable form that can be processed by the brain. For the encoding process to begin, you must pay attention to the information. This is similar when you are typing Psychology notes on your laptop; every time you press a key, information is converted into a form that can be displayed on your screen.

The second stage is **storage**, which is the retention of information in memory over a period of time. If we store the information in an organised way, it will make it easier to recover memories when we need them. When you save a copy of your Psychology notes on your computer, they can be retained for a long or short period until they are needed.

Storage
retaining information over time

Retrieval
accessing information that has previously been stored

The last stage of the information processing model is **retrieval** – the process of locating and recovering the stored information from memory so that we are consciously aware of it. Retrieval relies on using the right cues or hints so that we can locate the correct piece of information in the vast network of our memories. When you begin to study for a Psychology test, you would open the correct folder and file on a computer to retrieve your Psychology notes. If your folders are organised neatly, it will make locating your Psychology notes much easier than if your folders are disorganised or mislabelled.

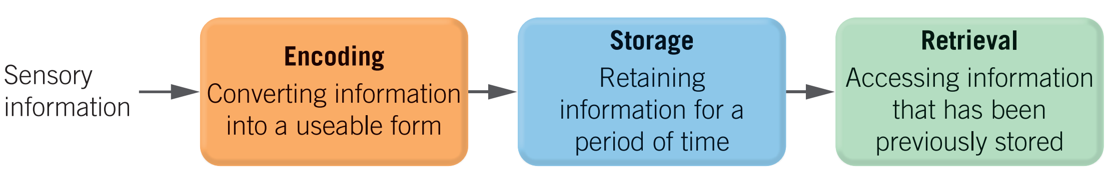


Figure 6A–3 A summary of the information processing model

Check-in questions – Set 1

1. Why is memory considered an active process?
2. Outline why memory is both similar and dissimilar to a computer.
3. Explain why the information process is sequential, with reference to an example.

ISBN 978-1-009-25416-8 Gallagher et al

Multi-store model of memory

There are many models of memory, as there are with learning. How do we know which model is correct? Although no single model is considered to have captured all aspects of human memory, it is agreed that memory consists of a collection of complex interconnected and interacting systems, each of which serves a different purpose and operates very differently to the others. Despite the uncertainty about precisely how many memory systems we have and the true nature of their roles, memory operates as if it is a single unit.

Role
the function of a memory store

Capacity
the amount of information held within a memory store

Duration
the length of time information is held within a memory store

The Atkinson–Shiffrin multi-store model of memory is one of the most widely accepted models of memory. This model proposes that there are multiple levels to memory and in order to store information for a long period of time, sensory information must pass through a series of levels or stores. More specifically, the multi-store model suggests that there are three independent stores that function simultaneously and interact with each other to process information. Each store processes information in different ways and varies in its **role**, **capacity** and **duration**.

The Atkinson–Shiffrin multi-store model is one of the most widely accepted models of memory because of its explanatory power – how well it explains memory.

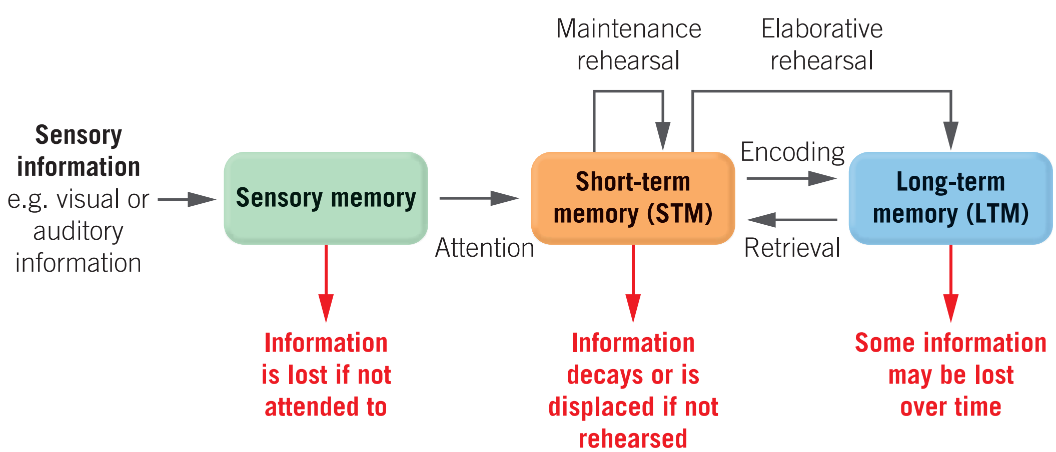


Figure 6A–4 A summary of the multi-store model of memory

Sensory memory

Every day we are bombarded with an immense amount of sensory information from both the external and internal environment. This sensory information is taken in by the first level of the multi-store model of memory – **sensory memory**. Sensory memory receives and stores large amounts of incoming sensory information for a brief time.

Sensory memory
a memory store that receives and stores an unlimited amount of incoming sensory information for a brief time

Information that enters sensory memory is in its raw form; that is, it is exactly the sensory information being received. For example, when you watch TV, you are being flooded with a range of sensory stimuli, including the visual information from the TV screen, the auditory information from the show that you are watching, the tactile information of the texture of the couch you are sitting on, and more. You have five senses, so information is taken in by a sensory store for each sense.

Although we are not consciously aware of the information that is held in sensory memory, you must pay attention to important sensory information for it to be further processed and transferred into the next memory store, short-term memory. If you do not attend to this sensory information, it will be lost from your memory forever. If you are watching TV and

ISBN 978-1-009-25416-8 Gallagher et al

your mother comes into the loungeroom and asks you what you would like for dinner, how are you able to process the information from the TV and respond to your mother's question at the same time? You could probably attend to the last part of what your mother said, therefore becoming aware of her question. This will allow you to respond. However, while you have been responding to your mother, you will not have paid enough attention to the TV show you were watching and therefore you will not recall what has occurred because this information has been lost.

Sensory memory differs from the other memory stores in its function, capacity and duration.

Figure 6A–5 When you watch TV, you are being bombarded with a range of sensory stimuli. However, when you turn your attention to another stimulus (e.g. a question from your mother), then it is likely that you will recall the question and your response rather than what you were watching on TV at that time.

Function

We receive huge amounts of incoming sensory information every minute; sensory memory is the entry point for all these new sensory stimuli. Sensory memory filters out any unnecessary information, thus preventing us from becoming overwhelmed by the vast amount of sensory information. This occurs because our sensory memory is more likely to focus on information that is novel, relevant or important to us. Because the duration of sensory memory is very brief, any information can be held long enough to decide whether the information is important enough to be attended to and therefore transferred to short-term memory.

Sensory memory also stores sensory impressions long enough for each impression to slightly overlap the first. This allows us to perceive the world around us as continuous, rather than as a series of disconnected images or sounds.

Capacity

Sensory memory has an unlimited capacity – its storage capabilities are structured to deal with the immense amounts of sensory stimuli entering at any given time.

Figure 6A–6 You are more likely to remember this meeting than other meetings because it is novel.

ISBN 978-1-009-25416-8 Gallagher et al

Duration

Sensory memory holds information for 0.2–4 seconds. This duration is extremely brief, but is long enough for the large amount of sensory information to be temporarily stored and assessed by the brain to decide whether it should enter short-term memory or not. As mentioned earlier, each sense has a sensory register, which is the first memory store that information flows into. Duration varies from a fraction of a second to a few seconds, depending on the sensory register. For example, it takes a small amount of time to process an image but longer to process each word of a sentence. Therefore information that enters our auditory (or echoic) register has a longer duration than information that enters our visual (or iconic) register.

These specific sensory registers are not in the study design, but are outlined in Table 6A–1.

Table 6A–1 Two types of sensory registers

	Iconic memory	Echoic memory
		
Function	Exact replica of visual information	Exact replica of auditory information
Duration	0.3–0.5 second	3–4 seconds
Capacity	Unlimited	Unlimited

ACTIVITY 6A–1 DEMONSTRATING SENSORY MEMORY

To demonstrate the duration of sensory memory, try the following activities.

1 Hold your hand about 30 centimetres from your face and stare at it for about 60 seconds. Close your eyes and describe the afterimage that remains. Can you see the outline of your hand? You might be able to see the afterimage your hand leaves on the receptors in the retinas of your eyes.

2 As a whole class, clap once. Can you hear the brief echo of the sound? You might be able to hear to sound of the clap for longer than you saw the afterimage of the hand because the duration of echoic memory is longer.

Check-in questions – Set 2

1 Define ‘sensory memory’.

2 Explain what raw information is.

3 What happens if information is not attended to in sensory memory?

Short-term memory

Short-term memory (STM) a memory store that has limited capacity of short duration, unless the information is renewed

After information has been attended to in sensory memory, it is moved to the second level of the multi-store model of memory – **short-term memory (STM)**. The storage capacity of short-term memory is limited – information is held for a relatively short period of time unless renewed. Information in sensory memory that has been attended to and therefore transferred to short-term memory is no longer in its raw form, but rather is an encoding of the information based on its sensory form (for example, visual, tactile or acoustic).

ISBN 978-1-009-25416-8 Gallagher et al

In this memory store, information is conscious and is actively manipulated so that we can retain the information for long enough to use it. For this reason, short-term memory is sometimes referred to as the seat of conscious control, because it is where all conscious mental processes such as decision-making or perception originates. For example, if you have ever had to deliver a message from your teacher to the school receptionist, you probably kept it in your conscious awareness long enough so you could deliver the message.

Figure 6A–7 If your teacher sends you to the school receptionist to ask for whiteboard markers, on your way you would probably repeat this request over in your mind to keep it in your conscious awareness.

Short-term memory is the only store that can access both other memory stores. More specifically, short-term memory receives information from sensory memory and transfers information to and from long-term memory. Since short-term memory has a limited duration and capacity, information can be easily lost unless it is renewed or manipulated in some way.

Short-term memory differs from the other memory stores in its function, capacity and duration.

Function

Once information has entered our short-term memory, we can actively manipulate encoded information while we complete everyday tasks. This occurs through receiving and integrating information from both sensory memory and long-term memory. For example, when you go to a cafe and try a new food, your sensory memory receives sensory information about the food, such as the colour, taste and texture, and sends it to your short-term memory.

Your short-term memory retrieves and compares existing information that was held by your long-term memory about similar foods that you have eaten in the past. By comparing this information, your short-term memory can then send new information (that the food is delicious) to your long-term memory for long-term storage.

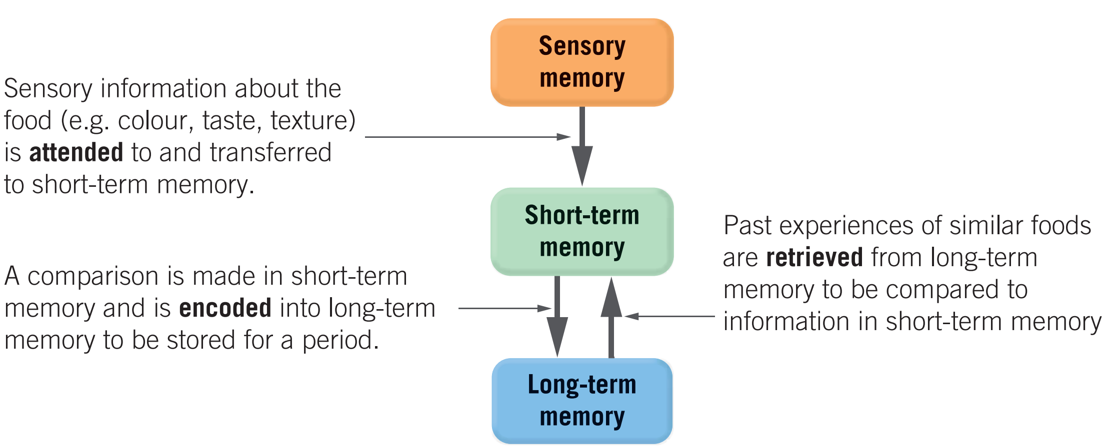


Figure 6A–8 A summary of how information (for example, about food) is integrated in short-term memory

ISBN 978-1-009-25416-8 Gallagher et al

Capacity

Short-term memory has a smaller capacity than sensory memory or long-term memory, holding a limited amount of information. The following exercise demonstrates the capacity of your short-term memory.

Read the sequence of letters and then look away or close your eyes and try to repeat the letters in the same order.

D C Y S O

How many letters did you remember? Now read this next sequence of letters and try to repeat in the same order when you can't see them:

W N V D C E I V D C S V

Was this easier or harder? You probably found it much more difficult, if not impossible! This is because an average adult can only hold 7 ± 2 items, or 5–9 unrelated items, in short-term memory. If short-term memory is at capacity, new items can only be added if some old items are pushed out.

For example, suppose you are listening to your science teacher give instructions for an important test, and your friend asks you a question about a concept that might be on the test. You may find that you do not remember your teacher's instructions because they have been displaced from your short-term memory by your friend's question. **Displacement** can make it difficult to do more than one task at a time when manipulating information in short-term memory.

Displacement adding new single items to short-term memory by pushing out old items

Fortunately, the capacity of short-term memory can be extended by a process called chunking. Chunking is grouping separate items together to form a larger single of information. For example, a phone number has 10 separate items of information:

1 4 6 8 7 0 2 6 1 3

This might be difficult to memorise successfully because 10 single items exceed the capacity of short-term memory. However, if we group the 10 items into 'chunks' of information, then this will result in a more successful memorisation of the phone number:

1468 702 613

This occurs because three units of information does not exceed the capacity of short-term memory.

Decay the fading away of information in short-term memory when not maintained by rehearsal

Rehearsal the conscious manipulation of information to keep it in short-term memory for longer or to transfer it to long-term memory

Duration

The duration of short-term memory is limited compared to sensory memory and long-term memory, lasting for 12–30 seconds. If, after 30 seconds, the information is not manipulated in some way, it will fade from short-term memory and be permanently lost. This process in known as **decay**. Decay can be prevented by **rehearsal**, which is when information is consciously manipulated to keep it in short-term memory for longer or to transfer it to long-term memory.

A common example of rehearsal is maintenance rehearsal, which is when you repeat the information being remembered either vocally (out loud) or sub-vocally (in your head) to preserve it in your short-term memory. In this way, information can be kept in your short-term memory for as long as you repeat the information and are not interrupted.

ISBN 978-1-009-25416-8 Gallagher et al

However, the best way to transfer information into long-term memory is to use elaborative rehearsal, which involves giving meaning to new information and making associations with other information already stored in your long-term memory. Common methods of elaborative rehearsal are making mnemonics, creating questions, making mind maps, and explaining a concept to someone who has no knowledge of the subject matter. This allows you to process new information at a deeper level, which results in more effective memory encoding and, therefore, retrieval.

ACTIVITY 6A–2 DEMONSTRATING THE CAPACITY OF SHORT-TERM MEMORY

In pairs, read the following number sets to each other, with a two-second pause between each number. After reading each set, allow your partner time to write the number set in the correct order.

a 6, 0, 2
b 1, 5, 7, 3
c 5, 8, 2, 6, 9
d 9, 1, 4, 3, 6, 8
e 5, 2, 0, 8, 0, 3, 2
f 5, 8, 2, 4, 6, 0, 2, 5
g 3, 6, 7, 9, 0, 2, 4, 7, 0, 3
h 4, 6, 2, 3, 4, 9, 0, 3, 6, 3, 0

Identify the last number set your partner remembered correctly. How many items could they recall correctly? What does this suggest about the capacity of short-term memory?

Check-in questions – Set 3

1 Define 'short-term memory'.
2 Explain why short-term memory is considered to be the seat of conscious control.
3 Outline the difference between decay and displacement in short-term memory.

Long-term memory

After information in short-term memory has been processed, it is transferred to the last level of the multi-store model, **long-term memory (LTM)**. Long-term memory is a relatively permanent memory system that holds vast amounts of information for an extended period, possibly for life. When information is transferred into long-term memory, it undergoes further encoding according to its meaning and it once again becomes unconscious. This is to prevent us from being overwhelmed by the vast amount of information that we have stored in our long-term memory.

LINK 6C THE ROLE OF EPISODIC AND SEMANTIC MEMORY

Long-term memory (LTM) memory that is relatively permanent and holds huge amounts of information for a long time, possibly lifelong

Long-term memory can also be differentiated from other memory stores by its function, capacity and duration.

Function

Information stored in long-term memory is organised semantically, which means that the meaning of the word, phrase, picture, event or thing is encoded, as opposed to its sensory input (e.g. sound, image or texture). **Semantic** information is stored for a long time in an organised way, according to meaning (and therefore relating to its function) and importance to your personal experience.

Semantic relating to meaning

ISBN 978-1-009-25416-8 Gallagher et al

Figure 6A–9 Long-term memory is organised like your files on your laptop; information is organised based on its meaning.

Having your memories well organised means that you can retrieve the information more efficiently. Imagine that your long-term memory is like a set of well organised files on your laptop. When you wish to find some information about your taxes, by knowing the meaning of 'tax' and what relates to it, you will easily be able to search for and locate the correct file to access and read through the relevant information. (If you just searched by sound, you might find information on 'tacks' instead.) Similarly, when information is required, it is retrieved by locating it in long-term memory and sending it back to it conscious awareness (short-term memory). When information is stored in an organised way, it only takes a few seconds to search the neural networks to find the required information.

Capacity

The capacity of long-term memory is unlimited, like to that of sensory memory. This allows it to store a lifetime of memories. We don't know how much information long-term memory can actively store, and this is still being explored by researchers.

Duration

In comparison to sensory and short-term memory, the duration of long-term memory is relatively permanent. This means that information is thought to last in the memory store for a long time, in some cases for life. However, stored information can decay because of physical or psychological factors, particularly through disuse of particular memories and brain diseases such as Alzheimer's disease and other dementias.

WORKSHEET 6A–1 THE MULTI-STORE MODEL OF MEMORY

Table 6A–2 A summary of sensory memory, short-term memory and long-term memory

Store	Role	Capacity	Duration
Sensory memory	• Entry point for sensory information • Filters out unnecessary information • Stores information long enough so that we perceive the world as continuous	Unlimited	0.2–4 seconds
Short-term memory	Actively manipulates encoded information, so it remains in conscious awareness	7 ± 2 items (or 5–9 items)	12–30 seconds
Long-term memory	Stores information that has been semantically encoded for future use	Unlimited	Relatively permanent

Check-in questions – Set 4

1 Define 'long-term memory'.
2 Information stored in long-term memory is stored semantically. Explain what this means.
3 Explain what 'relatively permanent' means.
4 Outline how information from sensory memory and long-term memory interacts through short-term memory

ISBN 978-1-009-25416-8 Gallagher et al

6A SKILLS

VIDEO 6A–2 SKILLS: ABBREVIATING KEY TERMS

Abbreviating key terms

In VCE Psychology, it is important that your responses are concise and detailed. One way to ensure that your responses are concise is to know which key terms can be abbreviated. You can find out this information by completing past VCAA exam papers and identifying which terms have been abbreviated within the exams.

In terms of the memory content, short-term memory (STM) and long-term memory (LTM) are two commonly abbreviated terms; however, sensory memory cannot be abbreviated. Let's have a look at a sample question and response.

Question:

Outline one difference between sensory memory and short-term memory. (1 mark)

Attempted answer:

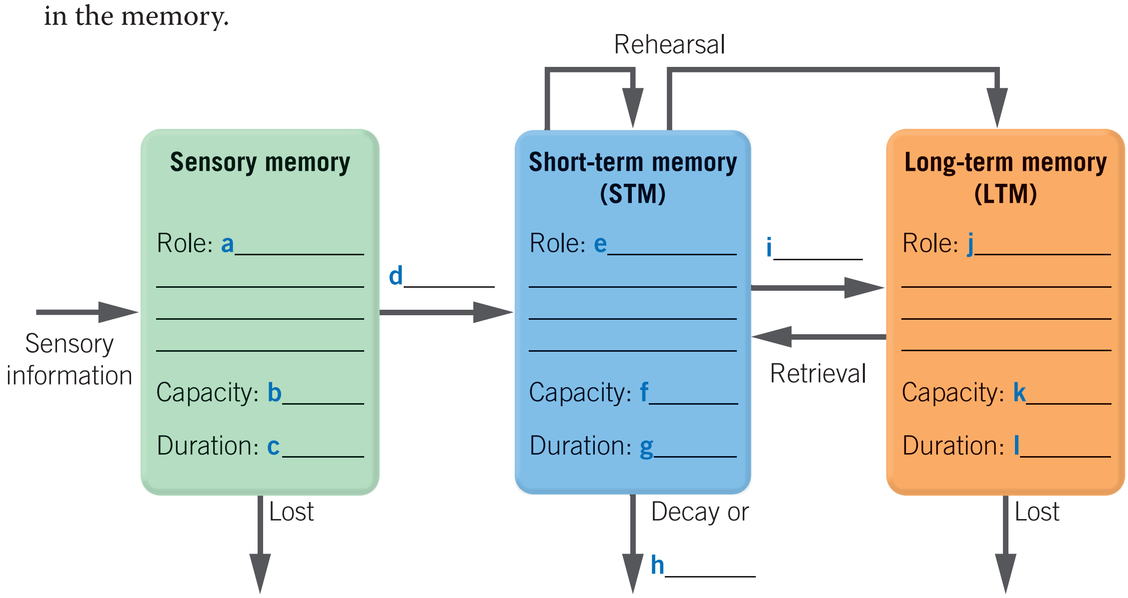
The information in SM is stored in its raw form whereas the information in short-term memory is stored in an encoded form.

Marking comments:

The response above would receive a score of 0/1 marks. Although the information is correct, SM is not an accepted abbreviation of sensory memory.

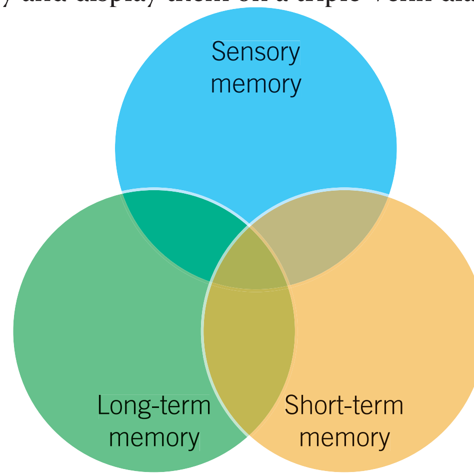
Section 6A questions

1 Write down the text that completes the blanks **a** to **l** in the following diagram of the multi-store model of memory. For **d** and **i,** write labels for the arrows indicating what passes in that direction. For **h**, add to the label to say what happens to the information in the memory.

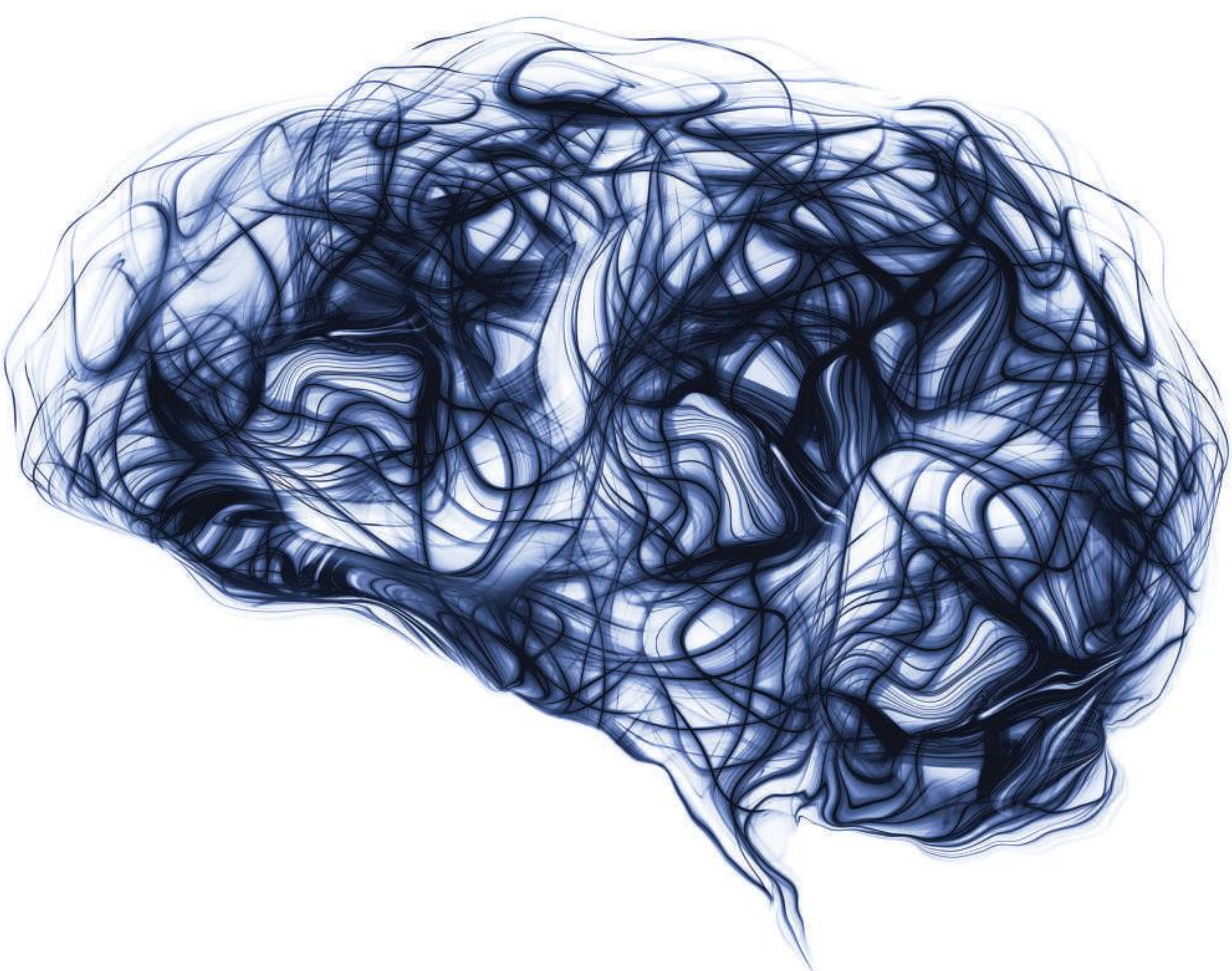


ISBN 978-1-009-25416-8 Gallagher et al

2 Identify the similarities and differences between sensory memory, short-term memory and long-term memory and display them on a triple Venn diagram.



3 Kieran was listening in class while his Science teacher wrote on the board and discussed key tips for the SAC he would sit in a week's time. Discuss the role of each of the relevant components of the Atkinson–Shiffrin multi-store model of memory in both storing the memory of the test tips and recalling them during the SAC.



6B The roles of specific regions of the brain in long-term memory

Study Design:
The roles of the hippocampus, amygdala, neocortex, basal ganglia and cerebellum in long-term implicit and explicit memories

Glossary:
Amygdala
Basal ganglia
Cerebellum
Cerebral cortex
Consolidation
Declarative memory
Episodic memory
Explicit memory
Hippocampus
Implicit memory
Neocortex
Semantic memory

ENGAGE

The man with 30 seconds of memory

In 1985, musician Clive Wearing contracted a virus, which especially affected the parts of his brain concerned with memory. He was 46 years old and was left with a memory span of seconds, said to be the most devastating case of amnesia ever recorded. Clive was able to perceive sight and sounds and process them normally, but he did not seem to retain any of these impressions for more than a few seconds. Consequently, Clive could no longer learn new information. For example, he could not recall the doctors who had cared for him, or even the news he had read in the paper. Clive continuously described his experience as 'having just woken up after a great void'. Interestingly, Clive was still able to play the piano and remember some family members such as his wife, Deborah.

Figure 6B–1 Clive Wearing's hippocampus was irreparably damaged, which left him unable to make new memories. Clive can only remember approximately 30 seconds of information before it decays.

It is from case studies such as Clive that researchers have been able to identify the parts of the brain involved in memory formation. Because of this research, it has been found that long-term memories are not stored in any one specific brain location. Instead, they are encoded and stored in multiple brain locations and linked together by a network of neural pathways. In this section, we will explore the different types of long-term memory and the different parts of the brain that process them.

EXPLAIN

Explicit and implicit memories

In Section 6A, you learned that information can be stored in long-term memory in a relatively permanent, organised fashion. As part of this organisation, different types of memories can be categorised as either implicit memory or explicit memory. Both of these types of memories involve information that is retrieved from long-term memory.

LINK 6A THE EXPLANATORY POWER OF THE ATKINSON–SHIFFRIN MULTI-STORE MODEL OF MEMORY

ISBN 978-1-009-25416-8 Gallagher et al

ACTIVITY 6B–1 DIFFERENTIATING EXPLICIT AND IMPLICIT MEMORIES

In small groups or as a whole class, try to answer the following questions:

a Who won the AFL Grand Final in 2015?
b What was the name of your year 6 teacher?
c What year was your mother born?
d Describe how to tie your shoelace.
e Recite a popular song (for example, 'Drivers Licence') without the melody.
f What is the highest mountain in Australia?

Some questions were easy to answer, and some were much harder to give a verbal description of the task. This difference can help us to distinguish between explicit memories, which are easy to verbalise, and implicit memories, which are difficult to verbalise.

Additionally, when answering questions, you may recall how you learned the information; for example, you may recall being in your year 7 Geography class when learning that the highest mountain in Australia is Mount Kosciuszko, or you might have no idea how you know this information. By considering if we can recall how we learned information, we can then identify whether the memory is episodic or semantic in nature.

Explicit memory information that can be consciously retrieved and stated, such as 'known facts'

Declarative memory an explicit long-term memory of specific facts and events, most of which can be stated or 'declared'

Semantic memory the declarative memory of facts or knowledge about the world

Episodic memory the declarative memory of personally experienced events

Explicit memory

What is the capital of France? What did you have for breakfast this morning? Do you remember who attended your tenth birthday party? All of these questions demonstrate explicit memory. **Explicit memory** occurs when information can be consciously or intentionally retrieved and stated. Explicit memory can otherwise be known as **declarative** or 'knowing that' information because it tends to be expressed as words or symbols and is easily verbalised.

Different types of memories can be considered explicit. Although these are not examined within the study design, they are helpful to know. These are:

- **Semantic memory**: memory of facts, worldly knowledge or general knowledge; for example, remembering the duration of short-term memory or who the first Prime Minister of Australia was.
- **Episodic memory**: memory of specific events or personal experiences; for example, remembering what you did on your last holiday or what you normally do when you get home from school.

Figure 6B–2 Remembering who you sat next to at Christmas dinner is an explicit episodic memory. Knowing that the Eiffel Tower is in Paris is an explicit semantic memory.

ISBN 978-1-009-25416-8 Gallagher et al

Implicit memory

Do you know how to bake a cake or ride a bike? Are you afraid of spiders and 'freak out' whenever you see a spider, despite how small it is? All of these are examples of implicit memory. **Implicit memory** does not require conscious or intentional retrieval. Implicit memories are referred to as non-declarative or 'how to' knowledge because they include memory of stored routines and emotional responses. These kinds of memories are different from explicit memory because it can be very difficult to verbalise how to perform a sequence of actions required to do something. For example, try to explain to a friend how to precisely complete a task such as eating with a knife and fork; it is quite difficult!

Implicit memory
memory not requiring conscious retrieval, such as 'how to' skills

LINK CHAPTER 5

Some types of implicit memories are:

- **procedural memory**: knowledge of skills, habits or actions; for example, knowing how to type, knowing how to arrange flowers or how to do your hair
- **conditioned emotional response**: a learned emotional reaction occurs in response to a stimulus or an event that you have formed an association with. A conditioned emotional response typically involves negative emotions such as fear or anger, but it can also involve strong positive emotions such as happiness or excitement. For example, if you experience fear whenever you go to the dentist because you have had some painful dental work previously, this is a classically conditioned response. These types of responses are considered implicit because we cannot control the experience of fear or excitement when exposed to the associated stimulus.

Figure 6B–3 Exactly how to ride a bike is difficult to explain to another person. This is a common characteristic of implicit procedural memories. We cannot control the things that we fear. This is why emotional memories are considered to be implicit memories.

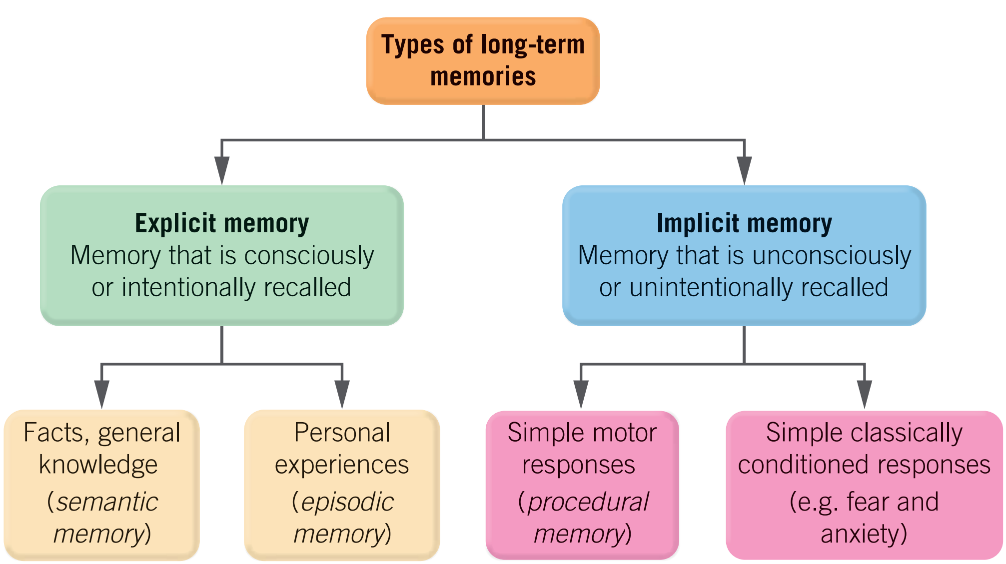


Figure 6B–4 Types of long-term memories

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 1

1 Categorise each of the following memories as implicit or explicit.
   a knowledge of English grammatical rules
   b the name of the highest mountain in Australia
   c memories of your weekend
   d knowing that a type of learning is operant conditioning
   e knowing how to arrange flowers
   f knowing how to bake a cake
   g remembering it's your sister's birthday
   h knowing the names of the players in your favourite sports team
   i feeling scared whenever you visit the dentist
2 Provide two examples of implicit and two example of explicit memories that have not been used in the text.
3 Explain why implicit memories are often hard to verbalise.

VIDEO 6B–1 BRAIN REGIONS THAT ARE INVOLVED IN MEMORY

Brain regions that are involved in memory

Five brain regions play a major role in encoding and storing implicit and explicit long-term memories: the hippocampus, amygdala, neocortex, basal ganglia and cerebellum (Figure 6B–5).

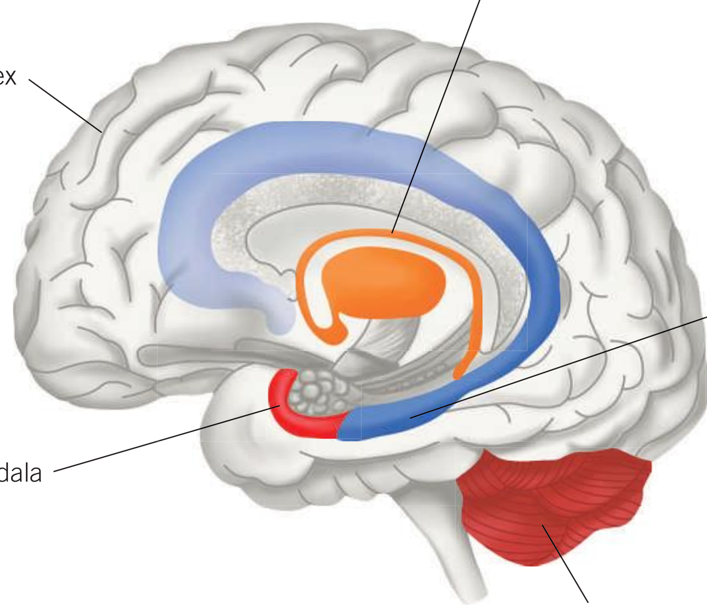


Figure 6B–5 The five labelled features are involved in encoding, storage and retrieval of memory.

Cerebral cortex a thin, outer layer of the brain; involved in complex mental abilities, sensory processing, voluntary movements and storage of explicit memories

Hippocampus

The hippocampus is in the temporal lobe, within the midbrain (that is, under the **cerebral cortex**). As seen in Figure 6B–6, the hippocampus is a finger-sized structure that resembles a wishbone. The lower part of the hippocampus forms two structures that each lie in one hemisphere of the brain.

ISBN 978-1-009-25416-8 Gallagher et al

The **hippocampus** has several key roles in memory. First, the hippocampus encodes, **consolidates** and retrieves explicit memories. For example, when you get on a plane to go on a holiday, you need to know your seat number. Your hippocampus forms (or encodes) and sets (or consolidates) the memory of the number of your seat. When you enter the plane, your hippocampus retrieves the allocated plane seat number into your conscious awareness so you can easily locate it.

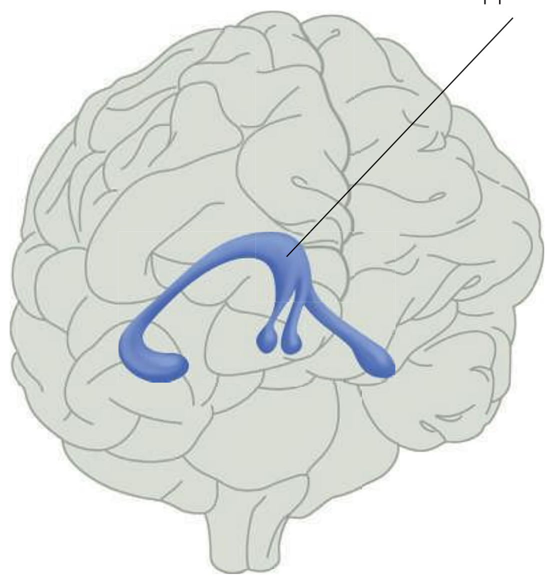


Figure 6B–6 The hippocampus is one of the structures involved in the formation and retrieval of explicit memories.

Hippocampus
a structure in the temporal midbrain; involved in formation of long-term explicit memories and their transfer to the cerebral cortex for storage

Consolidation
the process by which a temporary memory is transformed into a more stable, long-lasting form

LINK CHAPTER 8

The hippocampus also transfers newly encoded explicit memories to relevant parts of the brain for permanent long-term storage. For example, the hippocampus sends the memory of your plane seat number to be stored in your neocortex. In this section's Engage box you read about Clive Wearing, who exists in a self-described 'void' where he has been unable to make new memories for many years. When he was 46, Clive contracted an infection that attacked his central nervous system and damaged his hippocampus. Consequently, he has been unable to transfer new memories to be permanently stored, resulting in his unique and unfortunate circumstances.

Figure 6B–7 The hippocampus encodes, consolidates and retrieves the explicit details of an event such as your seat number in an aeroplane.

Additionally, research by German scientist Himmer and colleagues in 2019 shows that memory transfer occurs during sleep. In the study, German participants performed better in a recall task if they had slept for more than 8 hours after 12 hours of learning a list of German words.

Lastly, the hippocampus interacts with the **amygdala** to link emotions to explicit memories. For instance, when you have an emotionally arousing experience, your hippocampus encodes the explicit memories of the event, whereas the amygdala encodes the emotions related to the event. When you retrieve the memory from the neocortex in the future, the hippocampus's activity during memory formation will enable recall of where and when the event happened, and who was with you. Meanwhile, your amygdala will also be activated during retrieval, so you will also remember your emotions during the event. Sympathetic nervous system reactions such as heart rate, goose bumps and sweating that have been linked to the memory may also recur.

Amygdala
a structure located deep in the temporal midbrain; involved in emotional reactions and formation of emotional memories particularly relating to fear

ISBN 978-1-009-25416-8 Gallagher et al

Neocortex

UNIT 1 LINK

The brain is mostly covered by a thin wrinkly layer of neural tissue, 2.5 millimetres thick. This is the cerebral cortex. The **neocortex** is the top layer of the cerebral cortex that is involved in high-order mental processes such as language, attention and memory. As you learned in Unit 1 Psychology, the neocortex is divided into two hemispheres, each of which has four lobes (Figure 6B–8). These lobes have different roles and are all involved in memory.

Neocortex the top layer of the cerebral cortex that is involved in high-order mental processes such as language, attention and memory

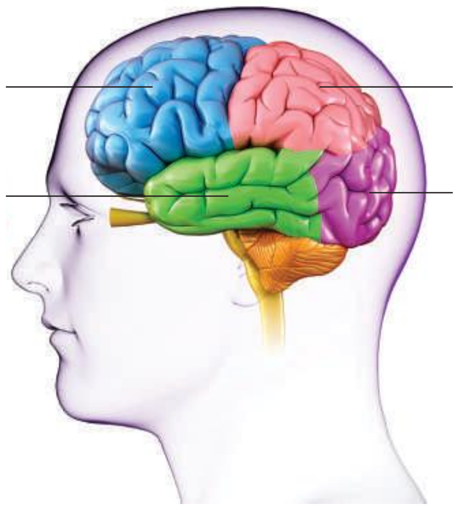


Figure 6B–8 The four lobes of the brain and their functions

Figure 6B–9 The cerebral cortex stores the explicit details of an event, such as who was playing at the most recent concert you went to.

Although the hippocampus encodes information and sends it to be stored, the neocortex is the part of the brain that actually stores explicit memories for a long time. Memories are widely distributed throughout the cortex and they are usually permanently stored in the areas where the sensory input was first processed. For example, if you go to a concert, each sensory part of the memory is stored in a different part of the brain; the sound of the music is stored in the temporal lobe, the vision of the musicians is stored in the occipital lobe and the sensation of the people brushing against you on the dance floor is stored in the parietal lobe.

These different components of the memory are linked by neural networks to ensure they do not remain as separate parts. When required, the separate parts are brought together, reconstructed and retrieved into consciousness as a single, integrated memory. The reconstruction of memories is analogous to putting together a jigsaw puzzle.

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 2

1 Outline three key roles of the hippocampus.
2 Compare and contrast the hippocampus and the neocortex.
3 Explain how memories stored in the neocortex might be compared to a jigsaw puzzle.
4 Give an example of how the hippocampus and the neocortex interact.

Amygdala

The amygdala lies behind the temple, deep under the cerebral cortex. The amygdala is an almond-shaped ball of neurons that is attached to the hippocampus. There is an amygdala in each hemisphere.

The amygdala is responsible for the regulation of emotions such as fear and aggression, which enhances the significance of an event. It plays a part in the memorability of experiences because the storage of memory is influenced by the initiation of the flight-or-fight-or-freeze response and stress hormones. The amygdala helps to store memories of events and emotions so that you can recognise similar situations in the future, particularly if what happened is linked to survival. For example, if you have ever been bitten by a dog, you may have felt a flood of adrenaline and your heart rate increase (as well as other signs of a stress response). This might increase your alertness around dogs in the future.

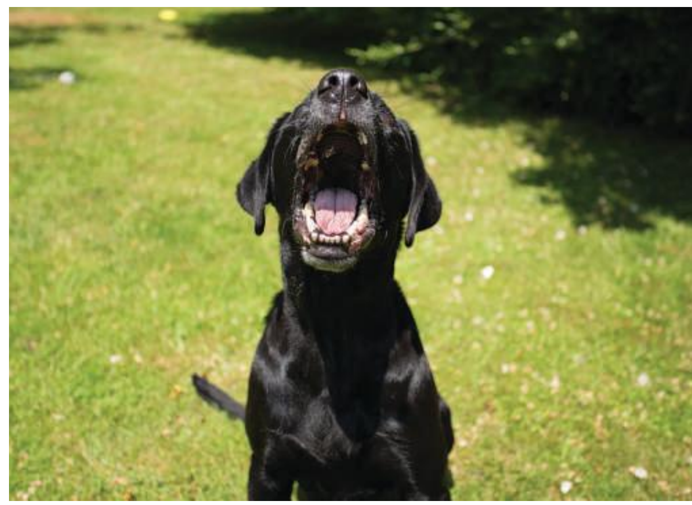


Figure 6B–10 The amygdala encodes the emotional memory associated with being bitten by a dog.

The amygdala is also responsible for encoding implicit memories to do with emotions. Being bitten by a dog would be a frightening event. Your amygdala encodes the emotion of fear that you felt at the time that the dog bit your leg, and then activates the hippocampus to encode the explicit event as significant.

Check-in questions – Set 3

1 Outline two roles of the amygdala.
2 Propose the benefit of the hippocampus and amygdala being near each other in the midbrain.

Basal ganglia

The **basal ganglia** are a group of structures deep within the cerebral hemispheres. These structures have primary roles in learning, procedural memory, routine behaviours and emotions.

Basal ganglia a group of structures deep within the cerebral hemispheres; involved in motor movement, procedural memory and learning

As with the hippocampus, much of what is known about the function of the basal ganglia has resulted from case studies of people who have sustained damage to that specific part of the brain. One such case study is that of Eugene Pauly, who in 1992 suffered from a disease that destroyed his hippocampus. Doctors soon realised there was something strange: although he didn't remember things, he could go for a walk alone and find his way back home. He was able to create new routines and habits. The part of the brain responsible for forming habits and guiding habits is the basal ganglia, which had not been affected by the disease. So Pauly could learn new habits.

ISBN 978-1-009-25416-8 Gallagher et al

As Eugene Pauly demonstrated, one of the basal ganglia's main roles is the formation (or encoding) of implicit procedural memory, specifically habits. The basal ganglia work to form habits by associating movement with reward or reinforcement.

The basal ganglia are active when we move a part of our body in a new way when stimulated by a cue. For example, we might encounter roadworks on our journey home and therefore take a route that results in getting home more quickly. Another example is trying to impress a new friend, so taking the time to learn a new skill in the kitchen that results in a delicious meal. When we feel a sense of accomplishment for trying something new, or when the action results in a positive outcome, the association between the reward and the action is recognised. The reward indicates to the basal ganglia that the behaviour is useful and worth remembering for the future.

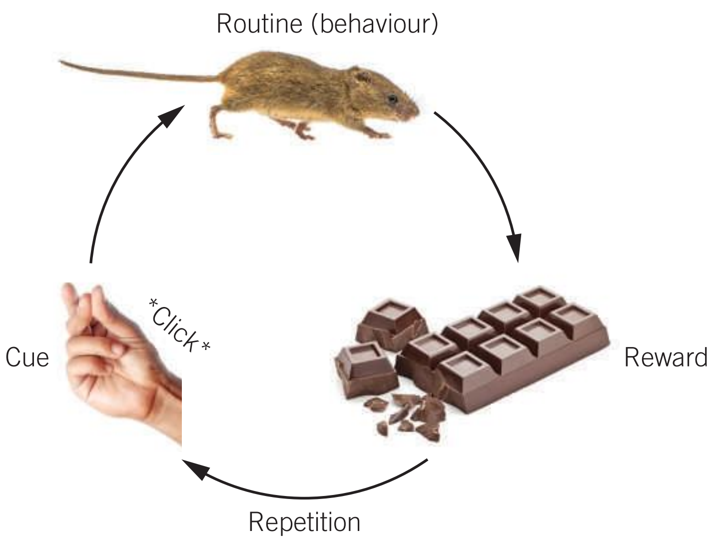


Figure 6B–11 The habit loop. The basal ganglia help to make an association between cue and reward, which results in the formation of a habit. The cue is the trigger that causes the brain to automatically go into a routine or behaviour that delivers a reward. In this example with a mouse, someone clicks their fingers and makes some chocolate accessible to a mouse. The mouse's routine or behaviour is to seek out the chocolate, which is the reward. Repetition reinforces the routine.

One model for this is the habit loop (Figure 6B–11), which involve a cycle of cue and reward. Whenever the loop is repeated, the behaviour related to the sequence of movement is strengthened and becomes more precise and efficient. This makes repetitive behaviours automatic, which in turn frees up our brain to focus on other more complex decisions. For example, we might now automatically take the quicker route home from work or school, leaving our brain free to focus on our schoolwork or what we might cook for dinner that night.

The basal ganglia are also responsible for the planning and control of fine motor control relating to a sequence of goal-directed behaviour so that it can be performed in a fluid manner. Holding and writing with a pencil seems like a smooth motion. However, if you were to record a video of this action and slow it down, it would look as though your finger is making hundreds of discrete, defined 'steps' to write with the pencil. Every small step uses trial and error to find the best movement for the overall behaviour.

The basal ganglia do this by communicating with other regions of the brain to acquire motor and cognitive skills gradually through practice. More specifically, the basal ganglia receive input from the cerebral cortex, asking them to perform a complex sequence of steps and movements required to perform a skill or goal. The basal ganglia consider the input or the 'plan' and refine it to include more appropriate or efficient movements. The basal ganglia then send two simultaneous messages to other regions of the brain (such as the cerebral cortex and the cerebellum). The release of dopamine stimulates a message to facilitate the correct movements and the release of GABA (gamma-aminobutyric acid) stimulates a message to inhibit competing movement. This 'loop' is primarily active when a sequence of movement has been well learned and can be executed seamlessly without conscious recollection of the prior learning episode or the rules underlying the task.

ISBN 978-1-009-25416-8 Gallagher et al

Figure 6B–12 The basal ganglia help to execute complex well-practised sequences of movement such as riding a bike, cooking a meal, brushing our teeth and driving a car seamlessly.

Check-in questions – Set 4

1 Outline two roles of the basal ganglia.
2 Compare and contrast the basal ganglia and the amygdala.
3 Explain how the basal ganglia and the hippocampus might both play a role in learning how to play soccer.
4 Suggest why the function of basal ganglia is useful when processing a range of complex information.

Cerebellum

The **cerebellum** is a cauliflower-shaped structure at the base of the brain alongside the brain stem. The cerebellum forms part of the hindbrain, which consists of structures that control the parts of the body that operate without conscious effort.

It makes sense, then, that the cerebellum has a role in the encoding and temporary storage of implicit procedural memories for motor skills, more specifically for those created by classical conditioning. For example, the cerebellum encodes simple reflexes acquired through classical conditioning such as blinking in response to the sound of a bell. Without a functioning cerebellum, people cannot develop certain conditioned reflexes, such as associating a beep with the puff of air that immediately follows, and so they do not blink in anticipation of the puff. When researchers disrupted nerve pathways in the cerebellum of rabbits, the rabbits became unable to learn a conditioned eye blink response.

Cerebellum a cauliflower-shaped structure at the base of the brain; coordinates timing and fluency of movements; encodes and temporarily stores implicit memories of simple conditioned reflexes

ISBN 978-1-009-25416-8 Gallagher et al

Figure 6B–13 The cerebellum helps an individual perform motor movements such as playing soccer in a smooth and coordinated manner.

The cerebellum also has a role in coordinating fine muscle movements and regulating posture and balance. For example, when you learn to play football, your cerebellum has a role in fine tuning the coordination of your feet when you are running or kicking a goal. This is not to be confused with your basal ganglia, which ensure that when you kick a goal or head-butt the ball, the series of movements occurs in a fluid, fast and smooth manner. Similarly, your cerebellum also forms and temporarily stores the memory of how to engage in this task.

WORKSHEET 6B–1 BRAIN REGIONS INVOLVED IN MEMORY

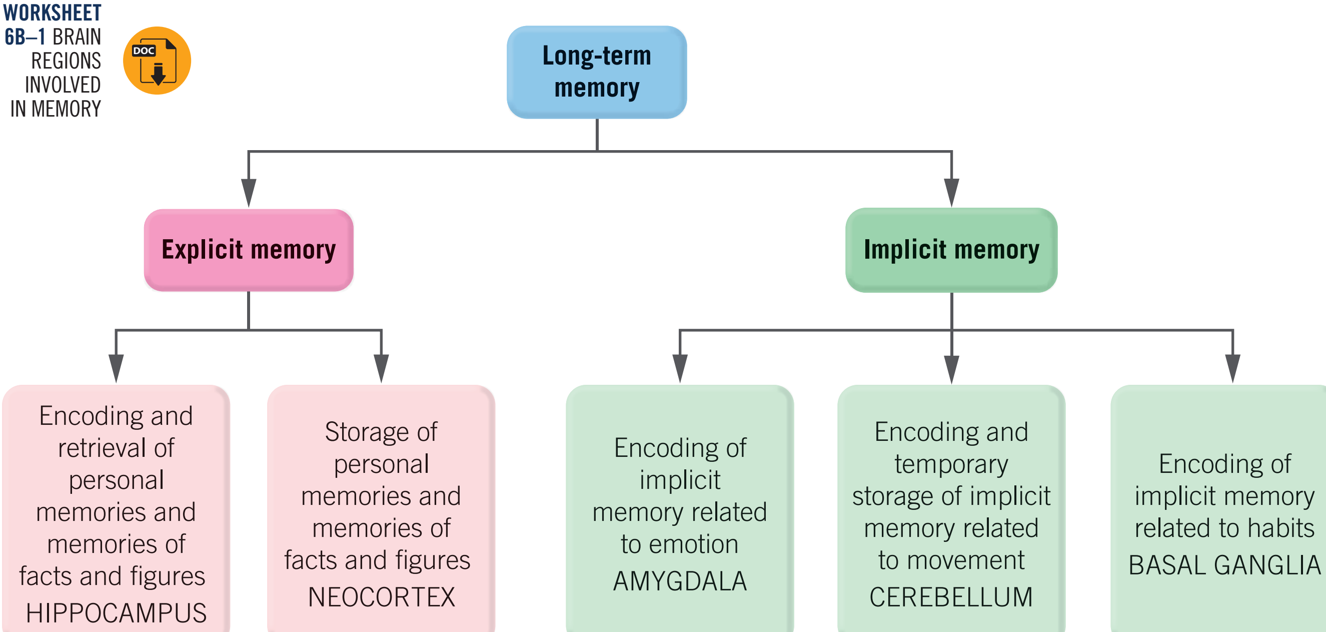


Figure 6B–14 A summary of the roles of the hippocampus, neocortex, amygdala, cerebellum and basal ganglia in encoding, storing and retrieving implicit and explicit memories

Check-in questions – Set 5

1 Outline two roles of the cerebellum.
2 Provide three examples of implicit memories that might be encoded by the cerebellum.
3 Compare and contrast the basal ganglia and the cerebellum.

ISBN 978-1-009-25416-8 Gallagher et al

6B SKILLS

VIDEO 6B–2
SKILLS: COMMAND TERMS

The importance of using command terms
In VCE Psychology, it is important to read and interpret the **command terms** in exam questions so that you can maximise the quality of your response as well as your timing in the exam.

Question:

Watson and Rayner classically conditioned 11-month-old 'Little Albert' to produce an emotional response to a white rat by pairing a loud noise with the presentation of a white rat.

During conditioning, Albert's response to the white rat was to startle and breathe heavily. After conditioning, he trembled and cried in fear every time he saw a white rat. He also generalised this emotional response to other white furry objects, including a rabbit and a dog.

Albert left the experiment still demonstrating an emotional response to white furry objects.

Identify and describe the role of the brain region that is primarily involved in the consolidation of Little Albert's conditioned emotional response. (1 mark) (2017 VCAA exam)

Comments:

The question requires the identification of **one brain area** and a **description of its function** in the development of an emotional memory. In this instance, either the hippocampus or the amygdala are appropriate choices, since they are both involved in the formation of emotional memories (albeit in different capacities). The cerebellum and the basal ganglia are not appropriate choices because they have roles associated with motor movement rather than emotion.

Attempted answer:

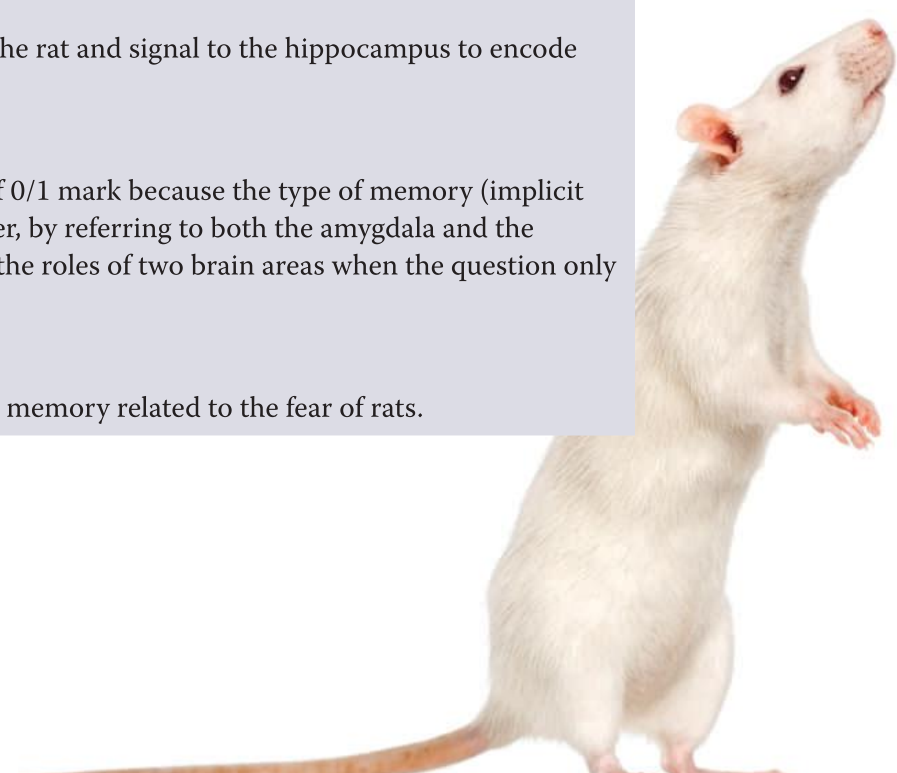
The amygdala will encode the fear of the rat and signal to the hippocampus to encode the memory as significant.

Marking comments:

This response would receive a score of 0/1 mark because the type of memory (implicit or explicit) has not been stated. Further, by referring to both the amygdala and the hippocampus this response discusses the roles of two brain areas when the question only askes for one.

Suggested answer for full marks:

The amygdala will encode the implicit memory related to the fear of rats.



ISBN 978-1-009-25416-8 Gallagher et al

Section 6B questions

1 Compare and contrast implicit and explicit memory.

2 Copy and complete the following table relating to the different brain areas.

Brain structure	Description	Type of memory	Role
Hippocampus			
Amygdala			
Neocortex			
Basal ganglia			
Cerebellum			

3 With reference to an example of your own, explain how the hippocampus, amygdala and cerebral cortex work together.

4 Explain how both the cerebellum and basal ganglia play a role in performing a motor skill such as cooking a lasagne.

5 Lillian is an avid deer hunter who hunts every weekend. She inherited this passion from her father who made her practise how to load and shoot a rifle until she could do it unconsciously. Unfortunately, Lillian was recently in a hunting accident where she was shot in the head. During surgery, doctors had to remove her cerebellum. With reference to two brain areas associated with memory, suggest, with reasoning, what Lillian would and would not be able to do if she were to resume hunting.

ISBN 978-1-009-25416-8 Gallagher et al

6C The role of episodic and semantic memory

Study Design:
The role of episodic and semantic memory in retrieving autobiographical events from the past and in constructing possible imagined futures, including evidence from brain imaging and post-mortem studies of brain lesions in people with Alzheimer's disease and aphantasia as an example of individual differences in the experience of mental imagery

Glossary:
Acquired
Alzheimer's disease
Amnesia
Amyloid plaque
Anterograde amnesia
Aphantasia
Autobiographical memory
Brain atrophy
Brain scan
Congenital
Dementia
Episodic future thinking
Lesion
Mental time travel
Neurofibrillary tangle
Reconstruction
Retrograde amnesia
Visual cortex

ENGAGE

Why some people are not spooked by scary stories

Telling scary stories is a common activity at sleepovers. Why are some people more easily spooked by stories than others? One reason could relate to how well they can visualise the scary scene in their mind. When some people listen to a story, they automatically visualise the scene in their imagination, while others have to focus really hard to create any sort of mental image. A small proportion cannot visualise images at all. No matter how hard they try, they do not see anything in their mind. This inability to visualise is known as aphantasia. If the ability to visualise images and scenes in the mind plays a role in how we react to spooky stories, what does that mean for people with aphantasia? How do they react when reading scary stories?

Researchers at the University of New South Wales tested how people with aphantasia reacted to reading distressing scenarios, such as being chased by a shark, falling off a cliff, or being in a plane that's about to crash. The researchers were able to physically measure each participant's fear response by monitoring changing skin conductivity levels – in other words, how much the story made a person sweat. This type of test is commonly used in psychology research to measure the body's physical expression of emotion. According to the findings, scary stories lost their fear factor when the readers could not visually imagine the scene – suggesting imagery may have a closer link to emotions than scientists previously thought!

According to researcher Joel Pearson, 'We found the strongest evidence yet that mental imagery plays a key role in linking thoughts and emotions. The findings suggest that imagery is an emotional thought amplifier. We can think all kind of things, but without imagery, the thoughts aren't going to have that emotional "boom".'

Figure 6C–1 People with aphantasia often do not find scary stories very scary at all.

ISBN 978-1-009-25416-8 Gallagher et al

EXPLAIN

What are episodic and semantic memories?

VIDEO 6C–1 EPISODIC AND SEMANTIC MEMORY

In this chapter you have learned about the interaction of explicit and implicit long-term memories and their link to brain areas. You might recall that explicit memories can also be known as declarative memories because they involve the long-term memory of specific facts and events, most of which can be stated or 'declared'. Examples of declarative memory include identifying a type of insect, explaining a mathematics formula to someone, remembering what you ate for lunch last week and recalling a sad or happy event from some time in the past. Declarative memories are often holistic, in that they involve the recall of many different aspects of the situation. For example, to consciously recall something, such as your memory of events that occurred yesterday, you not only recall the event but you also recall the context in which the event occurred; for example, the time of day, the place and the other objects and people that were present.

Psychologists believe that declarative memory is further subdivided into semantic memory and episodic memory. Semantic memory refers to the organised factual knowledge you have about the outside world; for example, what the capital of Norway is, what the main ingredient in an omelette is, what animals are on the Australian 50-cent piece. Each of these is a specific fact or piece of information. You would be able to research them, and providing the research was thorough, if every person in the classroom was asked about them, they should all come up with the same answers.

Figure 6C–2 Knowing the colour of the $20 note, who the first female prime minister of Australia was, and the names of the lobes of the brain are examples of semantic memories.

In contrast to semantic memories, which are impersonal, episodic memories are our 'diary like' record of personal experiences. Episodic memory contains memories of distinct personal events (or episodes) that are associated with a particular time and place – day after day, year after year. Can you remember your 10th birthday? An accident you witnessed? Your first day at secondary school? What you did over the weekend? All are episodic memories. In general, episodic memories are more easily forgotten than semantic memories. This is because new information is constantly pouring into episodic memory, making it difficult to attend to and therefore encode and store each new memory of a personal event.

Figure 6C–3 Episodic memories are personal; they allow us to recall who attended our tenth birthday party or what we ate yesterday.

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 1

1 What is the difference between an episodic and a semantic memory?
2 Decide whether each of the following examples is a semantic or an episodic memory.
   a remembering your wedding
   b the recipe of your favourite pasta dish
   c your phone number
   d the capital city of Portugal
   e the meaning of H_2O
   f your earliest birthday
   g the main ingredient of orange juice
   h writing an essay

The role of episodic and semantic memory in retrieving and constructing events

On the surface, the distinction between episodic and semantic memories is clear-cut. However, some psychologists believe that this is not necessarily the case. In recent years, research has suggested that episodic and semantic memories interact not only to retrieve past events but also to imagine future events.

Retrieving autobiographical events from the past

Consider the following scenario. A student is studying to complete an assignment one night. When researching and putting together the assignment, the student would have added new information to their existing knowledge on the task, but they would have also remembered where they were studying, when they began studying and the time they finished. The student is also likely to remember other information about the night, such as when their friend called and interrupted their study.

Figure 6C–4 If you consider the last time you studied for a test, you will probably easily recall both episodic and semantic information from that single memory.

Is episodic or semantic memory involved here? Endel Tulving, who proposed the concept of episodic memory, argues that the semantic and episodic systems store different information but often work together in forming new memories called **autobiographical memories**. Autobiographical memory is a memory system consisting of episodes recalled from person's life, based on a mixture of episodic (such as sensory details, thoughts and emotions, details that relate to times and places) and semantic (including general event knowledge, personal facts without context) memory. Therefore, autobiographical memories are a type of explicit memory. For example, the autobiographical memory of your first day at school might contain episodic information, such as meeting the teacher, but it might also contain semantic information, such as knowledge that the teacher's name was Susan.

Autobiographical memory a memory system consisting of episodes recollected from an individual's life, based on a combination of episodic and semantic memory

ISBN 978-1-009-25416-8 Gallagher et al

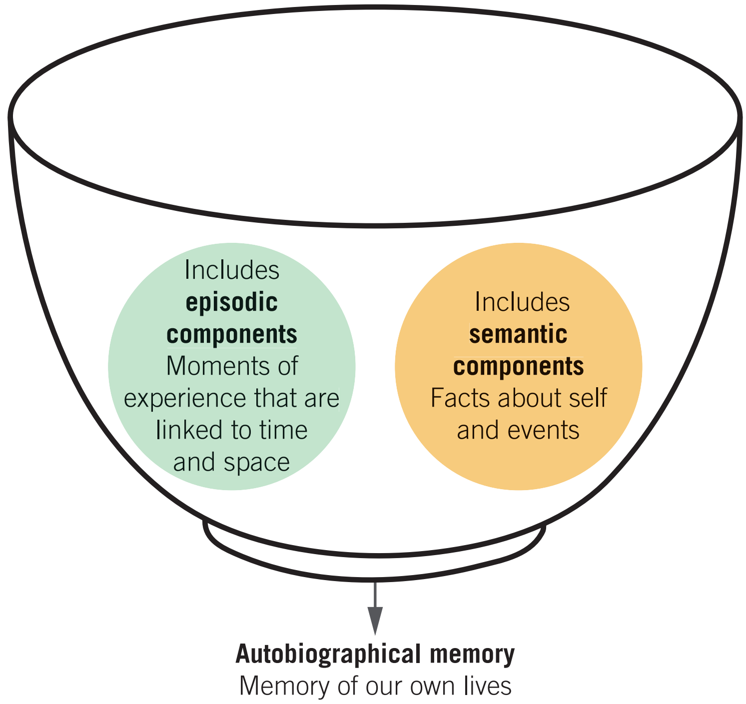


Figure 6C–5 Autobiographical memories are conceptualised as a container that holds both episodic and semantic information.

ACTIVITY 6C–1 BREAKING DOWN AUTOBIOGRAPHICAL MEMORIES

We have a multitude of autobiographical memories that we can access at any given time; for example, your last summer holiday or being at your grandparents' house. Consider three autobiographical memories that you can vividly remember and identify the episodic and semantic components of each memory in a table.

Autobiographical memory	Episodic components	Semantic components

Autobiographical memory is more than just episodic memory. Because it has both semantic and episodic components, it is a more constructive and integrative information processing system than episodic memory alone.

An important function of autobiographical memory is to support our sense of self and identity. Our self-identity includes abstract representations of our personal characteristics such as our traits (e.g. 'I am timid'), general knowledge about periods and events in our life (e.g. 'When I was in primary school, we used to visit my grandma on Sundays'), and memories of specific happenings in our past (e.g. 'The time I broke my leg in grandma's garden'). Whereas episodic memories are a series of single past events, autobiographical memory links past events together into a personal history that relates self through past, present and future, essentially forming a life narrative.

ISBN 978-1-009-25416-8 Gallagher et al

When we retrieve autobiographical experiences, episodic memory helps us richly recall an experience as it occurred during a specific time and place. Through **reconstruction** we combine stored information with other available information to form what is believed to be a more coherent, complete or accurate memory. For example, if you were asked to recall your favourite holiday, you might remember certain features, such as where you went, who was there, what you were wearing and what happened. As all these features and events are recalled from different locations in your long-term memory, they are put together to reconstruct the memory of your holiday, as you would piece together a jigsaw puzzle. This is illustrated in Figure 6C–6.

Reconstruction the combining of stored information with other available information to form what is believed to be a more coherent, complete or accurate memory

Autobiographical memory can be likened to a container that holds both episodic and semantic information (Figure 6C–5). In the previous scenario of the student studying at night, their episodic memory of having studied last night also contains semantic knowledge about what they learned.

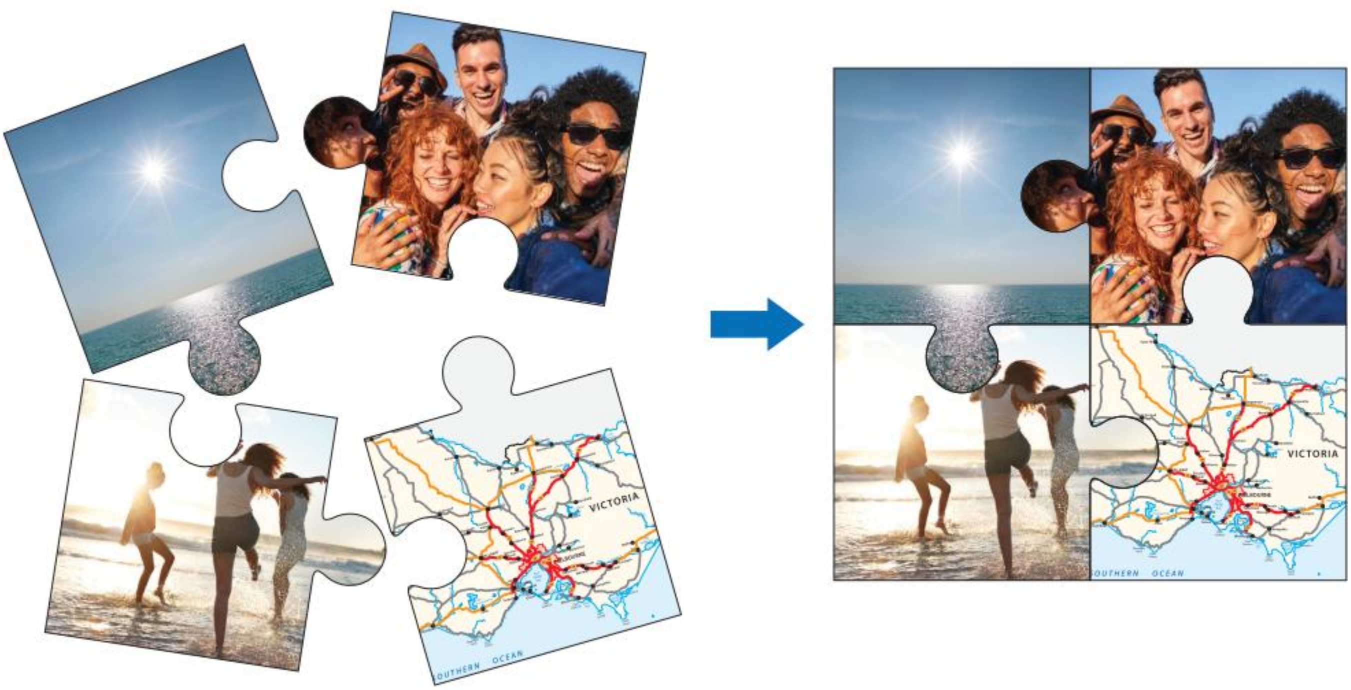


Figure 6C–6 The reconstruction of autobiographical memories is like putting together a jigsaw. When retrieving a memory about your most recent trip to the beach, information such as where the beach was located, which of your friends came with you, how sunny the day was and what you did is pieced back together so you can vividly recall the day.

ACTIVITY 6C–2 IS MEMORY RETRIEVAL ACCURATE?

Much of what we recall from long-term memory is not an accurate representation of what happened. This is because we tend to include inaccurate bits of information about the event that were not part of the original experience. This occurs because when we reconstruct a memory, we fill in a gap or unconsciously alter the event to make more sense to us.

Read the following story to another person and have them retell the story to someone who has not heard the story. What differences do you notice between the original story and the retelling?

ISBN 978-1-009-25416-8 Gallagher et al

Native American ghost story

One night two young men from Egulac went down to the river to hunt seals and while they were there it became foggy and calm. Then they heard war-cries, and they thought: 'Maybe this is a war-party.' They escaped to the shore and hid behind a log. Now canoes came up, and they heard the noise of paddles, and saw one canoe coming up to them. There were five men in the canoe, and they said:

'What do you think? We wish to take you along. We are going up the river to make war on the people.'

One of the young men said, 'I have no arrows.'

'Arrows are in the canoe,' they said.

'I will not go along. I might be killed. My relatives do not know where I have gone. But you,' he said, turning to the other, 'may go with them.'

So one of the young men went, but the other returned home.

And the warriors went on up the river to a town on the other side of Kalama. The people came down to the water and they began to fight, and many were killed. But presently the young man heard one of the warriors say, 'Quick, let us go home: that Indian has been hit.' Now he thought: 'Oh, they are ghosts.' He did not feel sick, but they said he had been shot.

So the canoes went back to Egulac and the young man went ashore to his house and made a fire. And he told everybody and said: 'Behold I accompanied the ghosts, and we went to fight. Many of our fellows were killed, and many of those who attacked us were killed. They said I was hit, and I did not feel sick.'

He told it all, and then he became quiet. When the sun rose he fell down. Something black came out of his mouth. His face became contorted. The people jumped up and cried.

He was dead.

Episodic future thinking projecting yourself forwards in time to pre-experience an event that might happen in your personal future

Mental time travel the capacity to mentally reconstruct past personal events and imagine possible future scenarios

Constructing possible imagined futures

One of the most fascinating aspects of human cognition is our ability to extract our consciousness from the current moment and to mentally transport ourselves to another time, place or perspective. In recent years, episodic and semantic memory has been reconsidered as encompassing our ability to imagine and envision possible future scenarios as well the ability to retrieve memories from our personal past. This form of imagining is called **episodic future thinking**; it involves projecting yourself forwards in time to pre-experience an event that might happen in your personal future and is also known as **mental time travel**. We frequently use future-oriented thoughts every day; these thoughts may be abstract or specific, and personal or non-personal.

ISBN 978-1-009-25416-8 Gallagher et al

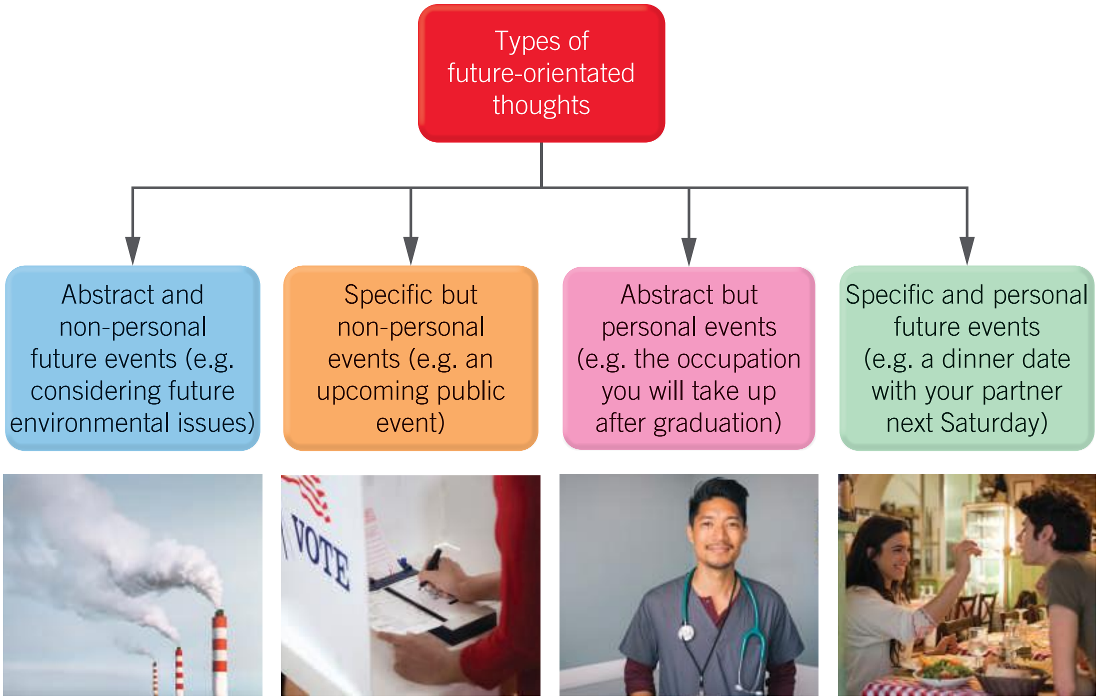


Figure 6C–7 Humans have different types of future-orientated thoughts.

Researchers believe that we rearrange our memories of the past to put together a vision of what the future might look like. They have discovered that autobiographical memories and episodic future thinking occur in the same regions of the brain and appear to use the same underlying processes. Scientists first learned about this connection by observing patients with **amnesia**. Not only were these patients unable to access their autobiographical memories, but they also could not imagine any events in their future.

Amnesia a permanent or temporary, complete or partial loss of memory

More recently, functional MRI (magnetic resonance imaging) studies have allowed researchers to see into the brains of healthy people while they remembered the past and predicted the future. It was observed that the activity in the brain during both tasks had some overlap.

Like reconstructing autobiographical memories, episodic future thinking involves a process of active construction of events that have not yet occurred but that is based on past events and knowledge. More specifically, episodic memory provides the episodic elements (e.g. people, objects, locations) used to recombine and construct future events and scenarios. Semantic memory provides a context or framework for constructing and organising the episodic future thinking. Semantic memory may also provide complementary knowledge of one's personal past. For example, if you imagine going on a trip to Paris, the knowledge of where Paris is located, what language is spoken there and how to get there will 'set the scene' or provide the context of the imagined future. However, your past episodic memories of experiences in Paris allow you to consciously construct the imagined future events there, such as the friends that you might meet there, the places you might revisit, and the specific dishes you might enjoy there.

Similarly, if you imagine your future wedding, you will probably pick elements from weddings that you have been to before, as well as weddings you have seen on TV, in movies or in magazines.

ISBN 978-1-009-25416-8 Gallagher et al

Figure 6C–8 Episodic future thinking occurs by using both semantic and episodic elements.

Being able to accurately imagine the future gives humans an evolutionary advantage. When we create a detailed simulation of what it would be like to go to university, get a desired job or have children, we can mentally explore various steps and consider potential obstacles to reaching that end goal. This ability to act with specific, individually anticipated future events in mind may account for why human behaviour is so immensely flexible.

Check-in questions – Set 2

1 What is the difference between episodic and autobiographical memories?
2 Give an example of an autobiographical memory that was not provided in the text and identify one episodic and one semantic element from it.
3 What is reconstruction in the context of memory?
4 What is episodic future thinking?
5 Why does episodic future thinking give humans an evolutionary advantage?
6 What role do episodic memories play in the construction of episodic future thinking?

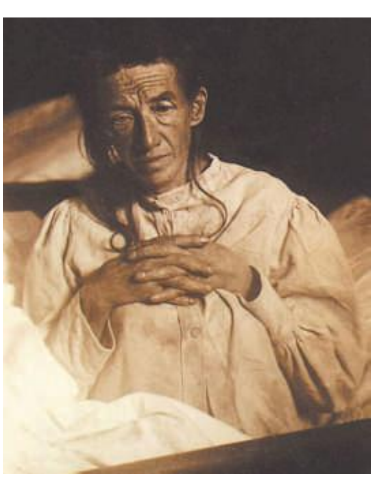


Figure 6C–9 Auguste Deter was the first documented person to have Alzheimer's disease. When Auguste died, Alois Alzheimer discovered changes in her brain that now define the disease.

Alzheimer's disease

In 1901, Auguste Deter was institutionalised when unwarranted jealousy directed at her husband, along with memory impairment and disorientation even while in her home, grew to be too much for her husband to cope with. In the institution, Auguste met Dr Alois Alzheimer, a German psychiatrist. Alzheimer was fascinated with Auguste's condition and spent many hours observing, testing and recording her symptoms. Alzheimer noted that when Auguste was shown objects, she would not remember what objects she had seen after a brief amount of time. Her speech would become confusing, and she would even wake up screaming in the middle of the night.

During Auguste's 5-year stay at the institution, her condition worsened to the point that she lost almost all cognitive ability. On 8 April 1906, at age 55, Auguste died. Alzheimer petitioned Auguste's family to let him perform an autopsy on her. He found that her brain revealed abnormalities and extensive atrophy in the cortex – the outer layer that is responsible for memory, language, judgement and thought in general. Although these findings were not unusual, it was Auguste Deter's age that made them remarkable.

ISBN 978-1-009-25416-8 Gallagher et al

Previously these abnormalities were seen only in patients in their 70s. The disorder that Auguste was suffering from was named after Alzheimer as Alzheimer's disease.

Alzheimer's disease is characterised by the progressive deterioration of brain neurons, causing memory loss, decline in cognitive and social skills and personality changes. Alzheimer's disease is classed as a neurodegenerative disease and is the most common form of **dementia**, affecting approximately 70% of people diagnosed with dementia. It mostly begins in older age and affects about 3% of people aged 65–74 years and 32% of people over 85 years. However, there are also rare inheritable forms that can begin in people as early as in their 30s.

Unfortunately, Alzheimer's disease is incurable, and most people die within 8–10 years of onset. Furthermore, there is no simple diagnostic test to identify the presence of Alzheimer's disease. One of the ways that can assist in diagnosing Alzheimer's disease is using **brain scans**, an examination of the brain that shows brain activity and tissues that cannot be detected otherwise. Brain scans such as computed tomography (CT) or magnetic resonance imaging (MRI) are generally included in the standard evaluation for Alzheimer's disease and other forms of dementia. CT and MRI scans reveal the anatomic structure of the brain and are used to rule out such problems as a tumour, haemorrhage (bleeding of the brain) and stroke, which can mask Alzheimer's disease. These scans can also show the loss of brain mass associated with Alzheimer's disease in the middle or later stages of the disease. Other brain scans may be performed if CT and MRI scans are inconclusive. Positron emission tomography (PET) and single-photon emission computed tomography provide images of brain activity based on blood flow, oxygen consumption or glucose use. These techniques can help narrow down a diagnosis by revealing neural abnormalities common in Alzheimer's disease. However, even these scans cannot show the microscopic **lesions** (areas of abnormal tissue) in brain tissue that characterise Alzheimer's disease. Thus, they cannot identify the disease with certainty; a diagnosis can only be confirmed when a post-mortem is conducted. In a post-mortem, doctors can detect these discrete microscopic lesions in the individual's brain.

Alzheimer's disease
a neurodegenerative disease characterised by the progressive deterioration of brain neurons, causing memory loss, decline in cognitive and social skills and personality changes

Dementia
a collection of symptoms that are caused by disorders affecting the brain

Brain scan
an examination of the brain that shows brain activity and tissues that cannot be detected otherwise

Lesion
a damaged or abnormal area of the brain that may appear like a scar or wound

ACTIVITY 6C–3 EXPLORING REAL-LIFE EXAMPLES OF ALZHEIMER'S DISEASE

In pairs, conduct some internet research into people who are suffering from Alzheimer's disease. Find a couple of real-life examples and compare the people's experiences with the disease and its progression. Take note of the risk factors that may have contributed to the development of Alzheimer's and the progression of each person's symptoms. In larger groups or as a whole class, discuss the similarities and differences in risk factors and progression of the disease between different people.

Symptoms of Alzheimer's disease

Alzheimer's disease typically progresses slowly in three general stages: early, middle and late (sometimes referred to as mild, moderate and severe in a medical context). Because Alzheimer's disease affects people in different ways, each person may experience symptoms or progress through the stages differently. General symptoms include gradual severe memory loss, confusion, impaired attention, disordered thinking, a decline in social skills and personality changes. Initially, patients have impaired explicit memory (episodic memory and semantic memory), and eventually they have a severe decline of both explicit and implicit memory.

ISBN 978-1-009-25416-8 Gallagher et al

Table 6C–1 provides more information of the symptoms associated with Alzheimer's disease.

Table 6C–1 Symptoms in the early, middle and later stages of Alzheimer's disease

Early stage (2–4 years)	Middle stage (2–10 years)	Late stage (1–3 years)
• Forgets recently read material • Has trouble organising or planning • Forgets where valuables have been placed • Has trouble managing money • Forgets recent events, names, details about own identity and dates • Has trouble with challenging tasks at work • Becomes lost in familiar places	• Experiences delusions, compulsions or repetitive behaviour • Experiences agitation, restlessness and anxiety • Needs assistance with getting dressed • Bladder and bowel function issues • Has trouble learning new things • Has problems with reading and writing • Loses track of time or surroundings • Experiences sleep disturbances	• Has significant personality and behaviour changes • Loses ability to hold a conversation • Has difficulty moving, eating and swallowing • Loses bladder and bowel control • Lacks awareness of recent activities or surroundings • Cannot remember family members and loved ones

Biological causes of Alzheimer's disease

Although people who are diagnosed with Alzheimer's disease progress through the three stages at difference paces, the general pattern of biological change is consistent. Dr Alois Alzheimer noted biological changes in the brain of Auguste Deter, such as the significant loss of neurons and a build-up of abnormal proteins. Some of these changes are shown in Figures 6C–10 and 6C–11.

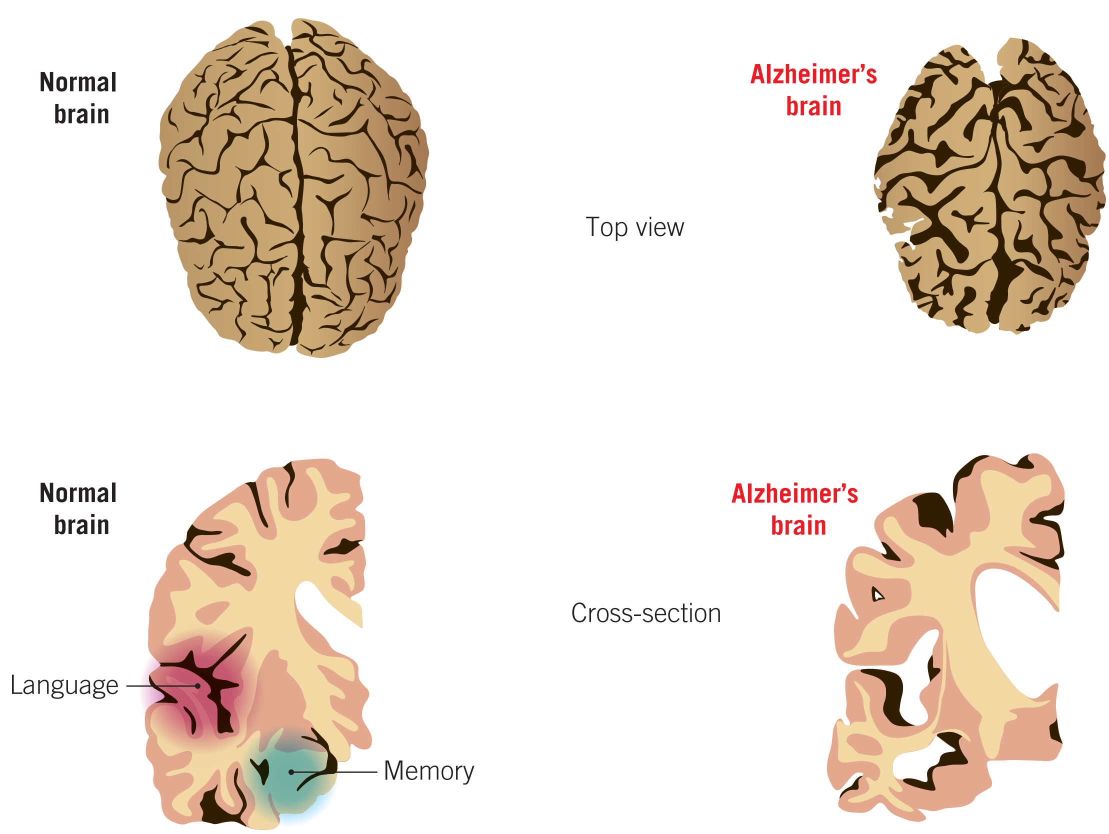


Figure 6C–10 In Alzheimer's disease, the brain progressively shrinks as a result of cell death.

ISBN 978-1-009-25416-8 Gallagher et al

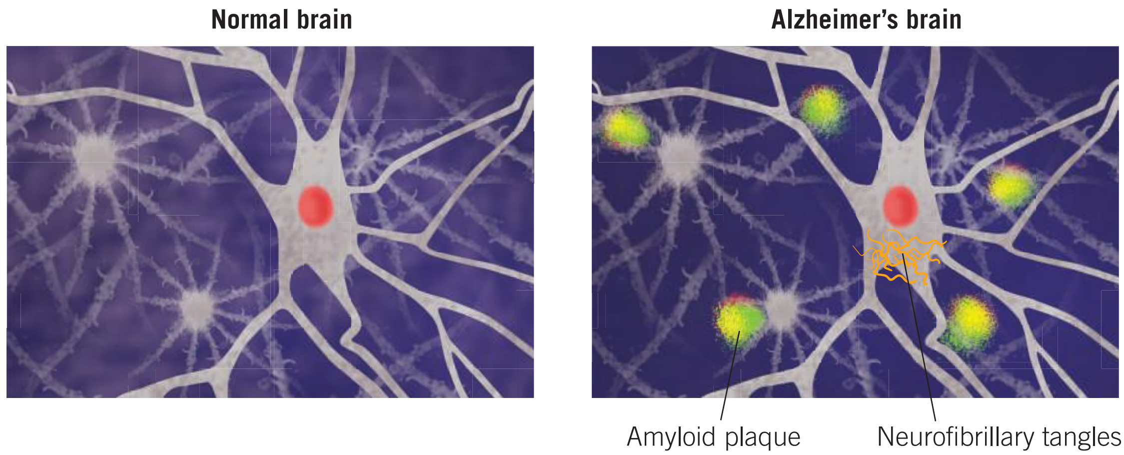


Figure 6C–11 Neurons in a normal brain (left) and after developing Alzheimer's disease (right). Beta-amyloid protein has built up to form amyloid plaques (green/yellow patches) between the neuron fibres and neurofibrillary tangles (orange fibres) inside the neuron.

Researchers have identified four changes in the brain that are characteristic of Alzheimer's disease.

- **Amyloid plaques** occur when beta-amyloid proteins build up. This abnormal build-up forms plaques between the synapses of neurons, and so interferes with neural communication.
- **Neurofibrillary tangles** occur when protein builds up inside the neuron and are associated with cell death. This interferes with the flow of information within and between neurons, disrupting communication.
- There is a lack of the important memory neurotransmitter acetylcholine. Alzheimer's disease systematically destroys the neurons that produce acetylcholine.
- **Brain atrophy** occurs. Amyloid plaques and neurofibrillary tangles progressively damage neurons, which die, causing the brain tissue to shrink.

The hippocampus is one of the first structures affected by atrophy; up to three-quarters of the neurons die and the rest are damaged. This means new explicit memories cannot be encoded and consolidated, resulting in **anterograde amnesia**. For example, a person suffering from the early to middle stages of Alzheimer's typically cannot learn new things and forgets where they have placed an object.

The loss of neurons then spreads to the cerebral cortex, resulting in the loss of stored explicit (including episodic, semantic and autobiographical) long-term memories (**retrograde amnesia**) as well as problems with attention and changes to personality and emotions. For example, a person might not recognise a loved one or might have emotional outbursts when normally they would have been calm. When autobiographical memories are lost, the person also loses their capacity for episodic future thinking. For example, a person will not be able to imagine going on a trip or to the supermarket and in turn will have trouble planning for that future event.

Amyloid plaque
an abnormal build-up of beta-amyloid proteins between the synapses of neurons that interfere with communication

Neurofibrillary tangle
an abnormal build-up of protein inside a neuron that is associated with cell death

Brain atrophy
the loss of neurons within the brain

Anterograde amnesia
the inability to form new explicit long-term memories after an amnesia-causing event

Retrograde amnesia
the inability to retrieve previously stored memories after an amnesia-causing event

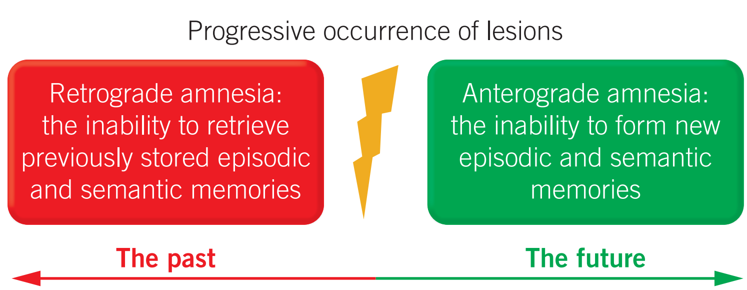


Figure 6C–12 Alzheimer's disease is characterised by retrograde and anterograde amnesia.

ISBN 978-1-009-25416-8 Gallagher et al

WORKSHEET 6C–1 ALZHEIMER'S DISEASE

Finally, the damage to the neurons extends to the rear of the cortex, known as the hindbrain. The hindbrain has a role in regulating automatic functions such as breathing and heart rate. Towards the final stages of Alzheimer's disease, the neurons of the hindbrain start to degenerate, and this is when death occurs.

6C SKILLS

VIDEO 6C–2 SKILLS: QUESTIONS ABOUT ALZHEIMER'S

Questions about Alzheimer's disease

In VCE Psychology, when you respond to questions about Alzheimer's disease or other concepts that involve changes to the brain that affect behaviour, do not get confused between the different key words – symptoms and changes to the brain. One way that you can ensure that you understand the meaning of key words within each area of study is to keep a glossary.

Question:

Outline two changes to the brain of a person with Alzheimer's compared with the brain of a healthy adult. (2 marks)

Attempted answer:

A person with Alzheimer's disease will be unable to encode explicit memories in comparison to a healthy adult. An individual with Alzheimer's disease will also experience increased confusion and changes to their personality whereas healthy adults may not.

Marking comments:

This response confuses the key words of 'changes to the brain' with 'symptoms' – they are not the same thing. As a result, the response does not answer the question correctly and will receive a score of 0/2 marks. Changes to the brain suggests that there is a biological difference compared with a healthy person that will then affect the way that a person functions in the world, or their symptoms.

Suggested answer for full marks:

An individual who is suffering from Alzheimer's disease may have both amyloid plaques, which occur as a result of an abnormal build-up of beta-amyloid protein between the synapse of neurons, and neurofibrillary tangles, which are an abnormal build-up of protein inside the neuron. In comparison, healthy adults do not have amyloid plaques or neurofibrillary tangles.

VIDEO 6C–3 SKILLS: ORGANISING AND PRESENTING DATA

Organising and presenting data

In VCE Psychology, you may be asked to organise a set of raw data and present it to an audience in a meaningful way. Raw data can be organised through measures of central tendency (mean, median or mode) or through measures of variability (range and standard deviation). When organising data, it is important that you consider the best method to present the data in the most accurate way. After you organise the data, you can then present it in a meaningful way in a table, bar chart or line graph. Each of these presentation methods has specific rules to follow so that the data is easy to interpret.

Question:

It has recently been hypothesised that people who have been diagnosed with Alzheimer's disease will experience more cortical shrinkage if they are exposed to risk factors such as substance abuse. In a recent study of 20 newly diagnosed Alzheimer's

ISBN 978-1-009-25416-8 Gallagher et al

disease patients, participants were interviewed to understand their levels of alcohol consumption on a day-to-day basis. They were allocated into two groups: high levels of alcohol consumption (three or more standard drinks a day) and low levels of alcohol consumption (two or fewer standard drinks a day). Participants then underwent a brain scan that measured the volume of the brain in cubic millimetres. The participants were allowed to go about their lives as usual but were asked to have a follow-up brain scan after 12 months in order to track the changes in brain volume. The researchers measured the reduction in brain volume from the initial brain scan and the scan 12 months later to measure the impact of substance abuse.

The raw results are below.

High levels of alcohol consumption (three or more standard drinks a day):

Reduction in brain volume (mm^3) 4.5, 3, 5, 2, 4, 4, 3.5, 2, 5, 4

Low levels of alcohol consumption (two or fewer standard drinks a day)

Reduction in brain volume (mm^3) 2, 1, 1, 4, 2, 3, 2.5, 1.5, 2, 2.5

a Identify the type of data that has been collected and justify your response. (2 marks)

b Identify and explain how one measure of central tendency could be used to organise these results. (2 marks)

c Organise this raw data into a bar graph to demonstrate the overall trends of the experiment. (4 marks)

Suggested answer:

a The research study used quantitative data because it was numerical.

or

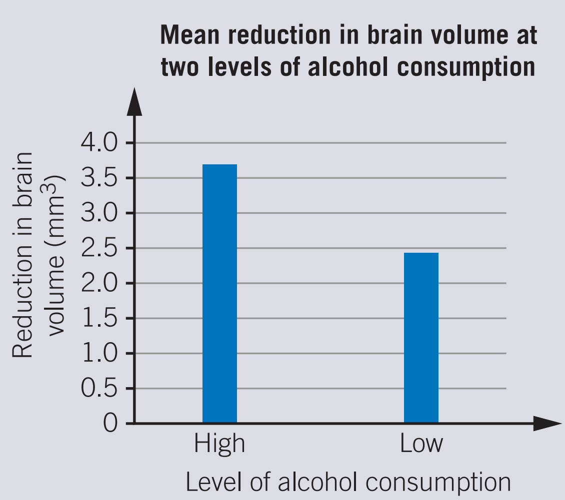
The research study used primary data because it was collected through first-hand experience.

b Measure of central tendency: The researcher could organise the results using a mean. The researcher could do this by adding up all the results in each data set and dividing the resulting number by the number of scores. For example:

Step 1: $4.5 + 3 + 5 + 2 + 4 + 4 + 3.5 + 2 + 5 + 4 = 37$

Step 2: $\frac{37}{10} = 3.7$

c



ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 3

1 Why is Alzheimer's disease considered a neurodegenerative disease?
2 When can Alzheimer's disease be diagnosed?
3 Outline four changes that occur in the brain of an individual who has been diagnosed with Alzheimer's.
4 Identify two symptoms experienced in each of the early, middle and later stages of Alzheimer's disease.

Aphantasia

Aphantasia the inability to visualise imagery

Imagine that it is a warm summer day, and you are sitting beside a swimming pool. The sun is shining, and your friends are laughing and splashing in the water. What sort of images do you see in your mind as you think about this scene? While most people can conjure an image of a scene or face in their minds, 2–5% of the population cannot visualise any type of image in their head. These people have **aphantasia** – they are unable to visualise imagery.

Figure 6C–13 If you were asked to imagine a story about travelling through the solar system, you would be able to visualise the important elements in your mind (e.g. the planets you might see or what the spaceship might look like). If someone with aphantasia was asked to imagine the same scene, they might be able to recall facts about space travel, but they would not be able to construct a scene in their mind's eye. Essentially, they have no visual imagination!

The word 'aphantasia' comes from the ancient Greek word *phantasia*, which means 'imagination', and the prefix *a-*, which means 'without'. People with aphantasia have no 'mind's eye', or their imagination is essentially blind. If you were to ask a person with aphantasia to imagine something, they could probably describe the object, explain the concept, and list some facts that they know about the object. But they would not be able to experience any sort of mental image to accompany this knowledge. People with this condition may have trouble remembering everyday things, like the number of windows on a building. Aphantasia can also affect other areas of life. People with aphantasia might:

- struggle to remember or 'relive' autobiographical events
- have difficulty imagining future or hypothetical events
- have problems with factual memory
- dream less
- have decreased imagery involving other senses such as sound or touch
- have trouble recognising faces.

ISBN 978-1-009-25416-8 Gallagher et al

ACTIVITY 6C–4 HOW GOOD IS YOUR VISUAL IMAGINATION?

Experts have suggested that the ability to visualise scenes or stories might exist on a spectrum – that everybody visualises things with varying levels of vividness. Consider the following questions.

- Think of a friend or family member. Try to conjure an image of their face in your mind. How clearly can you see their face's features, hair and shape?
- How clearly can you picture their characteristic movements and gestures?
- How vividly can you picture their clothing?

How successful were you? You might have been able to visualise a lifelike image of the person in your mind, or you might have conjured a dim or vague image. You might also have found that you could hold the image in your mind's eye for a few seconds or even longer! One thing to consider is that our mind's eye is just one aspect of imagination, and we use all of our senses when using our imagination!

The first modern account of aphantasia dates to an 1880 study in the United Kingdom, when Sir Francis Galton reported that some men in a group of 100 were unable to create a mental image of their breakfast table. Much of the current available information stems from a few small studies and anecdotal accounts from people who have described their symptoms.

Figure 6C–14 Sir Francis Galton was one of the first scientists to identify that some people are unable to visualise images in their mind.

ACTIVITY 6C–5 THE CASE OF MX

Dr Adam Zeman never gave the mind's eye much attention until he met someone who did not have one. In 2005, a patient told the British neurologist that a simple surgical operation had taken away his ability to generate pictures in his mind. The patient's case study ('MX') has been crucial to continuing research into the origins and symptoms of aphantasia.

Individually or in small groups, conduct some research on MX and learn more about the case study. While researching, consider the following questions.

- What caused MX's aphantasia?
- What was MX not able to do in relation to visualising things?
- What kinds of testing did Adam Zeman conduct on MX to test his imagination? What results did he find?

ISBN 978-1-009-25416-8 Gallagher et al

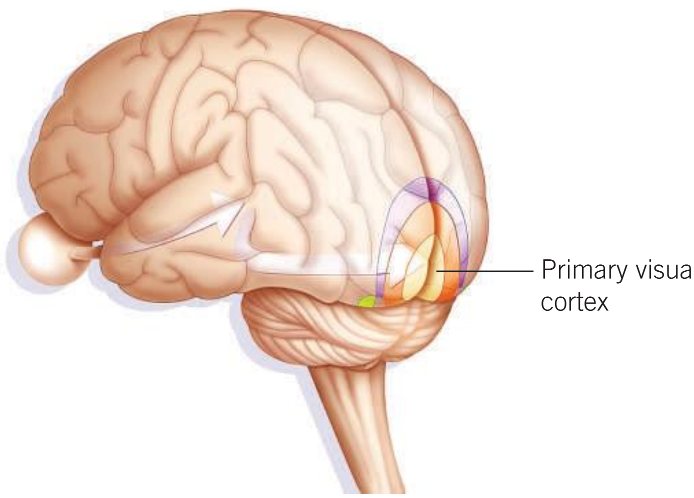


Figure 6C–15 The primary visual cortex in the occipital lobe of the brain is thought to have a role in aphantasia

Scientists are not sure what causes aphantasia; however, it has been suggested that areas of the brain involved in visual imagery, such as the **visual cortex**, may be underactive. Other theories suggest that people with aphantasia do experience mental imagery but cannot access the image in their conscious thoughts. However, researchers agree that there are two forms of aphantasia: **congenital** (present from birth) and **acquired** (present after brain injury or significant psychological event, such as depression or anxiety).

The famous case study in Activity 6C–5 is of acquired aphantasia in a retired building surveyor who had lost his ability to visualise after heart surgery. A more recent example of acquired aphantasia features in a 2020 study, which followed a former architect developing aphantasia after a stroke affected blood flow to the occipital lobe.

Visual cortex the primary cortical region of the brain that receives, integrates and processes visual information relayed from the retinas

Congenital present from birth

Acquired present after brain injury or a significant psychological event

There is no known 'cure' for congenital aphantasia. However, some people with acquired aphantasia have reported regaining imagery abilities after undergoing therapy. It is important to understand that aphantasia is not a disability but rather a unique variation in human experience. The available studies suggest that having aphantasia does not necessarily inhibit someone's success in life. Many people with different occupations experience aphantasia, including successful doctorate students, engineers and other professionals. People with aphantasia may not even know that they experience the world differently and lead normal lives.

Figure 6C–16 Aphantasia is not a disability and does not affect a person's success in lfe. Blake Ross, creator of Mozilla Firefox, and Ed Catmull, co-founder of Pixar and former president of Walt Disney Animation Studios, have aphantasia.

Check-in questions – Set 4

1. What is aphantasia?
2. Outline three symptoms of aphantasia.
3. Discuss the causes of aphantasia.
4. Discuss whether and how aphantasia can be 'cured'.

ISBN 978-1-009-25416-8 Gallagher et al

Section 6C questions

1 Copy and complete the table.

	Autobiographical memory	Episodic future thinking
Description		
Examples		
Types of memory systems involved		
Diseases or phenomena associated		

2 How are autobiographical memories and episodic imagined futures similar and different?
3 Explain the relationship between Alzheimer's disease and episodic and semantic memories.
4 Outline how episodic and semantic memories play a role in the construction of episodic imagined futures, with reference to an example not used in the text.
5 Compare and contrast amyloid plaques and neurofibrillary tangles.
6 Henry is an 89-year-old man who lives in an assisted living facility for people with neurodegenerative diseases. When he first arrived, he was extensively tested and presumptively diagnosed with Alzheimer's disease.
  a In the beginning of his diagnosis, Henry was able to recall memories from his childhood, but not make any new episodic and semantic memories. Identify what type of amnesia Henry was suffering from and explain why this occurred.
  b Identify and describe two biological changes that have occurred in Henry's brain when he developed Alzheimer's.
  c Identify two symptoms that Henry would have experienced in the later stages of the disease.
7 Outline two similarities and two differences between Alzheimer's disease and aphantasia.
8 Dr Mason was interested in the efficacy of a new visual therapy designed to reduce the symptoms of acquired aphantasia. To do this, Dr Mason accessed the records of people who had been diagnosed with acquired aphantasia in the last 5 years. She compared the severity of symptoms (on a scale of 1 to 5, where 1 represents no symptoms and 5 represents severe symptoms) of two participants for 6 weeks. Participant A had been using the new therapy and participant B had not. The results are shown in the following table.

The effect of visual therapy on the severity of aphantasia symptoms

	Severity of symptoms (on a scale of 1 to 5)					
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Participant A (exposed to visual therapy)	3	4	2	2	2	1
Participant B (not exposed to visual therapy)	3	4	3	1	3	1

  a Did Dr Mason use primary of secondary data to conduct her research? Provide a strength of this type of data.
  b Dr Mason wants to calculate a mean to organise this raw data. Comment on whether you agree that this is the best measure of central tendency to use, and justify your response.
  c Use a measure of central tendency other than the mean to organise this information.

ISBN 978-1-009-25416-8 Gallagher et al

6D Mnemonic devices to increase encoding, storage and retrieval

Study Design:
The use of mnemonics (acronyms, acrostics and the method of loci) by written cultures to increase the encoding, storage and retrieval of information as compared to the use of mnemonics such as sung narrative used by oral cultures, including Aboriginal people's use of songlines

Glossary:
Acronym
Acrostic
Dreaming
Dreamtime
Method of loci
Mnemonic
Oral culture
Songline
Sung narrative
Written culture

ENGAGE

The mind palace

Sherlock Holmes is a well-known literary character who uses his great intellect to solve all manner of crimes. In the BBC series *Sherlock*, starring Benedict Cumberbatch, Holmes uses a memory device called a 'mind palace' to solve crimes and outsmart his enemies. Holmes's mind palace, while seeming like a fictional device used to amaze an audience, is actually a method of remembering that dates back to ancient Greece.

Cicero, a scholar of ancient Rome, wrote that the Greek poet Simonides witnessed a horrible tragedy that had an unexpected consequence. Simonides recited a long poem to diners in a hall in Thessaly, then went outside. Without warning, the roof of the hall collapsed, crushing most of the diners, and many bodies were unrecognisable and so unidentifiable. When Simonides was called on as a witness, he found that he could remember who was sitting where, from having gazed around the hall while delivering his poem. He realised that memory could be closely tied to physical location in space. This became the basis for one of the best-known mnemonic devices in history, the memory palace, or the method of loci. Scholars like Cicero developed elaborate techniques based on this principle to remember lengthy speeches and stories. In antiquity, before writing became easy to copy through printing, this was how most people learned.

Figure 6D–1 Sherlock Holmes (here played by Benedict Cumberbatch) uses a memory device called a memory palace to solve crimes.

ISBN 978-1-009-25416-8 Gallagher et al

EXPLAIN

What is a mnemonic device?

Do you know what QANTAS or ANZAC stands for? Have you ever used the rhyme '30 days hath September, April, June and November'? Have you ever learned a list by making a crazy story from the key words? If you have, you will have used a mnemonic. Psychologists are interested in studying the applications of mnemonics in learning and memory for a range of individuals.

A **mnemonic** is any technique used for improving or enhancing memory. The benefit of mnemonic learning compared to learning by simple repetition, a form of maintenance rehearsal, has been demonstrated many times. In one study in 1973, Gordon Bower asked students to study five different lists of 20 unrelated words, 100 items in total. At the end of a study session, the subjects tried to recall all the items. Those participants who used mnemonics recalled an average of 72 items, whereas students who used rote learning remembered an average of only 28.

Mnemonic any technique used for improving or enhancing memory

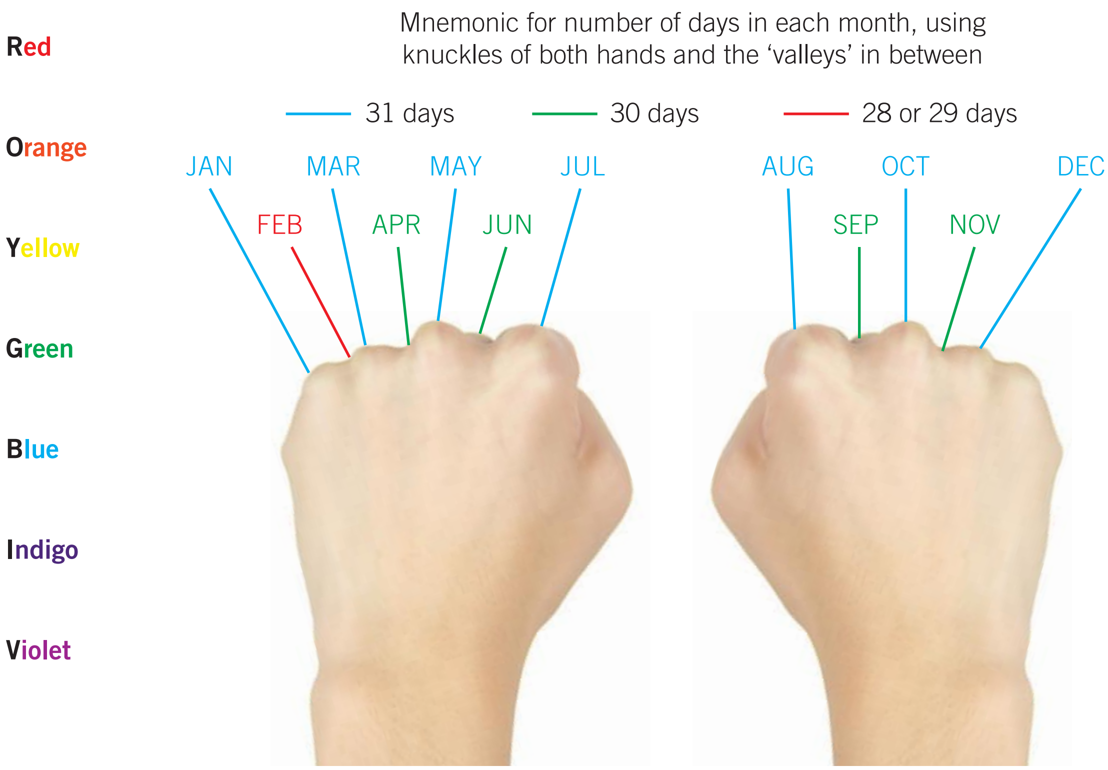


Figure 6D–2 There are many kinds of mnemonics. The one on the left is an acrostic; the one on the right uses the method of loci.

Mnemonic devices are particularly active at the encoding stage of memory processing. At the same time as information is encoded, retrieval cues that will make it easier to find the information are also encoded. Note that a mnemonic does not work by reducing the amount of information. Information is added to organise the material in long-term memory and to make it easier to locate and retrieve. Mnemonics tend to organise information into a cohesive whole, and to connect new information to existing information, so that retrieval of part of it generally assists retrieval of all of it. In this way, mnemonics help make less meaningful information more meaningful, and therefore more memorable.

ISBN 978-1-009-25416-8 Gallagher et al

Mnemonics work best for remembering information that needs to be memorised but is not necessarily understood. However, they also have limitations. Mnemonics are more effective for information that can be put into list form. As you can imagine, it would be difficult to put the whole of this textbook into a list. Further, since the creation and use of a mnemonic is a more active, effortful and effective process than the use of simple repetition, it requires more conscious effort and can be a time-consuming process. In this section, we will explore some examples of mnemonic devices used by both written and oral cultures.

Check-in questions – Set 1

1 What is a mnemonic?
2 How do mnemonics enhance memory?
3 Identify two limitations of using mnemonics.

Mnemonics in written cultures

Have you ever wondered how secondary school might be different from country to country? For example, many Australian schools have a uniform, whereas many schools in the United States and Germany do not. In Japan, students are expected to help clean their classrooms and the school grounds at the end of the day. South Korean students in secondary school can be at their desks for 14–16 hours; the standard school day is 8 a.m. until 4 p.m., and then students go home for some dinner, and then head out again to a private school from 6 p.m. to 9 p.m. for intensive revision.

Figure 6D–3 There are many differences between secondary schools around the world.

While there are many differences from country to country, the process of learning and retaining information is similar, primarily through studying written texts. In this way, much of the modern world is a **written culture** – stories and information are shared and preserved through the processes of reading and writing. Written cultures have played a vital role in preserving values, norms and traditions of societies, cultures and religions so that they can later be studied.

Written culture a culture in which stories and information are shared and preserved through the processes of reading and writing

In most instances, recording information through the written word allows it to be easily conserved over a great length of time, in many cases generations. Additionally, written text can be easily disseminated to others who might require it at any given time. In this section, we explore the mnemonic devices that are useful for retaining and recalling written information.

ISBN 978-1-009-25416-8 Gallagher et al

Method of loci

Sherlock Holmes's memory palace is an example of a mnemonic system called the **method of loci** (*loci* is Latin for 'places'). This method was also used by many ancient peoples to enable them to recall speeches and poems and even learn the habits of local wildlife.

The method of loci involves committing a familiar location or sequence of locations to memory, and visually linking these locations with information that needs to be recalled.

Each location acts as a retrieval cue that makes it easier to retrieve the information when it is needed. Ideally, the locations used are familiar to the individual. Locations such as your local shopping centre, your school buildings or grounds, or the layout of your house are often the more effective locations to use. For example, to learn the items of a shopping list, you might visualise each item of the list in a different room in your house (Figure 6D–4). You might place a carton of milk in the first room, a bag of oranges in the next, a loaf of bread in the next room, and so on. Or you may associate items with locations in which they are typically used, such as eggs in the kitchen and soap in the bathroom. The number of items to be associated must match the number of spaces in your location. When you need to recall the items of the shopping list, you take a mental walk through the house and retrieve each item associated with each location.

The method of loci works best when the items to be remembered are in a set order, such as a list, a speech or a series of steps in a recipe.

Method of loci a mnemonic system that commits a familiar location or sequence of locations to memory, then visually links them with information that needs to be recalled

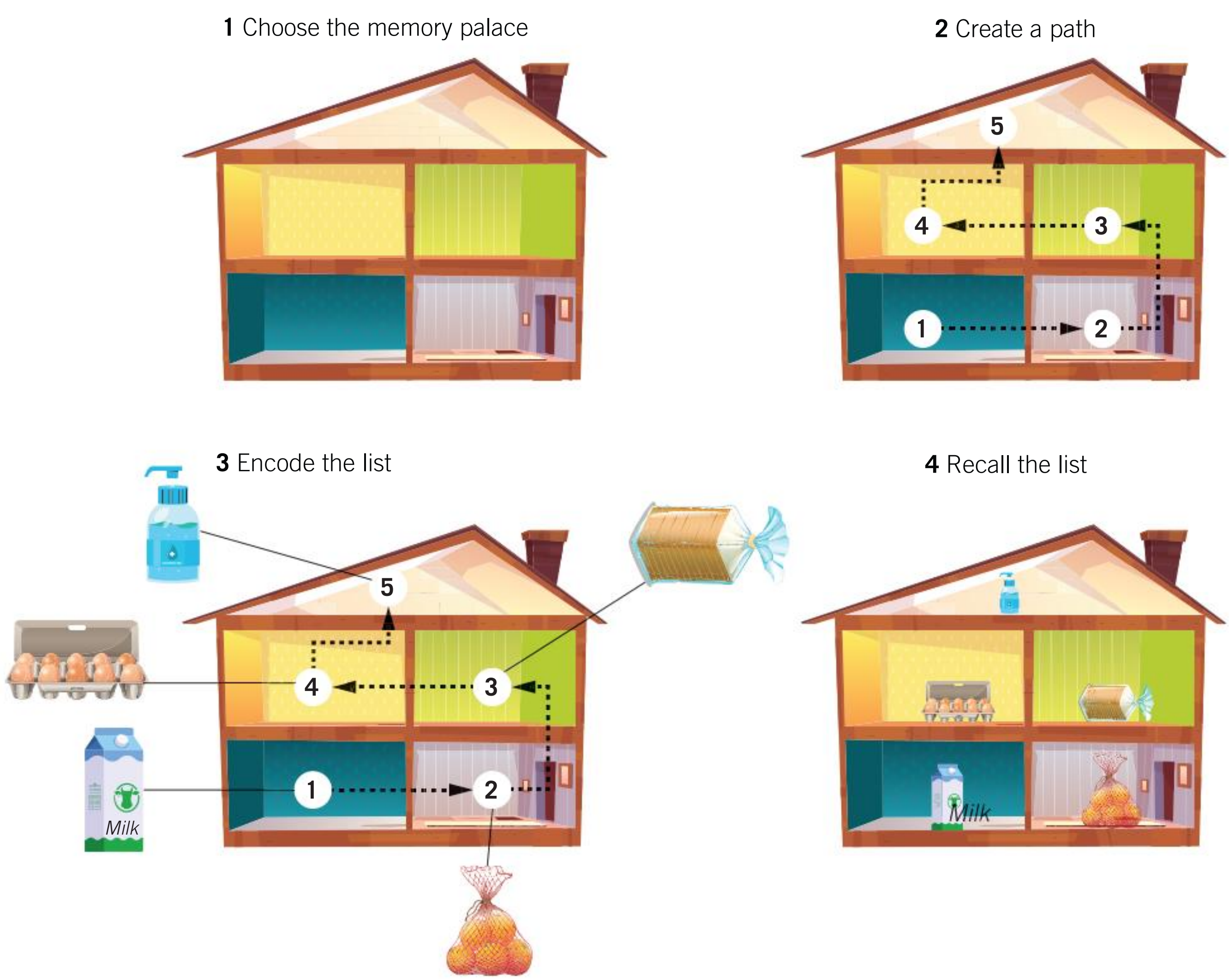


Figure 6D–4 The method of loci involves using familiar locations as retrieval cues. In this example, a shopping list is encoded.

ISBN 978-1-009-25416-8 Gallagher et al

Acronyms

You are probably familiar with abbreviations such as ANZAC (Australian and New Zealand Army Corps), NASA (National Aeronautics and Space Administration) or FOMO (fear of missing out). These are **acronyms** – a word formed from the first letter of each word to be remembered. The letters of the abbreviation act as cues to retrieve more complex material. In this way, acronyms and other abbreviations are mnemonics.

Acronym
an abbreviation formed from the first letter of each word and pronounced as a single word

When constructing an acronym, the mnemonic doesn't have to be a real word, but it needs to be pronounceable. For example, abbreviations such as AFL or ATM are not considered acronyms because the letters do not form a pronounceable word.

Figure 6D–5 Both UNESCO and QANTAS (Queensland and Northern Territory Aerial Services) are acronyms that also work as mnemonics.

Acrostics

Acrostic
a phrase (or poem) in which the first letter of each word functions as a cue to help with recall

Acrostics are phrases in which the first letter of each word functions as a cue to help with recall. You may have learned the phrase 'Never Eat Soggy Weet-bix', which identifies the layout of north, south, east and west on a compass. Or you may have learned to recall the planets in the solar system by using the phrase 'My Very Excellent Mother Just Served Us Nachos'.

Acrostics are useful when you need to remember information in sequential order, such as a set of history facts or a list of information. For example, if you wanted to remember the different neurotransmitters in the brain and body, you could organise each type of neurotransmitter (dopamine, serotonin, GABA) into a sentence. When you next need to recall them, you could recall the sentence, and each word in the sentence becomes a retrieval cue to recall a specific neurotransmitter.

ACTIVITY 6D–1 DEMONSTRATING THE POWER OF MNEMONICS

Naveen needs to go to the supermarket and do his weekly shop. He requires the following 10 items: butter, apples, ice cream, bacon, bananas, sugar, cheese, cereal, coffee, soap.

Demonstrate how Naveen could use each of the following devices to help him remember the items on his list.

a acronym
b acrostic
c method of loci

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 2

1 Explain what a written culture is.
2 Define the following mnemonics and provide a personal example of each.
   a method of loci (your example must have at least three items and matching number of locations)
   b acrostic
   c acronym
3 Describe three ways that methods of loci, acrostics and acronyms are similar.
4 How can you use the information learned about mnemonics to assist you in learning information?

Mnemonics in oral cultures

Technology has changed the world we live in. We have access to more resources, more information, and more entertainment. If we get lost, we can look at our GPS to find the correct route to our destination. If we forget something, we can look it up on the internet. How did ancient peoples survive without access to the same information? Before the ability to read and write was commonplace, most societies were **oral cultures** – people communicated vital information and spread stories by word of mouth. Stories, poems or **sung narratives** were performed in order to pass along an immense amount of historical, religious, cultural and moral teachings to others. The teachings from the Bible, Norse legends and even the works of William Shakespeare are examples of stories designed to be told in the oral tradition.

Oral culture a culture in which information and stories are communicated by word of mouth

Sung narrative a story told through singing, music and sometimes dance

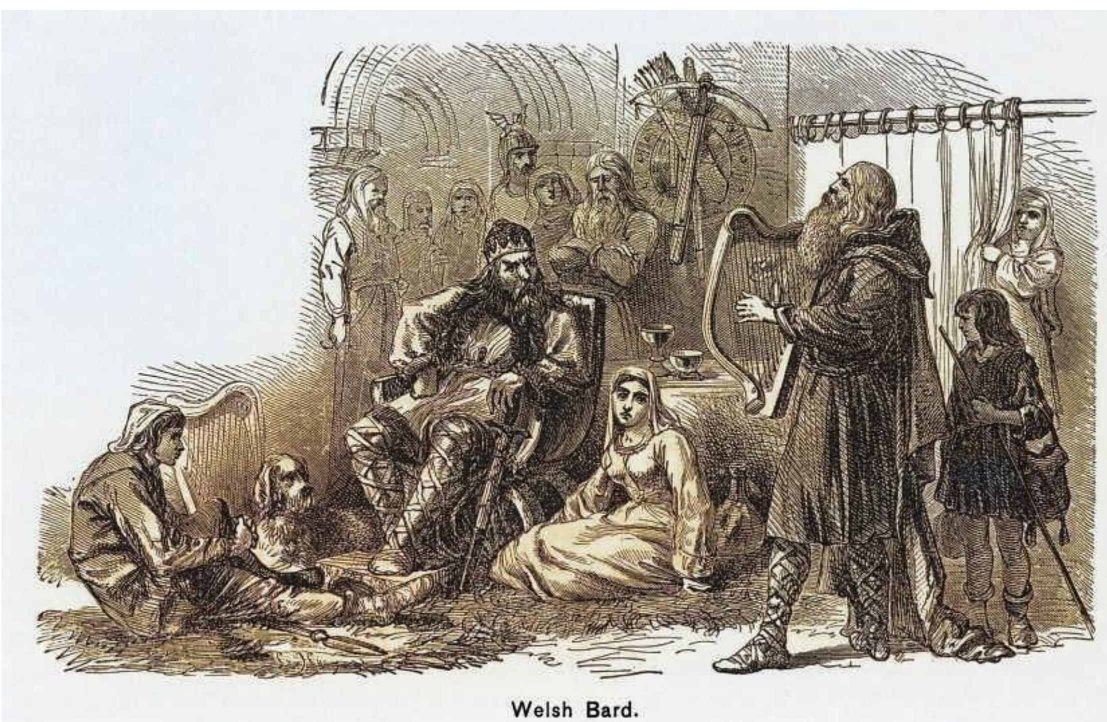


Figure 6D–6 Bards were trained to memorise and recall a great number of stories, poems and sung narratives. They travelled the country, telling their stories at important events such as religious ceremonies and town fairs or in the local pub in exchange for money, food or lodging.

Oral cultures were effective in retaining information because stories and narratives were performed or sung in a ritualistic way, in which certain things must be said and done in the right order by the right people. This meant that this vast amount of information was held by few individuals who could then disseminate the information for money or during important ceremonies or at significant times of the year.

ISBN 978-1-009-25416-8 Gallagher et al

Although most societies have become written cultures, some oral cultures remain, such as Native American peoples, Pacific Islander peoples and Aboriginal and Torres Strait Islander peoples. There is evidence that these peoples not only have encyclopaedic knowledge of a vast range of subjects, but they used a relatively simple memory technique to learn this detailed knowledge.

First Australians' use of songlines

DOCUMENT 6D–1 RESOURCES ON SONGLINES

For more than 60 000 years, First Australians' stories and knowledge have been passed down from generation to generation in the form of songlines and Dreamings. Note that the description that follows may not apply to all First Australian communities.

Dreaming
a guide to life and living; Dreaming is not just stories, it is art, songs, dance; it is written into the land itself

Songline
one of many sung narratives of the landscape that weave across Country and enable every significant place in Aboriginal Dreaming to be known

The word **Dreaming** refers to the timeless concept of moving from 'dream' to reality which in itself is an act of creation. The word Dreaming is used for the stories and beliefs about creation. All living things were either the spirit ancestors or created by spirit ancestors. The stories are entwined into songs, artwork and dance, and are closely tied to the landscape. First Nations peoples can recall essential information about climate and seasons, food sources, tool making, hunting, laws and navigation. The Dreaming is not linear; it exists in the past, present and future. It evolves to explain events today, such as storms, floods and events in people's lives, both good and bad.

It is through songlines that First Nations peoples have acquired this encyclopaedic memory of Dreamings and practical knowledge, such as the thousands of species of plants and animals across Australia required to survive. **Songlines** are sung narratives of the landscape that weave across Country and enable every significant place in Aboriginal Dreaming to be known. Songlines trace the journeys of ancestral spirits as they created the land, animals and lore. A knowledgeable person can find their way across their Country by singing the songline, which describes landmarks and locations, waterholes and other natural features.

Figure 6D–7 The Rainbow Serpent is a well-known Dreaming figure. This image was painted by Michael Connolly, a descendant of the Kullilla Tribe from the Thargomindah and Eulo region on his father's side and from the Muruwari People from Goodooga and Brewarrina region of north-west New South Wales on his mother's side. (© Michael Connolly/Copyright Agency, 2022)

ISBN 978-1-009-25416-8 Gallagher et al

At each location, a song or story, dance or ceremony is performed that will always be associated with that location and allows the retrieval of Dreaming Stories that contain knowledge of a wide range of subjects. For example, within these songs or dances are details of animal behaviours such as a kangaroo's stance when it is approached by humans or when a crocodile's eggs would be ready to be collected and eaten. Thus, a songline provides a table of contents to the entire knowledge system that is the key to literal and cultural survival, that can be navigated both physically and mentally.

Figure 6D–8 At each significant location within a songline, a song, ceremony or dance is performed. (Left hand image: © Josephine Watjara Mick/Copyright Agency, 2022)

The use of songlines is remarkably like that of the method of loci, used by the ancient Greeks. However, research suggests that there are differences. David Reser and co-workers at Monash University conducted a study where medical students learned a list of 20 butterfly names by using either the method of loci or songlines. At the end of a 20-minute training session, students who used a memory technique recalled more butterfly names than students who did not use a memory technique. Furthermore, those who used songlines were almost three times as likely to remember the entire list in their second test than students who used the method of loci. The researchers concluded that both memory techniques were effective in learning information that is sequential in nature; however, the Aboriginal method seems better suited to teaching in a single, relatively short instruction period.

WORKSHEET 6D–1 APPLYING MNEMONIC DEVICES

ACTIVITY 6D–2 INVESTIGATING AUSTRALIA'S SONGLINES

Australia has an extensive network of songlines, from a few kilometres in length to hundreds of kilometres through the Country of different First Nations peoples. One such example is that of the Seven Sisters. Conduct some research and learn this exciting Dreaming and make a group or individual presentation on it. If you are a First Nations person, you may prefer to make a presentation on a songline you know, or if you have contact with a local First Nations community you may like to research and make a presentation on one of their songlines.

ISBN 978-1-009-25416-8 Gallagher et al

6D SKILLS

VIDEO 6D–1 SKILLS: MNEMONICS

Applying your understanding of mnemonics

On VCE Psychology exams, when responding to questions about mnemonic devices, it is important to consider what occurs in both encoding and retrieval.

Question:

Ben is trying to remember a list of band names to impress a girl he has a crush on. Using an example, explain how Ben could use an acrostic to aid his retrieval of the following band names: Nirvana, Arcadia, Garbage, Eurythmics, Phoenix.

In your response, you must ensure that you discuss how a mnemonic is used when information is encoded and when information is retrieved.

Suggested answer for full marks:

Ben would use the first letter of each band name to create a meaningful sentence/story, in the correct order, such as: New Actors Get Everything Paid. When he encodes the information, the first letter of each word in the sentence acts as a retrieval cue. Each of these cues aid Ben's recall of the band names from long-term memory in the correct order; for example, New is for Nirvana.

Check-in questions – Set 3

1 What is an oral culture?
2 Identify three examples not used in the text of societies that still use oral traditions.
3 What is a songline?
4 How does a songline work as a memory device?
5 What kind of knowledge is contained in songlines?
6 How are Dreamings and songlines related?

Section 6D questions

1 Copy and complete the following table.

Memory device	Description	How device enhances memory
Method of loci		
Acronym		
Acrostic		
Songline		

2 A councillor needs to memorise the outline of a speech about plans for improving city landscapes, kindergartens, libraries, recycling and facilities for the elderly. Explain how she could use the method of loci to memorise the speech.
3 Identify two differences between written and oral cultures.
4 On her way to visit her grandmother, Fatima must remember to buy stamps, underwear, cheese and hardware in that order, since that is the order along the route of the places that sell them.
   a Give an example of an acronym and an acrostic Fatima could use to help her remember what to buy and in what order she will find them.
   b Explain how acrostics and acronyms assist in the retrieval of information from memory.
5 Compare and contrast method of loci and Indigenous use of songlines.

ISBN 978-1-009-25416-8 Gallagher et al

Chapter 6 review

Summary

Create your own set of summary notes for this chapter on paper or in a digital document. A model summary is provided in the Teacher Resources which can be used to compare with yours.

Checklist

In the Interactive Textbook, the success criteria are linked from the review questions and will be automatically ticked when answers are correct. Alternatively, print or photocopy this page and tick the boxes when you have answered the corresponding questions correctly.

Success criteria – I am now able to:		Linked questions
6A.1	Define 'encoding', 'storage' and 'retrieval'	1☐
6A.2	Outline the role, capacity and duration of sensory memory, short-term memory and long-term memory	2☐, 3☐
6A.3	Explain how sensory, short-term and long-term memory interact when processing sensory information, according to the multi-store model of memory	9☐
6A.4	Apply my understanding of how sensory memory, short-term memory and long-term memory allow us to interact with the world with reference to examples	16☐
6B.1	Define 'implicit memory' and 'explicit memory' and provide examples of each	4☐, 17a☐
6B.2	Compare and contrast implicit and explicit memories	17b☐
6B.3	Outline the roles of and discuss how the hippocampus, amygdala, neocortex, basal ganglia and cerebellum encode, store and retrieve explicit and implicit memories	5☐, 19a☐
6B.4	Apply my understanding of how the hippocampus, amygdala, neocortex, basal ganglia and cerebellum interact with reference to examples	6☐, 15☐
6C.1	Explain what is meant by episodic and semantic memory and provide relevant examples of each	4☐, 18☐
6C.2	Explain what is meant by autobiographical memory and episodic imagined futures and provide relevant examples of each	19a☐
6C.3	Explain the roles of episodic and semantic memory in the construction of autobiographical memory and episodic imagined futures	19b☐
6C.4	Apply my understanding of the roles of episodic and semantic memory in the construction of autobiographical memory and episodic imagined futures to a real-world scenario	19c☐
6C.5	Explain what is meant by Alzheimer's disease and how it acts as a lesion model for episodic and semantic memory	8☐, 12☐

ISBN 978-1-009-25416-8 Gallagher et al

Success criteria – I am now able to:		Linked questions
6C.6	Outline the symptoms associated with the early, middle and later stages of Alzheimer's disease with reference to the changes to the brain	10☐
6C.7	Explain what is meant by aphantasia and outline its symptoms, causes and treatments	7☐
6D.1	Explain what is meant by a mnemonic device and how it increases the encoding, storage and retrieval of information.	13☐
6D.2	Explain what is meant by the method of loci, acronyms and acrostics and provide relevant examples of each	11☐
6D.3	Explain how written cultures use method of loci, acronyms and acrostics to each increase encoding, storage and retrieval of information	17c☐
6D.4	Explain what is meant by sung narrative used by oral cultures, including Aboriginal people's use of songlines	20☐
6D.5	Apply my understanding of sung narrative used by oral cultures, including Aboriginal people's use of songlines to a real-world scenario	20☐
6D.6	Compare the use of mnemonics used by written and oral cultures to increase the encoding, storage and retrieval of information	14☐

Key Science Skills

Skills	Questions and Skills boxes
Systematically generate and record primary data, and collate secondary data, appropriate to the investigation	Chapter review – 21
Record and summarise both qualitative and quantitative data, including use of a logbook as an authentication of generated or collated data	Interactive Textbook
Organise and present data in useful and meaningful ways, including tables, bar charts and line graphs	Chapter review – 21

Multiple-choice questions

1 The correct sequence of actions in the memory process is:
- **A** storage, encoding, retrieval.
- **B** encoding, storage, retrieval.
- **C** storage, retrieval, encoding.
- **D** retrieval, encoding, storage.

2 Conscious awareness of a memory is more likely when it is in _________ memory rather than in _________ memory.
- **A** long-term, short-term
- **B** sensory, short-term
- **C** short-term, sensory
- **D** sensory, long-term

ISBN 978-1-009-25416-8 Gallagher et al

3 Research indicates that sensory memory usually has a __________ capacity and _______________ duration.

A 12–30-second, 5–9-item
B unlimited, relatively permanent
C unlimited, 0.2–4-second
D small, short

4 Aisha is explaining the rules of football to Shane. The information about rules is being retrieved from Aisha's

A explicit episodic memory.
B implicit episodic memory.
C explicit procedural memory.
D implicit procedural memory.

5 The part of the brain that enables us to remember intense emotional experiences is the

A substantia nigra.
B basal ganglia.
C cerebral cortex.
D amygdala.

6 Leo was recently in a car crash and sustained damage to his hippocampus. Since then, Leo is unlikely to remember

A how to bake a cake.
B how to tie his shoelaces.
C the name of the doctors who treated him at the hospital.
D the names of his family members.

7 One difference between congenital and acquired aphantasia is that

A congenital aphantasia develops after brain trauma, whereas acquired aphantasia is present at birth.
B congenital aphantasia results in progressive degeneration of the neurons, whereas acquired aphantasia does not.
C congenital aphantasia is present at birth, whereas acquired aphantasia develops after becoming an alcoholic.
D congenital aphantasia is present at birth, whereas acquired aphantasia develops after physical or psychological trauma to the brain.

8 Alzheimer's disease

A is a normal part of ageing.
B is a disease that progressively produces the growth of neurons in the brain.
C can be tentatively diagnosed through the use of brain scans such as an MRI.
D is a form neurodegenerative disease that is characterised by the inability to carry out fine motor movement.

ISBN 978-1-009-25416-8 Gallagher et al

9 The correct descriptions for displacement and decay are

	Displacement	Decay
A	When short-term memory is full, new single items can only be added by pushing out some old ones.	When information held in short-term memory is not maintained by rehearsal, it fades away over time.
B	When short-term memory is full, new information fades away.	When information held in short-term memory is not maintained by rehearsal, it fades away with over time.
C	When information held in short-term memory is not maintained by rehearsal, it fades away over time.	When short-term memory is full, new single items can only be added by pushing out some old ones.
D	When short-term memory is full, new single items can only be added by pushing out some old ones.	When information held in short-term memory is not attended to, the information fades away.

10 ____________________ is the symptom; __________________ is the disease

A Confusion and memory loss; Alzheimer's
B Trauma; confusion and memory loss
C Memory loss; Parkinson's
D Alzheimer's; changes in personality

11 Memorising a list of names in a specific sequence by constructing a word or pronounceable phrase from the first letters of the names is an example of

A an acrostic.
B a personal narrative.
C an acronym.
D a method of loci.

12 Neuronal death as seen in Alzheimer's disease is associated with the presence of _____________, which inhibit communication between neurons and _____________, which inhibit communication within neurons.

A myloid plaques; acetylcholine
B amyloid plaques; neurofibrillary tangles
C acetylcholine; amyloid plaques
D neurofibrillary tangles; amyloid plaques

13 An acronym is a mnemonic device that can be used to memorise a shopping list. How do mnemonics enhance memory?

A Mnemonics simplify information so that there is less to remember.
B Mnemonics involve the constant repetition of information to be learned.
C Mnemonics elaborate on information so that information is stored in long-term memory as a more organised whole.
D Mnemonics involve going back to the location where you learned the information.

14 Over time, most societies have changed from an oral culture to a written culture. This might be considered advantageous because information

A can be easily distributed to many people at once.
B can be preserved for a long time, even if the culture becomes extinct.
C can never be lost.
D is more easily understood when it is written down.

ISBN 978-1-009-25416-8

15 Some similarities between the basal ganglia and the cerebellum are that they both
- **A** encode and retrieve explicit memory.
- **B** have a role in motor movement and procedural memory.
- **C** have a role in the storage of implicit memory.
- **D** regulate emotions such as fear or aggression.

Short-answer questions

16 Kabelo has just introduced himself to a girl at a party and she recites her mobile phone number for him. Kabelo tries to remember the number while he searches for a pen to write it down, but he forgets the last two digits. Explain why Kabelo is having difficulty remembering the 10-digit phone number. (2 marks)

17 Alannah is telling her friend Chiara about her recent trip to Greece. She fondly tells a story of having dinner at her grandmother's house.
- **a** With reference to implicit and explicit memory, Alannah telling Chiara a story about having dinner at her grandmother's house is an example of what kind of memory? (1 mark)
- **b** Identify two characteristics of this type of memory. (2 marks)
- **c** Chiara is impressed with Alannah's accurate recollection of her time in Greece and asks her how she remembers so many details. Alannah explains that she uses a mnemonic device called the method of loci. Explain how Alannah may have used this device to recall so many details from her trip to Greece. (3 marks)

18 Cooper has recently been diagnosed with Alzheimer's disease. Cooper is having trouble recalling the things he did the previous day, including going to dinner with his children, but can still complete the newspaper's daily quiz with ease. Explain why Cooper's explicit memory has been affected, rather than his semantic memory. (2 marks)

19 On her way home from work, Leila saw a dog get hit by a car. She stopped riding, jumped off her bike and ran over to help the driver tend to the dog. As she was trying to help the driver get the dog into the car to take it to the vet, Leila noticed her palms were sweaty and her heart rate was accelerated.

Later that night Leila was visited by a police officer who asked her some questions about the event because the owners of the dog had pressed charges against the driver. Leila found that she could remember many details because she was in a much calmer state.
- **a** Discuss the role of the amygdala, hippocampus and neocortex in the encoding and storage of this event for Leila. (3 marks)

A few weeks after the incident, the police officer phoned Leila to ask her to go to the police station to give another statement of the events that she witnessed. Leila was taken aback by this request and began to imagine what kinds of questions the police officer might ask.
- **b** When Leila began to imagine the questions she would be asked at the police station, what phenomenon was she using? (1 mark)
- **c** With reference to episodic and semantic memory, explain how Leila was able to construct an autobiographical memory of the car accident. (3 marks)

20 Explain how songlines are of cultural importance to Aboriginal peoples. (2 marks)

ISBN 978-1-009-25416-8 Gallagher et al

21 Read the following study.

Exercise may be the key to delaying the progression of Alzheimer's disease

by Helena Graviana

A research team led by the University of Pittsburgh and the University of Illinois investigated how regular exercise may help protect the brain from the normal age-related decline of brain structures that are important for memory and learning.

The researchers randomly allocated 120 healthy older adult volunteers to either a moderate-intensity aerobic exercise group (brisk walking) or a low-intensity exercise group (stretching). Each group was led by an exercise instructor for 40 minutes, three times a week for one year.

Brain images (using magnetic resonance imaging, or MRI) were taken of each participant to measure the volume of the hippocampal structures at the beginning of the study, after six months and after one year. The groups differed slightly in mean hippocampal volume at the beginning of the study but, after one year, the moderate-intensity aerobic exercise group demonstrated a 2% increase in volume, whereas the low-intensity exercise group demonstrated a 1.4% decrease.

The researchers also interviewed each participant and asked them to describe any examples of memory improvement during the one year that the study took place.

Mean hippocampal volume in older adults undertaking low- and moderate-intensity exercise measured over a one year period

Group	Mean hippocampal volume (mm^3)		
	Beginning	6 months	12 months
Moderate-intensity aerobic exercise	4.95	5.00	5.05
Low-intensity exercise	4.90	4.85	4.80

The table shows the mean hippocampal volume (in cubic millimetres) for the left and right hemispheres for the moderate-intensity aerobic exercise group and the low-intensity exercise group over a one-year period.

The results provide evidence that regular moderate-intensity aerobic exercise can reverse the normal age-related decline in hippocampal volume, and that this could protect against the development and progression of Alzheimer's disease.

Adapted from 2018 VCE Psychology examination, VCAA

a Provide an example of qualitative and quantitative data that was gathered in this study. (2 marks)

b Identify whether primary or secondary data was collected in this study. Justify your response. (2 marks)

c Organise this raw data into a graph to demonstrate the overall trends of the experiment. (4 marks)

d Explain the difference between a large and a small standard deviation. (2 marks)

ISBN 978-1-009-25416-8 Gallagher et al

Unit 3 Revision exercise

Multiple-choice questions

1 Which of the following correctly describes the transmission of a neural impulse from the brain to the muscles in your hand when you are composing a text?

- **A** chemical signals within neurons; chemical signals between neurons
- **B** electrical signals within neurons; electrical signals between neurons
- **C** electrical signals within neurons; chemical signals between neurons
- **D** chemical signals within neurons; electrical signals between neurons

2 Rosalia is anxious about a speech she needs to give on Monday morning. On Sunday night, she decided to pretend she was feeling sick. The next morning, she asked her mother if she could stay home. Her mother agreed and Rosalia felt relieved straight away.

When Rosalia realised that she wouldn't have to go to school and do her speech, which of the following identifies the division of the nervous system that would have been dominant and the physiological changes that would have occurred as a result?

- **A** sympathetic nervous system; increased heart rate and increased breathing rate
- **B** parasympathetic nervous system; decreased heart rate and return to normal saliva production
- **C** sympathetic nervous system; dilated pupils and decreased production of saliva
- **D** parasympathetic nervous system; increased perspiration and return to normal heart rate

3 Raj is at his local textile store looking for a specific type of fabric to sew a dress for his daughter. He knows the 'feel' of the fabric he is looking for and begins to browse the store.

Which two divisions of the nervous system interacted to allow Raj to feel and then decide which fabric is most appropriate for his daughter's dress?

- **A** autonomic and central nervous systems
- **B** somatic and central nervous systems
- **C** somatic and sympathetic nervous systems
- **D** autonomic and parasympathetic nervous systems

4 When comparing the role of glutamate and GABA in the transmission of neural information across a synapse, it can be said that

- **A** glutamate produces inhibitory effects, making the next neuron more likely to fire, whereas GABA produces excitatory effects, making the next neuron less likely to fire.
- **B** glutamate produces inhibitory effects, making the next neuron less likely to fire, whereas GABA produces excitatory effects, making the next neuron more likely to fire.
- **C** both GABA and glutamate produce excitatory effects, making the next neuron more likely to fire.
- **D** glutamate produces excitatory effects, making the next neuron more likely to fire, whereas GABA produces inhibitory effects, making the next neuron less likely to fire.

ISBN 978-1-009-25416-8 Gallagher et al

5 Which of the following is correct in terms of models of stress?

A The GAS model does not explain biological contributors to stress.

B The transactional model explains the influence of individual perception on the stress response.

C The transactional model explains the role of the flight-or-fight-or-freeze response.

D The GAS model accounts for biological and psychological responses to stress.

6 A psychologist wanted to investigate people's responses to being pricked by a needle. Before the first trial, all of the participants were shown the needle that was to be used in the study. One of the participants, Narissa, felt stressed when she saw the needle. Her blood pressure dropped, and she fainted. In this case, Narissa experienced

A an involuntary freeze response, dominated by the parasympathetic nervous system.

B a voluntary freeze response, dominated by the sympathetic nervous system.

C an involuntary flight response, dominated by the sympathetic nervous system.

D a voluntary flight response, dominated by the parasympathetic nervous system.

7 During which stage in the general adaptation syndrome is cortisol first released?

A shock

B countershock

C alarm reaction

D resistance

8 Paul has been renting an apartment for the past five years. He loves the apartment because it is cheap and within walking distance from his work. He recently found out that his apartment is going to be sold and will no longer be available to rent. Paul is very anxious because he knows it will be difficult to find such a good apartment for such a reasonable price and that he may end up having to pay more, which he isn't sure he can afford.

In terms of primary appraisal in the transactional model of stress and coping, finding a new apartment to rent has been perceived by Paul as

A not stressful and a harm/loss.

B not stressful and benign/positive.

C stressful, and a challenge.

D stressful and a threat.

9 Which of the following differences between classical conditioning and operant conditioning is correct?

A In classical conditioning the learner is active, whereas in operant conditioning the learner is passive.

B In classical conditioning the learning is unconscious, whereas in operant conditioning the learning is conscious.

C Classical conditioning is a behavioural approach to learning, whereas operant conditioning is a social-cognitive approach to learning.

D In classical conditioning the learning is voluntary, whereas in operant conditioning the learning is involuntary.

ISBN 978-1-009-25416-8 Gallagher et al

10 Petrina is interested in learning to surf; however, she doesn't have the money to pay for lessons. Instead, she walks down to the beach every morning to watch the surfers before she gets in the water herself to try and surf. According to the social-cognitive approach to learning, which statement best indicates that Petrina is likely to succeed at learning to surf?

A Petrina is more likely to learn from a surfer who attracts her attention and appears highly skilled.
B Petrina cannot swim well, especially under water.
C Petrina feels she has things in common with the surfers she watches.
D Petrina does not handle cold water well and is nervous about things in the water, such as jellyfish and sharks.

11 Which of the following correctly matches a stage of observational learning with its relevant description?

A Action: The learner must have the physical and mental capabilities to perform the behaviour.
B Attention: The learner must store a mental representation of the model's behaviour for future use.
C Attention: The learner must actively watch the model's behaviour and their consequences.
D Retention: The learner must have the desire to perform the behaviour.

12 Felicity has always wanted to learn how to curl her hair properly and has envied her friend Marie-Jose who can do it very well and gets lots of compliments as a result. Felicity attempts to learn to curl her hair on her own, so she will not be envious and will also receive compliments. In this situation Felicity is most likely utilising

A classical conditioning.
B operant conditioning.
C observational learning.
D learning embedded in relationships.

13 If the basal ganglia of the brain were damaged, an individual might have difficulty with

A learning information after the damage occurred.
B being able to regulate emotions such as happiness or fear.
C being able to store information for long periods of time.
D being able to form new habits.

14 Similarities between Indigenous use of songlines and the method of loci include

A using a location as a retrieval cue.
B making information more simple.
C allowing information in sensory memory to be more easily attended to.
D being examples of acrostics.

15 People with aphantasia report which of the following symptoms?

A dreaming more
B not being able to recall previously learned information
C having difficulty imagining future or hypothetical events
D lacking social skills

ISBN 978-1-009-25416-8 Gallagher et al

16 Short-term memory has a capacity of _________ and a duration of _________.

A 5–9 items; 3–4 seconds
B 4–4 items; 5–9 seconds
C 5–9 items; 12–30 seconds
D 12–30 seconds; 5–9 items

Short-answer questions

17 Anne is playing with her son, Max, in the garden. He has set up a racetrack and is running through the bushes, pretending the cars are driving through a forest. Suddenly, Max's arm flinches and he screams out in pain. Anne sees a lump appear on Max's arm and thinks he may have been stung by a bee or bitten by a spider. She puts some ice on the lump and gives Max a hug. When he starts to vomit, Anne assumes it is in response to the pain he is experiencing. When Max starts having trouble breathing a few minutes later, Anne grabs her phone and calls an ambulance.

a When Max's arm flinches as a result of the insect bite, what type of response to a sensory stimulus did Max's nervous system produce? (1 mark)

b Describe the role of sensory neurons, motor neurons and interneurons when Max's arm flinched in response to the insect bite. (3 marks)

c Describe the role of two different divisions or subdivisions of Anne's nervous system when she called the ambulance. (4 marks)

18 Mark just found out that his mother has been diagnosed with breast cancer. Initially, he was shocked, but then his mind started racing. Mark kept thinking about how his life would change and what would happen to his mother as her condition progressed. That night, Mark went over to his friend Haruki's house, and they spent most of the next day playing backyard cricket. Haruki noticed that Mark was acting differently and seemed a little stressed but decided not to question him about it. A few days later, Mark called Haruki and told him about his mother's diagnosis. Haruki recently studied breast cancer in Biology and Mark hoped that he would be able to provide him with more information about the disease so that he could support his mother more effectively.

a In terms of coping strategies, identify what type of strategy playing backyard cricket was for Mark and how it helped him cope with the stress of stress he was experiencing because of his mother's diagnosis. (2 marks)

b Outline a limitation of using this type of strategy for Mark. (1 mark)

c Do you think Mark demonstrates high coping flexibility after learning about his mother's diagnosis? Justify your response. (2 marks)

19 Abeni is undertaking a 6-week computer course. At the end of the 6 weeks, Abeni will sit an examination.

a Explain how the three memory stores in the Atkinson–Shiffrin model would interact to allow Abeni to learn the computer course and be successful in the examination. (6 marks)

b State the capacity and duration of sensory memory. (2 marks)

c When Abeni recalls information she has previously learned for the computer exam, would this be an example of implicit or explicit memory? Justify your response. (2 marks)

d Outline the role of the neocortex and the cerebellum when Abeni is completing her computer exam. (2 marks)

e Abeni used a mnemonic device to study for her computer exam. Explain how a mnemonic would improve her memory. (2 marks)

ISBN 978-1-009-25416-8 Gallagher et al

20 Lachlan is a news reporter who was doing a big story on a professional surfer. Lachlan travelled to Queensland with his crew to shoot an interview with the surfer and watch him perform some stunts. One morning, Lachlan decided to blow off some steam by going surfing with his crew. He was riding a wave quite fast when his board suddenly flipped, and he hit his head on a sandbank. He was unconscious for a few moments. When he got home from Queensland, he could not remember the name of the doctor who treated him. However, he could recall basic facts about the beach he was surfing at, such as the length of the beach in kilometres. After a few days, Lachlan had no difficulty with his memory.

- **a** With reference to examples in the scenario, outline the difference between episodic and semantic memories. (3 marks)
- **b** One of Lachlan's crew members suggested that Lachlan might be suffering from Alzheimer's disease. Is Lachlan's crew member correct? Justify your response with reference to Lachlan's symptoms. (3 marks)
- **c** After a few weeks, Lachlan's boss wanted to send him back to Queensland to conduct more interviews with the pro-surfer. Outline how episodic and semantic memories might play a role in the construction of Lachlan's imagined futures of this event. (4 marks)

21 Roger's dog Basil is known for constant yapping and barking at night. Roger is concerned that Basil makes too much unwanted noise in the neighbourhood. So he has ordered an electric collar that will automatically give Basil a shock whenever he barks. Roger plans to use it to help Basil learn to be quieter at night.

- **a** Using the three-phase model of operant conditioning, explain how Basil will learn to be quieter at night with the electric collar. (5 marks)
- **b** Roger gets grumpy during the day because the neighbours' children play basketball in front of their house and at times their ball lands on his roses. He wants to use similar teaching methods to those that he used with Basil, by squirting them with cold water each time the ball hits his roses.
  In terms of beneficence, what would Roger need to consider before going ahead with his plan to use the cold water on the neighbours' children? (2 marks)
- **c** Instead of squirting water on the children, if Roger gave the children a lolly every time they played basketball and they didn't hit his roses, what would this consequence be called? (1 mark)

22 Learning within the Wurundjeri people of the Kulin nation has been passed on through generations for centuries. Kirra is an eight-year-old girl from this mob, who spends her days with her uncle, Jarrah, as they share life and learn together.

- **a** Explain why the connection to the Australian land is so important to Kirra and Jarrah's ways of knowing. (2 marks)
- **b** Describe how Kirra and Jarrah may use yarning as a way of learning. (2 marks)

ISBN 978-1-009-25416-8 Gallagher et al

UNIT 4 HOW IS MENTAL WELLBEING SUPPORTED AND MAINTAINED?

CHAPTER 7 THE DEMAND FOR SLEEP

Introduction

Many aspects of human consciousness are still a mystery, and even the idea of what consciousness is, is still debated among scientists. We know that our consciousness can vary from being hyper alert if we feel threatened, to being relaxed and drowsy, to being asleep or unconscious from an anaesthetic or a head injury. How and why these different states arise from the activity of electrical signals in our brain is still unknown.

In this chapter, you will be introduced to the concept of consciousness, and investigate sleep as a naturally occurring altered state of consciousness. You will learn about demand for sleep in humans, including the biological mechanisms driving sleep and the differences in sleep across the life span. The next chapter then discusses the importance of sleep, including sleep deprivation, circadian rhythm disorders and ways to improve sleep and mental wellbeing.

Curriculum

Area of study 1
How does sleep affect mental processes and behaviour?

Study Design	Learning intentions – at the end of this chapter I will be able to:
• Sleep as a psychological construct that is broadly categorised as a naturally occurring altered state of consciousness and is further categorised into REM and NREM sleep, and the measurement of physiological responses associated with sleep, through electroencephalography (EEG), electromyography (EMG), electro-oculography (EOG), sleep diaries and video monitoring	**7A Sleep as a naturally occurring altered state of consciousness** **7A.1** Compare and contrast the features of normal waking consciousness and altered states of consciousness **7A.2** Describe the features of sleep as a naturally occurring altered state of consciousness **7A.3** Describe and compare the features of REM and NREM sleep

ISBN 978-1-009-25416-8 Gallagher et al

Study Design	Learning intentions – at the end of this chapter I will be able to:
• Sleep as a psychological construct that is broadly categorised as a naturally occurring altered state of consciousness and is further categorised into REM and NREM sleep, and the measurement of physiological responses associated with sleep, through electroencephalography (EEG), electromyography (EMG), electro-oculography (EOG), sleep diaries and video monitoring	**7B Techniques used to measure sleep** **7B.1** Describe the use of electroencephalography (EEG), electromyography (EMG), and electro-oculography (EOG) in measuring the physiological responses associated with sleep **7B.2** Describe the use of sleep diaries and video monitoring in measuring sleep **7B.3** Determine an appropriate technique for measuring sleep in different situations
• Regulation of sleep–wake patterns by internal biological mechanisms, with reference to circadian rhythm, ultradian rhythms of REM and NREM Stages 1–3, the suprachiasmatic nucleus and melatonin	**7C Internal biological mechanisms that regulate sleep–wake patterns** **7C.1** Explain the role of circadian rhythms in regulating sleep–wake patterns **7C.2** Explain the role of the suprachiasmatic nucleus and melatonin in regulating sleep–wake patterns **7C.3** Explain the interaction of internal biological mechanisms that regulate sleep–wake patterns **7C.4** Explain the role of ultradian rhythms in regulating sleep-wake patterns of REM and NREM Stages 1–3 sleep
• Differences in, and explanations for, the demands for sleep across the life span, total amount of sleep and changes in a typical pattern of sleep (proportion of REM and NREM)	**7D Sleep across the life span** **7D.1** Provide differences in the total amount of sleep required for different ages across the life span **7D.2** Provide differences in the typical pattern of sleep as highlighted by the proportion of REM and NREM sleep experienced in different ages across the life span **7D.3** Explain reasons for the differences in the total amount of sleep required for different ages across the life span **7D.4** Explain reasons for the typical pattern of sleep as highlighted by the proportion of REM and NREM sleep experienced for different ages across the life span **7D.5** Apply my understanding of the differences in sleep experienced across the life span to real-world examples

Key Science Skills

- Process quantitative data using appropriate mathematical relationships and units, including calculations of percentages, percentage change and measures of central tendencies (mean, median, mode), and demonstrate an understanding of standard deviation as a measure of variability
- Identify and analyse experimental data qualitatively, applying where appropriate concepts of: accuracy, precision, repeatability, reproducibility and validity; errors; and certainty in data, including effects of sample size on the quality of data obtained
- Identify outliers and contradictory or incomplete data

Glossary

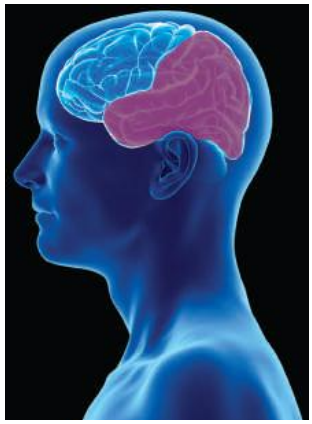
Altered state of consciousness
Circadian rhythm
Consciousness
Electroencephalography (EEG)
Electromyography (EMG)
Electro-oculography (EOG)
Hypnogram
Induced altered state of consciousness
Life span
Melatonin
Naturally occurring altered state of consciousness
Non-rapid eye movement (NREM) sleep
Normal waking consciousness
Polysomnography
Psychological construct
Rapid eye movement (REM) sleep
Sleep
Sleep diary
Suprachiasmatic nucleus
Ultradian rhythm
Video monitoring
Zeitgeber

ISBN 978-1-009-25416-8 Gallagher et al

Concept map

An understanding of consciousness and how sleep (including REM and NREM) occurs as an altered state of consciousness

7A Sleep as a naturally occurring altered state of consciousness

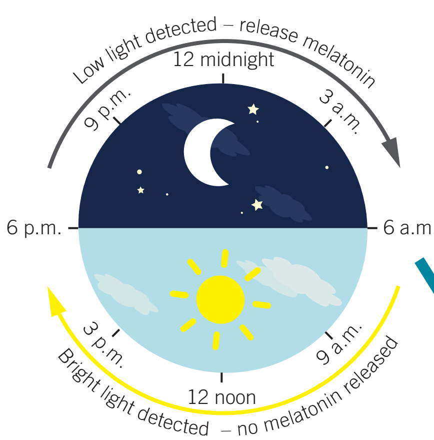


How EEG, EOG, EMG, sleep diaries and video monitoring can help measure features of sleep

7B Techniques used to measure sleep

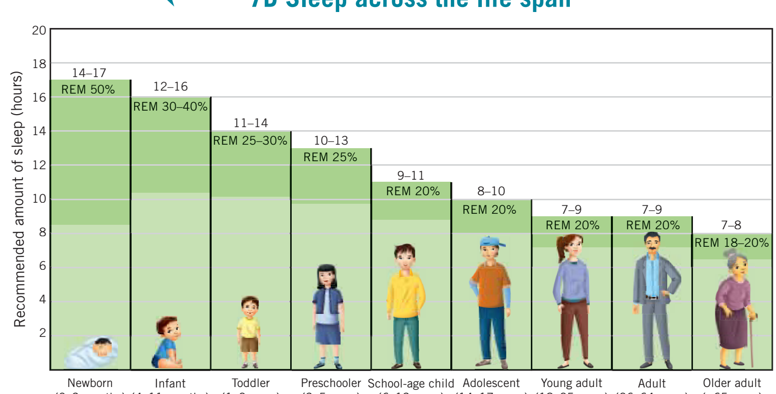
How circadian rhythms, ultradian rhythms, the suprachiasmatic nucleus and melatonin act in regulating sleep

7C Internal biological mechanisms that regulate sleep–wake patterns



Explaining differences in the demand for sleep and changes in a typical pattern of sleep (REM/NREM) across the life span

7D Sleep across the life span



See the Interactive Textbook for an interactive version of this concept map interlinked with all concept maps for the course.

7A Sleep as a naturally occurring altered state of consciousness

Study Design:
Sleep as a psychological construct that is broadly categorised as a naturally occurring altered state of consciousness and is further categorised into REM and NREM sleep, and the measurement of physiological responses associated with sleep, through electroencephalography (EEG), electromyography (EMG), electro-oculography (EOG), sleep diaries and video monitoring

Glossary:
Altered state of consciousness
Consciousness
Hypnogram
Induced altered state of consciousness
Naturally occurring altered state of consciousness
Non-rapid eye movement (NREM) sleep
Normal waking consciousness
Psychological construct
Rapid eye movement (REM) sleep
Sleep

ENGAGE

Where in the brain is our consciousness?

In this chapter, concepts around the theme of consciousness, or our awareness, will be discussed. But where in our brain does our consciousness physically reside?

Recent research has shown that consciousness does not appear to be confined to any single structure or region of the brain, but instead involves multiple pathways across a number of regions, depending on the type of neural activity that is involved.

Conscious awareness is thought to be related to the cerebral cortex of the brain. A 'hot zone' at the back of the brain consisting of the parietal, temporal and occipital lobes has been found to be most active during a conscious experience.

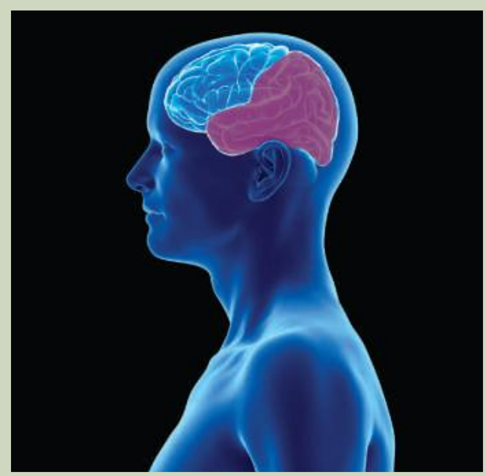


Figure 7A–1 The posterior hot zone of the brain (shown in red) is found to be most active during a conscious experience.

Research into consciousness has interesting and important applications, such as medications and treatment for anxiety disorders such as phobias, aiding recovery from coma, and better understanding the mechanisms underlying hallucinations and psychosis.

Consciousness the awareness of your own internal mental processes, including your thoughts, feelings, sensations and perceptions, and your awareness of the external world around you

EXPLAIN

What is consciousness?

Consciousness is the awareness of your own internal mental processes, including your thoughts, feelings, sensations and perceptions, and your awareness of the external world around you. Consciousness is unique, subjective and constantly changing, and can be thought of as what information takes possession of your mind. For example, one moment

ISBN 978-1-009-25416-8 Gallagher et al

you may be aware of the words that you are reading on this page, then you realise you have been daydreaming about having your favourite dinner tonight, then the contents of your consciousness may shift to your friend who is sitting next to you and asking you a question.

Figure 7A–2 Consciousness is the awareness of our internal mental processes and of the external world around us.

If you walked past a stranger on the way to school, could you accurately describe their personality or their intelligence? What about the contents of their consciousness? Consciousness is considered a **psychological construct** because it cannot be objectively observed or measured through the collection of data, but it is widely understood to exist. Each person knows how they feel, what they are thinking and perceiving in their environment; that is, their subjective experience. However, it is impossible to precisely know someone else's conscious experience. You cannot look inside a stranger's head to find out their feelings and experiences.

Psychological construct a concept that cannot be objectively observed or measured directly through the collection of data, but is widely understood to exist

There is no one particular brain structure in which our consciousness resides and the physiological mechanisms behind consciousness are still not fully understood. We believe consciousness exists; however, we can only indirectly measure it through qualities that are more easily assessed, such as physiological changes or observable behaviours, or through self-report methods.

Normal waking consciousness and altered states of consciousness

Our consciousness does not turn 'on or off'. It is continuously shifting through different levels of awareness. Over the course of a day, a person's state of consciousness may smoothly shift many times. For example, you may be in a caffeine-induced state after your morning coffee, a state of focused attention during a maths test, a state of lethargy at the end of the school day, a daydreaming state on the bus ride home, and then finally a state of sleep with periods of dreaming.

The various states of consciousness that we experience are broadly categorised into normal waking consciousness and altered state of consciousness.

Normal waking consciousness is a state associated with being aware of our internal and external environments. We experience normal waking consciousness in everyday activities when we are awake and have a regular level of awareness. We can manage our attention and our behaviour, and our thoughts and perceptions are organised and clear, such as when reading a book, chatting with a friend or having dinner with our family.

Normal waking consciousness a state associated with being aware of our internal and external environments

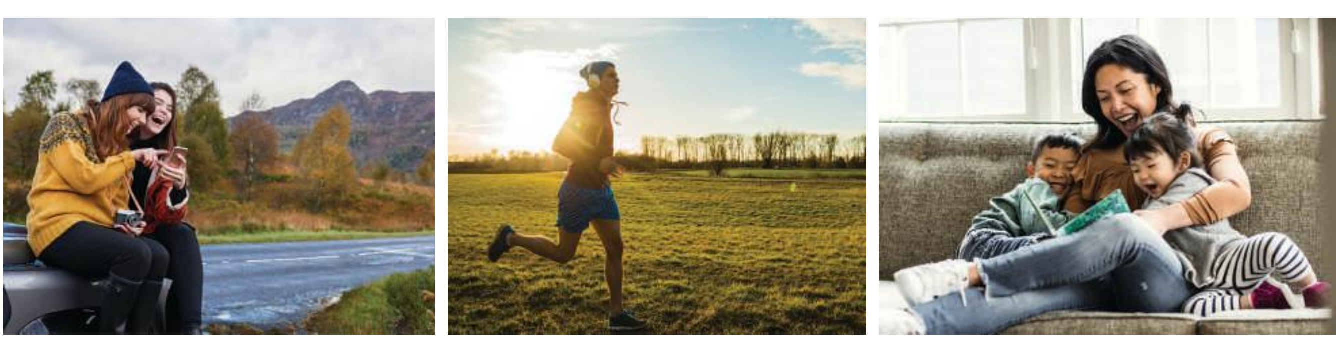


Figure 7A–3 Normal waking consciousness is experienced in everyday activities when you are awake and aware of your internal and external environments.

ISBN 978-1-009-25416-8 Gallagher et al

Altered state of consciousness any state that differs in awareness when compared to normal waking consciousness

Naturally occurring altered state of consciousness an altered state of consciousness that occurs without any external influence

Induced altered state of consciousness an altered state of consciousness that has been brought about on purpose

An **altered state of consciousness** is any state that differs in awareness from normal waking consciousness. In altered states of consciousness, our levels of awareness are lower or higher than in normal waking consciousness. A child daydreaming on a long car ride or an elite tennis player serving a winning point are both in an altered state of consciousness. There is also a change in mental processing where perceptions or thinking may be altered. **Naturally occurring altered states of consciousness** occur without any external influence, such as sleep or a state of fatigue. **Induced altered states of consciousness** are brought about on purpose, such as an alcohol-induced state, an anaethetised state for an operation or a meditative state.

Figure 7A–4 An altered state of consciousness is experienced when your level of awareness is different from that of normal waking consciousness.

Check-in questions – Set 1

1 Explain the difference between normal waking consciousness and altered states of consciousness.
2 List two situations you have been in today where you have been in a normal waking consciousness.
3 List two altered states of consciousness you have experienced in the last 24 hours.

ACTIVITY 7A–1 IDENTIFYING EXAMPLES OF STATES OF CONSCIOUSNESS

Individually or with a partner, take a photo of yourself showing the following states of consciousness: heightened awareness, lethargic, daydreaming, normal waking consciousness, asleep. You can be as creative as you like.

Using an electronic device and any appropriate software, or A3 paper and print-outs of your photos, create a table with two columns labelled as normal waking consciousness and altered states of consciousness. Label each photo with the state it is representing and place the photos into their correct category. You can add justifications with each photo. Make sure you include a title and a description of what is being shown on your poster.

Sleep

Sleep a naturally occurring and reversible altered state of consciousness, characterised by a reduction in awareness and responsiveness to external surroundings

Sleep is a naturally occurring and reversible altered state of consciousness, characterised by a reduction in awareness and responsiveness to external surroundings. During sleep, there is unique brain wave activity and other distinguishable physiological changes. These changes help to differentiate sleep from other altered states of consciousness that might result from brain injury or taking substances. As sleep is a part of the construct of consciousness, sleep may also be considered a psychological construct. As sleep is fundamentally private in nature to an individual, we may only infer sleep based on observations and the physiological responses associated with sleep, which will be discussed in the next section.

ISBN 978-1-009-25416-8 Gallagher et al

Over the course of a night, you experience two different types of sleep – rapid eye movement (REM) sleep and non-rapid eye movement (NREM) sleep. During an eight-hour sleep episode, the average person will experience about five sleep cycles, each lasting approximately 90 minutes and featuring distinguishable repetitive patterns of REM and NREM sleep.

Figure 7A–5 A typical episode of sleep for an adult consists of mostly light sleep, equal smaller proportions of deep sleep and REM sleep, and some short periods of waking.

NREM and REM sleep

Non-rapid eye movement (NREM) sleep is a type of sleep characterised by a progressive decline in physiological activity. NREM sleep consists of three distinct stages and takes up around 80% of a sleep episode in people of school age and older.

NREM Stage 1 (N1) is a transitional phase between wakefulness and sleep. It is considered to be light sleep; physiological responses begin to slow down, including brain activity, heart rate and body temperature. It is the period when a person 'dozes off' to sleep and when they may most easily be woken up. As a sleep episode progresses, a person may not experience much more time in N1. If they are not disturbed for a couple of minutes in N1, a person quickly moves into NREM Stage 2 (N2).

Figure 7A–6 N1 and N2 are considered light sleep, during which a person still wakes easily.

N2 is also considered light sleep, during which physiological responses continue to slow down. A person still wakes relatively easily during N2; however, bursts of brain activity help resist being woken by environmental stimuli such as noises. N2 is the stage of sleep that is experienced the most throughout a sleep episode.

NREM Stage 3 (N3) is considered to be deep sleep, during which physiological responses are at their slowest and a person is most difficult to wake up. N3 is known as 'slow-wave sleep' due to brain activity being at its slowest. During a sleep episode, N3 is experienced

Non-rapid eye movement (NREM) sleep a type of sleep characterised by a progressive decline in physiological activity

VIDEO 7A–1 REM AND NREM SLEEP

LINK 7D SLEEP ACROSS THE LIFE SPAN

LINK 7C INTERNAL BIOLOGICAL MECHANISMS THAT REGULATE SLEEP–WAKE PATTERNS

ISBN 978-1-009-25416-8 Gallagher et al

more in the first half of the night than the second half of the night. As a sleep episode progresses, a person experiences less N3 sleep, and may not experience it at all in the last one or two sleep cycles of a typical night. People of different ages spend different amounts of time in N3, which will be further discussed later in this chapter. It is thought that our body is repairing itself during NREM sleep.

Figure 7A–7 N3 is deep sleep, during which physiological activity is slowest.

Rapid eye movement (REM) sleep a type of sleep characterised by quick darting of the eyes behind closed eyelids and an increase in physiological activity

During **rapid eye movement (REM) sleep**, your eyes make quick darting movements behind their closed eyelids and your physiological activity increases. During REM sleep, brain activity resembles wakefulness, and heart rate and breathing rate increase. Voluntary muscles are seemingly paralysed and twitch only intermittently. The most vivid and memorable dreams occur during REM sleep. A period of REM occurs at the end of each sleep cycle, and these periods get longer and closer together as the sleep episode progresses, which means you have more REM in the second half of sleep than in the first half. REM sleep also differs markedly across different ages, but typically takes up 20% of a sleep episode in people aged around 5 years and older. If you have less sleep than normal, you may experience more REM sleep when you next sleep. It is thought that our mind is repairing itself during REM sleep.

WORKSHEET 7A–1 CONSCIOUSNESS AND SLEEP CROSSWORD

Figure 7A–8 REM sleep is the time when the most vivid and memorable dreams occur.

Hypnogram a line graph that represents the stages of sleep plotted against time

Figure 7A–9 shows a **hypnogram**, which is a line graph of a person's sleep mapped over time. A hypnogram displays the sleep architecture or patterns of a sleep episode, with a typical night's sleep for an adult consisting of five sleep cycles featuring REM and NREM sleep. Time (in terms of the time of a 24-hour day or hours since attempting to sleep) is plotted on the horizontal *x*-axis. The types and stages of sleep are shown on the vertical *y*-axis, with wakefulness at the top and deepest sleep at the bottom. Therefore, a hypnogram shows how a person's sleep progresses through several sleep cycles consisting of REM sleep and the three stages of NREM sleep, over the course of a night.

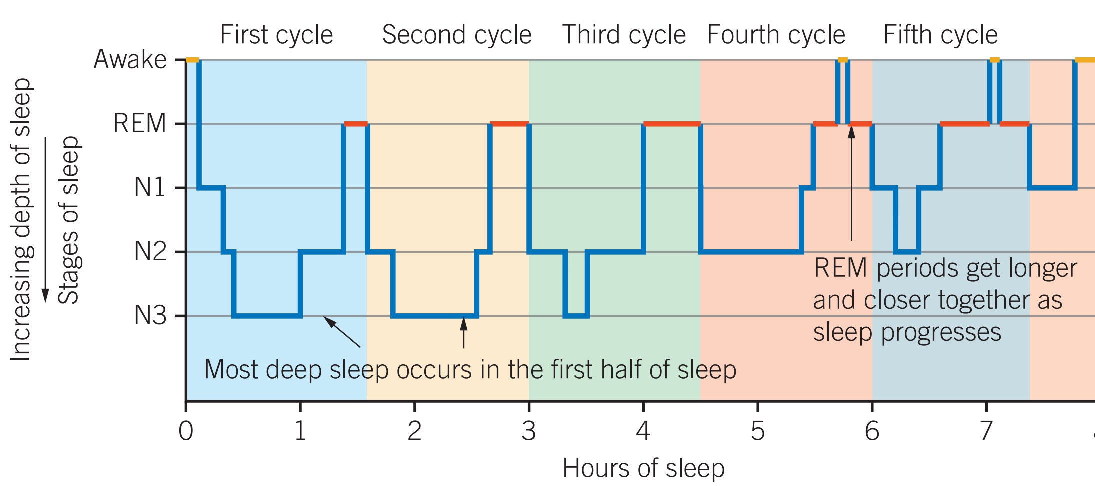


Figure 7A–9 A hypnogram is a line graph that shows the experience of the stages of sleep over time. Time is plotted on the horizontal axis. Depth of sleep is plotted on the vertical axis, with wakefulness at the top and the deepest sleep at the bottom.

ISBN 978-1-009-25416-8 Gallagher et al

7A SKILLS

Interpreting hypnograms
In VCE Psychology, you need to be able to interpret data presented in different forms, including tables, bar charts and line graphs. Data of a person's sleep can be presented in a type of line graph known as a hypnogram, as shown in (Figure 7A–9).

When interpreting the data displayed in a hypnogram, first consider the *y*-axis and the order in which REM and N1–3 are included. A hypnogram often also includes 'awake' time. Read from left to right to track the types and stages of sleep being experienced, and for how long. When the line continues horizontally, time is being spent in that type or stage of sleep.

Several features being displayed in the hypnogram can give evidence of a person's age or whether they may be experiencing a normal sleep pattern or a sleep disorder. Consider:
- how many sleep cycles are being experienced
- the amount of REM sleep and when it occurs
- the total number of hours of sleep experienced
- the time of night/day the person falls asleep or wakes
- how many times a person wakes up or how long it takes them to fall asleep
- the amount of time spent in N3 deep sleep compared to N1 or N2 light sleep.

In the hypnogram in Figure 7A–9, each sleep cycle can be determined by the U-shape pattern of the line. After the person goes to sleep, they first enter N1, then N2 and N3, before progressing back up the stages and finishing with a period of REM. This pattern is repeated for the second sleep cycle. In the third, fourth and fifth sleep cycles, the person experiences little, or does not experience any, N3 sleep. You can see that the periods of REM sleep get longer each time they occur. There are also a couple of short awakenings throughout the sleep. Based on this data, this person would likely be a young to middle-aged adult because these are features of sleep that are typically experienced during this part of the adult stage of the life span.

VIDEO 7A–2
SKILLS: INTERPRETING HYPNOGRAMS

7A KEY SCIENCE SKILLS

Processing quantitative data
Calculating statistics such as percentages, percentage change, measures of central tendency and measures of variability allow you to understand raw data and draw conclusions for the data.

In VCE Psychology, you are often required to interpret statistics during SACs and the exam, and you may also need to calculate statistics from raw data during SACs. In Chapter 2, you learned about the following statistics:
- measures of central tendency (including mean, median and mode), which describe the central location of a set of data
- mean – the average value of a set of data
- median – the middle value in an ordered data set
- mode – the most frequently occurring value in a data set
- measures of variability – describe the distribution of data
- standard deviation – the spread of data around the mean.

VIDEO 7A–3
KEY SCIENCE SKILLS: PROCESSING QUANTITATIVE DATA

LINK CHAPTER 2

ISBN 978-1-009-25416-8 Gallagher et al

Question:

Two 17-year-old patients in a home sleep study recorded features of their sleep over one week using a device. The following table presents their data. A doctor analysing this data is comparing the patients' results to the expected results for an adolescent, which would be around 8–10 hours of sleep each night, with approximately 20% of this being REM sleep.

	Patient A	Patient B
Mean hours slept each night	4.3	8.1
Mode percentage of REM sleep	33%	20%
Standard deviation of hours slept	2	0.5

a Referring to the data in the table, comment on whether each patient appears to be achieving an expected amount of total sleep and an expected pattern of REM sleep.
b Describe what the standard deviations in the data table can tell us about the sleep of each patient.

Suggested answer for full marks:

a On average, patient B achieves 8.1 hours sleep a night, which is an appropriate number of hours for their age. However, patient A achieves on average only 4.3 hours of sleep a night, which is fewer than is appropriate for an adolescent.
Patient B often achieves an appropriate percentage of REM sleep for their age, with the most frequently occurring percentage of REM being 20%. However, patient A frequently achieves a higher percentage of REM sleep than is expected for their age, with the most frequently occurring percentage being 33%.
b The standard deviation for patient A is larger (2 hours) than that for patient B (0.5 hours). This tells us patient A's amount of sleep each night varied further from their weekly mean amount. Patient B's amount of sleep each night was closer to their mean weekly amount, indicating a smaller spread of results.

Check-in questions – Set 2

1 Identify two differences between NREM and REM sleep.
2 How many stages of NREM sleep are there?
3 What is the approximate proportion of NREM and REM sleep in a typical night for an adult?
4 What is the duration of a sleep cycle, and on average how many sleep cycles are experienced in a typical eight-hour sleep episode?

Section 7A questions

1 Eliza suffers a concussion while playing football on the weekend. As the team trainer walks Eliza off the field, Eliza 'sees stars' and is not aware of the spectators clapping as she walks to the medical room.
Justify whether Eliza is experiencing normal waking consciousness or an altered state of consciousness as she walks off the field.

ISBN 978-1-009-25416-8 Gallagher et al

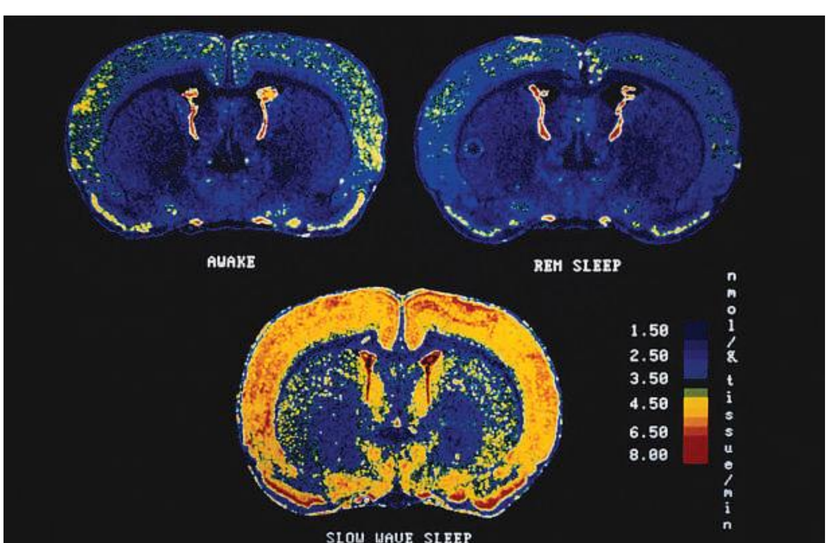
2 Nia, Arya and Lynne are in English class where they are reading the assigned novel together as a class. Nia is asked to read out loud. She is a little nervous and so is concentrating on reading each word carefully so she does not make a mistake. Arya is following along in her copy of the book because it might be her turn to read next. Lynne is staring out the window, thinking about going to the beach on the weekend.
Classify the state of consciousness that each person is likely to be experiencing during the class, and give a reason for your answer.

3 Describe the general physiological changes experienced as a person moves from awake to N3 sleep.

4 Adam has just finished his birthday weekend. He spent three nights in a row out late celebrating with friends, before waking up after only a few hours of sleep for his morning shift at work. He is finally able to sleep in on Monday morning. When he wakes up, he notices his smart watch has tracked some unusual features of his sleep. Usually, Adam sleeps 20% of his total sleep in REM sleep, but last night he slept 27% of the time in REM sleep.
   a Determine the percentage change in REM sleep that Adam experienced, and provide an explanation for why this occurred.
   b Adam's smart watch shows his rolling weekly mean amount of sleep. He knows it usually displays about 7.5 hours, but after his extended sleep last night, the rolling weekly mean now displays 8.5 hours.
   Justify whether the mean is the most accurate statistic to describe Adam's sleep this week.

5 Priyanka is 26 years old and is getting ready to go on an overseas holiday. She has left her packing until the last minute, and is up late making sure she has packed everything that she needs. Priyanka has an early flight, and the airport is a long way from her home. When Priyanka finally gets to bed, she only gets 3 hours of sleep before her alarm sounds for her to wake up and leave for the airport.
   a How many sleep cycles is Priyanka likely to achieve during this sleep episode?
   b Justify which type of sleep Priyanka will most miss out on during this sleep episode.
   c Justify whether Priyanka is likely to receive her usual amount of N3 sleep during this sleep episode.

6 With reference to the brain scans shown, provide one difference between brain activity experienced during REM sleep and NREM deep sleep (indicated as 'slow-wave sleep' in the scan).



7B Techniques used to measure sleep

Study Design:
Sleep as a psychological construct that is broadly categorised as a naturally occurring altered state of consciousness and is further categorised into REM and NREM sleep, and the measurement of physiological responses associated with sleep, through electroencephalography (EEG), electromyography (EMG), electro-oculography (EOG), sleep diaries and video monitoring

Glossary:
Electroencephalography (EEG)
Electromyography (EMG)
Electro-oculography (EOG)
Polysomnography
Sleep diary
Video monitoring

ENGAGE

Using EEG to control a prosthetic hand by thought

Prosthetic limbs using various degrees of technology have been around possibly for thousands of years and help amputees regain some movement and functioning. Recently, the technology has advanced to allow a person to grasp objects with a prosthetic hand powered only by their thoughts.

Before this development, similar prosthetic movements were only possible after invasive surgery to implant electrodes to detect brain signals, or they relied on electrical signals from muscles, which was not always possible. The new technology researched by neuroscientists and engineers Agashe, Paek, Zhang and Contreras-Vidal working in the United States in 2015 utilises electroencephalography (EEG), which measures brain activity from the outside surface of the scalp, without invasive surgery.

The researchers designed a computer program that could harness the intention of the patient as they imagined themselves controlling the hand, allowing them to grasp objects with great success.

The research has further exciting prospects for rehabilitation of other injuries, such as spinal cord injuries.

EXPLAIN

Measuring sleep

There are different techniques for measuring sleep based on objective physiological changes in the activity of the body, observations and subjective reports. These techniques can allow a person to detect and record features such as the onset of sleep, sleep duration, sleep quality, awakenings during sleep, any body movements and wake-up time. This data is useful for diagnosing sleep disorders, tracking how a person's sleep is affected by various factors

Figure 7B–1 There are many different ways to measure and observe an individual's sleep patterns.

ISBN 978-1-009-25416-8 Gallagher et al

such as new medication, or even improving the performance of athletes. The different techniques include electroencephalography, electromyography, electro-oculography, sleep diaries and video monitoring. These techniques are often combined in a kind of sleep study called **polysomnography**.

Electroencephalography

Electroencephalography (EEG) is a technique that detects, amplifies and records the electrical activity of the brain. When undertaking an electroencephalogram, electrodes are attached to a person's scalp or through a cap or headset (Figure 7B–2). The electrodes detect the synchronised electrical impulses of many neurons communicating together just beneath the scalp at the surface of the cortex. Wires connected to the electrodes transmit this data to an instrument (electroencephalograph) that amplifies the signals to a readable level and then sends them to a computer, where they are recorded as brain wave patterns and interpreted by a specialist (Figure 7B–3).

Polysomnography a multi-parameter sleep study used as a diagnostic tool in sleep medicine

Electro-encephalography (EEG) a technique that detects, amplifies and records the electrical activity of the brain

Figure 7B–2 The electrodes of an EEG can be attached to a cap or headset, or to the person's scalp.

The electrical impulse of one neuron alone is not strong enough to be detected by an EEG, and so the brain wave recordings produced by an EEG are summaries of the activity of thousands of neurons in the area.

Different types and stages of sleep produce different brain waves, and EEGs may be used to identify a particular stage or abnormal brain activity that differs from what would usually be expected. For example, abnormal brain activity during sleep can indicate a sleep disorder, or a particular pattern can determine when a person has fallen asleep.

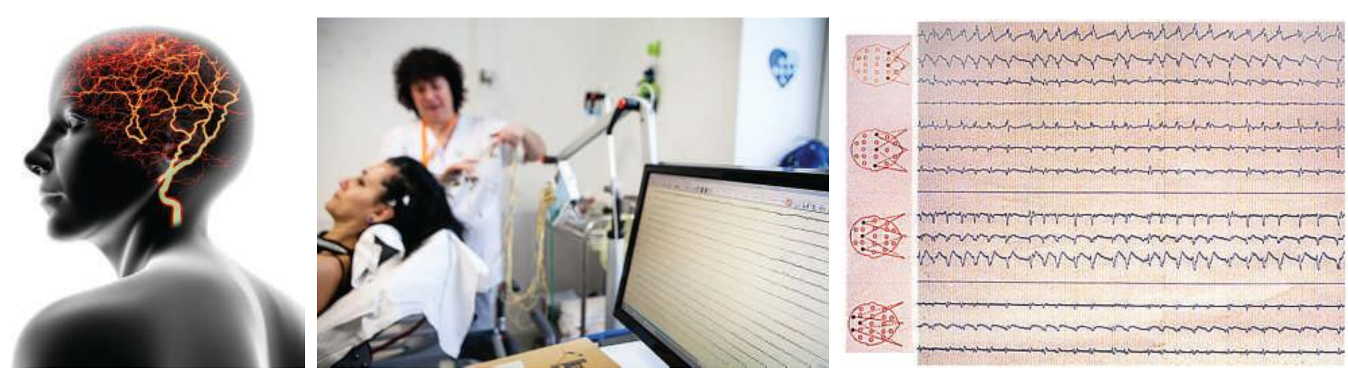


Figure 7B–3 Wires connect the electrodes to instruments that can amplify the signal to be recorded as brain wave patterns on a computer.

ISBN 978-1-009-25416-8 Gallagher et al

There are several main types of brain waves, named beta, alpha, theta and delta, which are characterised by specific patterns of activity and occur at different times during wake and sleep. The brain wave patterns differ in terms of their frequency and amplitude.

The frequency of a brain wave indicates the speed of the brain waves or how much activity is occurring every second. Frequency can be visually identified in a brain wave recording according to how close together the waves are and the number of times the wave repeats in a 1-second interval. Slower-frequency brain waves are prevalent when we are tired, relaxed or asleep. Faster-frequency brain waves are prevalent when we are awake and alert (Figure 7B–4).

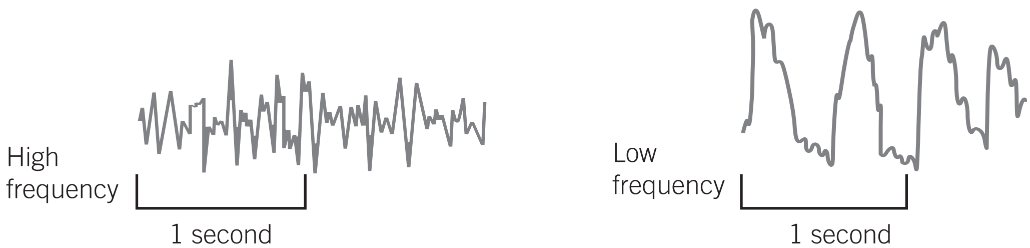


Figure 7B–4 The frequency of a brain wave indicates how much activity is occurring every second.

The amplitude of a brain wave indicates the intensity or strength of the brain wave, or how many neurons are firing at the same time together. This characteristic can be visually identified in a brain wave recording as the height of the brain waves or the distance between the peaks and troughs (Figure 7B–5). Higher peaks and lower troughs indicate more synchronised brain activity from multiple neurons working on a similar task, such as sleep, whereas lower peaks and troughs indicate groups of neurons are working on different tasks, such as driving a car.

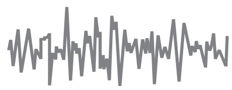
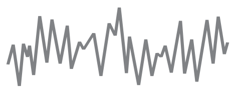
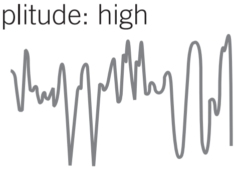
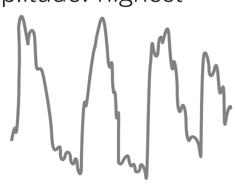
Figure 7B–5 The amplitude of a brain wave indicates its intensity or strength.

7A SLEEP AS A NATURALLY OCCURRING ALTERED STATE OF CONSCIOUSNESS LINK

The brain wave types relate to the person's level of awareness or state of consciousness, and a general pattern across the four brain wave types shows that as the frequency of a brain wave decreases, the amplitude increases. As a person drifts into the deeper sleep stages of a sleep cycle, their brain wave activity decreases, as indicated by progression through the four brain wave types. The increase in brain activity during REM sleep is indicated by faster brain wave patterns.

ISBN 978-1-009-25416-8 Gallagher et al

Table 7B–1 How the four brain wave patterns are used to measure sleep

	Brain wave	Frequency and amplitude	State
	Beta	Frequency: highest Amplitude: lowest 	• Normal waking consciousness • Awake, alert and focused • High environmental stimulation • Brain working on several things at once
	Alpha	Frequency: high Amplitude: low 	• Lower alertness • Awake but relaxed • Quiet and calm • Drowsy • Eyes closed • Low environmental stimulation
	Theta	Frequency: low Amplitude: high 	• Low alertness • Light sleep • Senses withdrawn from the external environment • Deep meditation
	Delta	Frequency: lowest Amplitude: highest 	• Lowest alertness • Deep N3 sleep • Dreamless sleep

Electromyography

Electromyography (EMG) is a technique that detects, amplifies and records the electrical activity of the skeletal muscles. When undertaking an electromyogram as part of a sleep study, electrodes are attached to the surface of the skin, typically around the jaw and sometimes the legs or other body parts (Figure 7B–6). The output of an EMG is recorded wave patterns similar to an EEG; however, we don't refer to the waves with the same names. An EMG may be used during a sleep study to measure muscle tension, which can indicate the stages and type of sleep the person is experiencing. In general, more muscle tension indicates greater alertness, so as a person drifts into deeper sleep, muscle movement decreases. Additionally, no muscle movement is detected during REM sleep. An EMG can also detect abnormal movements during sleep, such as tossing and turning, teeth grinding or leg movements, which may indicate a sleep disorder such as periodic limb movement disorder or sleep bruxism.

Electromyography (EMG)
a technique that detects, amplifies and records the electrical activity of the skeletal muscles

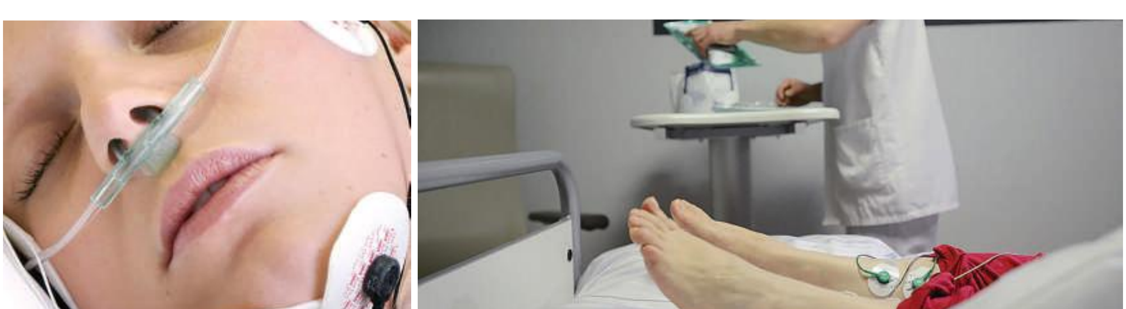


Figure 7B–6 The electrodes of an EMG are attached to the skin above any muscle of interest during sleep, typically the jaw or legs.

ISBN 978-1-009-25416-8 Gallagher et al

Electro-oculography

Electro-oculography (EOG) a technique that detects, amplifies and records the electrical activity of the muscles controlling the eyes

Electro-oculography (EOG) is a technique that detects, amplifies and records the electrical activity of the muscles controlling the eyes. When undertaking an electro-oculogram during a sleep study, electrodes are attached to the surface of the skin around the sides of each eye (Figure 7B–7). The output of an EOG is recorded wave patterns similar to an EEG. An EOG may be used during a sleep study to determine the onset of sleep as well as when the stages and types of sleep occur. As you drift into deeper sleep, your eye movement decreases and slows down, and when you experience REM sleep, your eye movement increases.

Figure 7B–7 The electrodes of an EOG are attached to the skin at the sides of the eyes.

VIDEO 7B–1 SKILLS: THE ROLES OF EEGs, EMGs AND EOGs

7B SKILLS

Defining the roles of EEGs, EMGs and EOGs

In VCE Psychology, it is important to define the role of EEGs, EMGs and EOGs including the following four key words: detect, amplify, record, electrical.

You can use the acronym DARE to remember to include these four words, and use the following definition template for each device. Simply substitute in the name of the technique and the part of the body that is being measured.

An _______ detects, amplifies and records the electrical activity of the _______.

EEG	brain
EMG	muscles
EOG	muscles controlling the eyes

Use this full definition in all responses referencing these techniques.

In VCE Psychology, when describing the output produced by the three devices, only EEG recordings are described in terms of the beta, alpha, theta, and delta brain wave types.

For example:

'During a state of consciousness with high awareness and focused attention, an EEG would detect, amplify and record electrical activity of the brain, showing beta waves with a high frequency and low amplitude.'

When you describe the recordings of an EOG or EMG, you only need to say that the output is either 'high activity' or 'low activity'.

For example:

'During a state of consciousness with high awareness and focused attention, an EMG would detect, amplify and record high electrical activity of the muscles.'

ISBN 978-1-009-25416-8 Gallagher et al

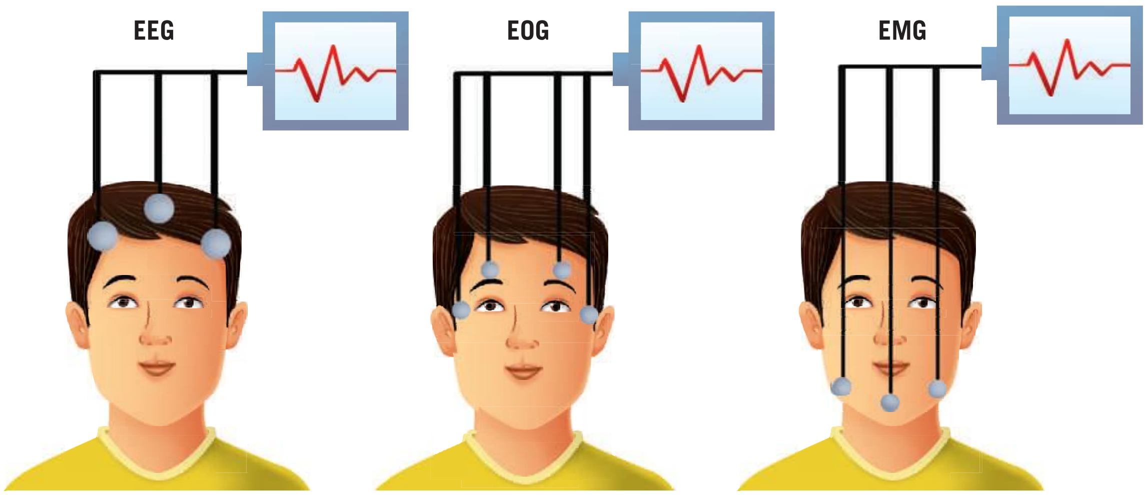


Figure 7B–8 The placement of electrodes for an EEG, EOG and EMG

Check-in questions – Set 1

1 What is an EEG?
2 Describe the overall pattern of the changes to brain wave frequency and amplitude as a person drifts into deeper sleep.
3 What is the function of an EMG?
4 Describe the expected output of an EMG when a person is in deep N3 sleep.
5 What is the role of an EOG?
6 Describe the expected output of an EOG when a person is in REM sleep.

Sleep diaries

Before a diagnosis of a sleep disorder can be made, people who report having trouble sleeping often complete an assessment of their typical sleep, including the nature of their sleep, severity of symptoms and investigation into possible causes. **Sleep diaries** are a subjective, self-report tool used by a person to track their own sleep and wake patterns. Sleep diaries aim to identify any patterns or habits that may be leading to the sleep trouble, and they can provide the sleep specialist with a personal and subjective account of the quantity and quality of sleep being experienced.

LINK 8A THE EFFECTS OF PARTIAL SLEEP DEPRIVATION

Sleep diary a subjective self-report tool used by a person to track their own sleep and wake patterns

There are many types and formats of sleep diaries, but typically they include spaces to record the time of sleep onset, waking time, how the person felt upon waking and any disturbances to sleep such as periods of waking, or unusual behaviours such as sleep walking or night terrors. They also may include space to track anything else that could be affecting a person's sleep patterns, such as caffeine intake over the day, any naps taken and exercise completed. Usually the person records their sleep in a sleep diary for a couple of weeks.

Disturbed sleep may be the cause or consequence of a mental health disorder, so once subjective data has been collected through a sleep diary, a sleep specialist can interpret it and make further assessments. A more accurate assessment can be made if information from the sleep diary is combined with information from objective measures such as physiological changes determined by an EEG, EOG or EMG.

ISBN 978-1-009-25416-8 Gallagher et al

Sleep Diary

SleepFoundation
A OneCare Media Company

Complete in the Morning

Start date: / Day of week:	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
What time did you get into bed?	PM AM	PM AM	PM AM	PM AM	PM AM	PM AM	PM AM
What time did you try and go to sleep?	AM PM	AM PM	AM PM	AM PM	AM PM	AM PM	AM PM
How long did it take you to fall asleep?	HRS. MINS.	HRS. MINS.	HRS. MINS.	HRS. MINS.	HRS. MINS.	HRS. MINS.	HRS. MINS.
What time did you wake up this morning?	AM PM	AM PM	AM PM	AM PM	AM PM	AM PM	AM PM
How many times did you wake up during the night?							
No. of times							
No. of minutes							
Last night I slept a total of:	HRS. MINS.	HRS. MINS.	HRS. MINS.	HRS. MINS.	HRS. MINS.	HRS. MINS.	HRS. MINS.
How would you rate your sleep quality?							
Very Poor	○	○	○	○	○	○	○
Poor	○	○	○	○	○	○	○
Fair	○	○	○	○	○	○	○
Good	○	○	○	○	○	○	○
Very Good	○	○	○	○	○	○	○
Was your sleep disturbed by any factors? If so, list them here (ex. allergies, noise, pets, discomfort/pain, etc.)							
Any other comments about your sleep worth noting?							

Complete in the Evening

Day of week:	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
I consumed caffeinated drinks in the: (M)orning, (A)fternoon, (E)vening, (N/A)							
M / A / E / NA							
How many?							
How much exercise did you get today?							
No. of minutes							
Time of day (morning, afternoon, evening, night)							
Did you take a nap? (circle one)	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
If Yes, for how long?							
List all Medications you took today							
Approximately 2-3 hours before going to bed, I consumed:							
Alcohol	○	○	○	○	○	○	○
A heavy meal	○	○	○	○	○	○	○
Caffeine	○	○	○	○	○	○	○
Not applicable	○	○	○	○	○	○	○
In the hour before going to sleep, my bedtime routine included: List activities including reading a book, using electronics, taking a bath, doing relaxation exercises, etc.							

Figure 7B–9 A template for a sleep diary

DOCUMENT 7B–1 SLEEP DIARY

DOC

ACTIVITY 7B–1 SLEEP DIARY

1 Access the sleep diary templates in the online resources and make two copies.
2 Each day for two weeks, record data on your sleep. There are two components to the sleep diary: one to complete in the morning and one to complete at the end of the day. Each entry will only take you a couple of minutes.
3 After the first week, review your diary.
   - Identify any trends or patterns (both beneficial and detrimental) in your sleep habits.
   - Identify how often you achieved the total recommended hours of sleep for your age group.
   - Compare your usual daily practices to the suggested best practices for good sleep hygiene.
   - Identify one or two changes that you could make to help improve your sleep over the next week.

ISBN 978-1-009-25416-8 Gallagher et al

4 Complete the sleep diary for the second week.
5 Once the two weeks are finished, review your completed diary.
- Identify any trends or patterns (both beneficial and detrimental) in your sleep habits.
- Identify how often you achieved the total recommended hours of sleep for your age group.
- Were you able to incorporate the one or two proposed changes to your sleep routine? Did you have any challenges preventing the success of those changes?
- Did those changes appear to be beneficial to your sleep during the second week?
- Identify one or two changes that you will continue with, or that you would now like to try over the coming weeks.

Video monitoring

During a sleep study, **video monitoring** is used to collect qualitative visual and audio information about a person's sleep. Video monitoring is used alongside EEGs, EOGs and EMGs, and can validate the data collected by these devices to show exactly what activity is occurring while a person is asleep, such as their sleeping positions, specific movements, laboured breathing, sleep talking or teeth grinding. Video monitoring can be a valuable tool to use with children who have sleep problems and may have trouble verbalising their experience or who are too young to complete a sleep diary. The additional information provided by video monitoring alongside physiological measures and sleep diaries can help diagnosise sleep disorders.

Video monitoring a sleep study tool used to collect qualitative visual and audio information about a person's sleep

Check-in questions – Set 2

1 Describe why a sleep diary is considered a subjective measure of sleep.
2 List four features of a person's sleep that may be recorded in a sleep diary.
3 List four things that video monitoring might detect during a sleep study.

Section 7B questions

1 Provide one similarity and one difference between an EOG and an EMG.
2 Identify which device(s) would be used in the following situations to measure sleep, and describe what they would be likely to show.
   a Malik is in a sleep study because he has trouble falling asleep. He often feels rushes of energy through his legs and he gets a strong urge to move them, which prevents him from falling asleep easily.
   b Felix is in a sleep study because he has trouble going back to sleep after experiencing night terrors. He often lies in bed looking around his room to make sure that the figures from his night terrors are not there.
3 Alberta is having trouble staying asleep for the whole night. Her doctor suggests she maintain a sleep diary for two weeks to collect data that may help her diagnosis. Identify four of the most useful things that Alberta would record in her sleep diary to help determine her sleeping issue.
4 Explain why video monitoring is useful alongside other measures during a sleep study.

ISBN 978-1-009-25416-8 Gallagher et al

7C Internal biological mechanisms that regulate sleep–wake patterns

Study Design:
Regulation of sleep–wake patterns by internal biological mechanisms, with reference to circadian rhythm, ultradian rhythms of REM and NREM Stages 1–3, the suprachiasmatic nucleus and melatonin

Glossary:
Circadian rhythm
Melatonin
Suprachiasmatic nucleus
Ultradian rhythm
Zeitgeber

ENGAGE

2017 Nobel Prize in Physiology or Medicine for body clock studies

In 2017, researchers Jeffrey C. Hall, Michael Rosbash and Michael W. Young were awarded the Nobel Prize in Physiology or Medicine for their discoveries about the mechanisms of the circadian rhythm.

The research team studied fruit flies, which have a very similar genetic make-up to humans, and isolated a gene that controls their daily circadian rhythm. The researchers showed that the gene produces a protein that builds up in cells overnight, then breaks down during the day. This helps explain the previously unknown mechanisms of how living things, including humans, adapt their biological rhythm so that it is synchronised with the daylight cycle of the environment, affecting when we sleep and when we are awake.

Figure 7C–1 The 2017 Nobel Prize in Physiology or Medicine was awarded to three researchers for their studies into the mechanisms of the circadian rhythm using fruit flies.

EXPLAIN

Regulating sleep–wake patterns

8B CIRCADIAN RHYTHM SLEEP DISORDERS **LINK**

The regular patterns of the sleep–wake cycle can be explained by the precise functioning of several biological mechanisms, including the circadian rhythm, ultradian rhythms, the suprachiasmatic nucleus in the brain and the hormone melatonin.

Circadian rhythms

Circadian rhythm biological processes that coordinate the timing of body activities over a 24-hour period

Circadian rhythms are biological processes in all animals that coordinate the timing of activity of body systems over a 24-hour period. Circadian rhythms allow for optimised functioning at certain time points over the course of 24 hours. This is done by controlling our sleep–wake cycle, release of hormones and regulation of body temperature. In humans, circadian rhythms follow a 24-hour period, with most people sleeping at night and being awake and active during the day.

ISBN 978-1-009-25416-8 Gallagher et al

The circadian rhythm develops and undergoes changes over the course of the life span, as detailed in the next section of this chapter.

Ultradian rhythms

Ultradian rhythms are biological processes that coordinate the timing of activity of body systems over periods of less than 24 hours. Ultradian rhythms may last from a few minutes to a few hours, allowing them to cycle repeatedly over the course of a day. Some biological processes that follow an ultradian rhythm include heart rate, digestion, blood pressure, some hormone secretions and appetite.

Ultradian rhythm biological processes that coordinate the timing of body activities over a period of less than 24 hours

Although the daily cycle of wakefulness and sleep follows a circadian rhythm, the sleep portion consists of several sleep cycles occurring as ultradian rhythms. Within a typical 8-hour sleep episode, a person will experience around five sleep cycles, each lasting around 90 minutes and cycling through a repetitive and reasonably predictable pattern of REM and NREM sleep. Sleep cycles tend to increase in length over the course of a sleep episode, with a general pattern of increased REM sleep and decreased N3 sleep as we progress through each cycle or ultradian rhythm. The hypnogram in Figure 7C–2 displays a typical sleep episode for a healthy adult, showing the cyclical patterns of REM and NREM sleep.

LINK **7A** SLEEP AS A NATURALLY OCCURRING ALTERED STATE OF CONSCIOUSNESS

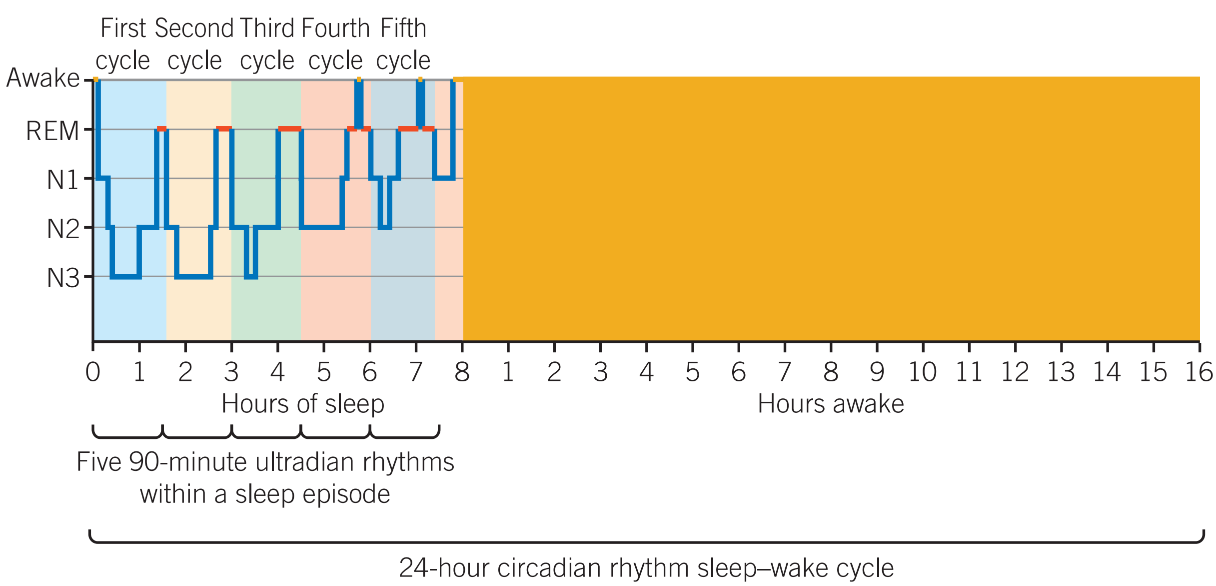


Figure 7C–2 The human sleep–wake cycle runs on a 24-hour circadian rhythm. Each 90-minute sleep cycle within a sleep episode is an ultradian rhythm.

Suprachiasmatic nucleus

Many cells in the body can independently maintain a 24-hour circadian rhythm. However, they are ultimately synchronised and controlled by a part of the brain's hypothalamus called the **suprachiasmatic nucleus**, which functions as the master body clock (Figure 7C–3). At specific times in a 24-hour day, the suprachiasmatic nucleus sends signals to regulate various activities in the body and keep it functioning to a daily schedule of sleep and wakefulness.

The suprachiasmatic nucleus can function independently to maintain an approximately 24-hour cycle because of a precise feedback loop of gene expression and inhibition. However, it is influenced by external cues known as **zeitgebers**, such as exercise, social activity, eating patterns and temperature. The suprachiasmatic nucleus is particularly sensitive to light, and this is why the human circadian rhythm is so closely connected to day and night.

Suprachiasmatic nucleus a master body clock in the hypothalamus that regulates body activities to a daily schedule of sleep and wakefulness

Zeitgeber an environmental cue such as light, temperature and eating patterns that can synchronise and regulate the body's circadian rhythm

ISBN 978-1-009-25416-8 Gallagher et al

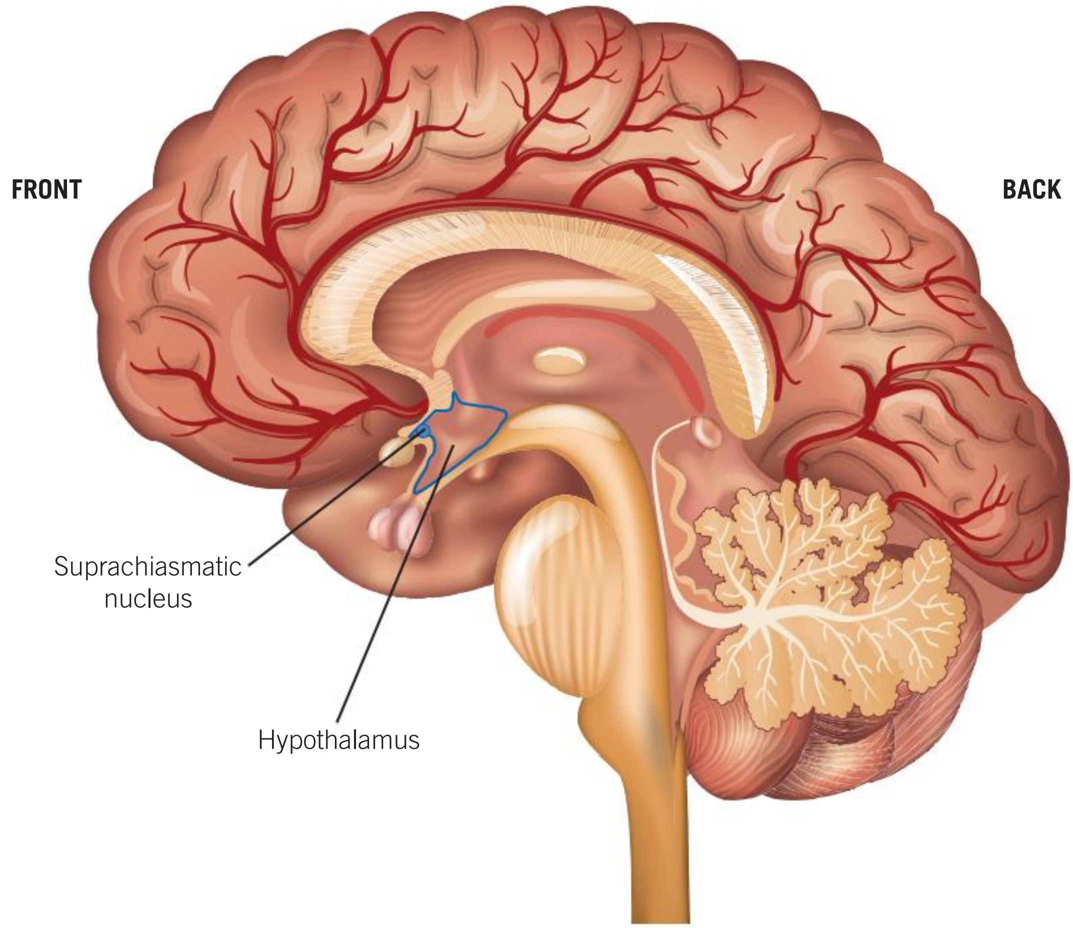


Figure 7C–3 A cross-section of the human brain showing the suprachiasmatic nucleus, a small part of the hypothalamus

7C SKILLS

VIDEO 7C–1 SKILLS: SPELLING KEY TERMS

Spelling key terms

In VCE Psychology, knowing how to spell key terms is an important skill. If you spell a general word incorrectly on an exam, you will not lose marks if the misspelled word is a general word in the answer and not a specific key term. However, if you spell a key term incorrectly, you may not receive full marks. For example, if you misspelled the key term 'melatonin' as 'melanin,' then you would not receive marks for identifying or explaining this term.

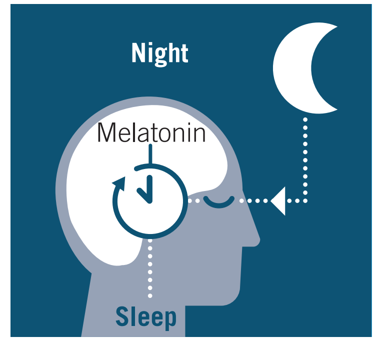
You should aim to practise spelling all key terms progressively while you are learning the theory in a topic. Try some different methods for practice, such as using flashcards, 'Look Cover Write Check' technique, or quizzing with a friend, and continue to read your textbook regularly.

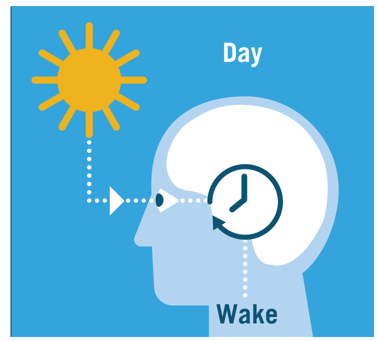
It is common to see and use abbreviations for some of the longer key terms in science; however, only use abbreviations if they are explicitly included in the study design dot point. For example, you can use the abbreviations NREM, REM, EEG, EOG and EMG because these are listed in the study design. For other well-known abbreviations that are not included in the study design, such as the abbreviation SCN for suprachiasmatic nucleus or BAC for blood-alcohol concentration, you should first spell the key term out in full followed by the abbreviation in brackets, and then you may use the abbreviation thereafter within the same question. If you need to use this same abbreviation in another question, you should spell it out in full again. You should not use abbreviations that you have made up and that are not commonly used or well known or accepted in psychology.

ISBN 978-1-009-25416-8 Gallagher et al

Melatonin

The suprachiasmatic nucleus regulates the circadian rhythm with the help of light signals from the environment. Light-sensitive neurons in the retinas of the eyes detect incoming light and send messages to the brain's suprachiasmatic nucleus about the amount of light in the surroundings. More light being received by the eyes indicates daytime; less light being received by the eyes indicates night-time.





At night-time when the eyes detect no light, the suprachiasmatic nucleus sends a signal to the pineal gland in the human brain. This results in the pineal gland releasing **melatonin**, a hormone that induces drowsiness. The increased release of melatonin by the pineal gland at night-time induces sleepiness and decreases cell activity. This process ensures that our sleep is connected to night-time.

During the day when the eyes detect more light, the suprachiasmatic nucleus sends inhibitory messages to the pineal gland, resulting in the inhibition of melatonin release by the pineal gland. Less melatonin release by the pineal gland increases cell activity in the body. The result is that a person does not feel drowsy, and therefore wakefulness is promoted during the day.

This process allows the circadian rhythm to be synchronised with the outside world and creates a stable cycle that enables you to feel awake during the day and fall asleep at night. This process regulates when you go to sleep and wake up, but a different process regulates how much you sleep. Table 7C–1 shows how wakefulness and sleepiness are regulated by light in some different situations.

LINK 7D SLEEP ACROSS THE LIFE SPAN

Melatonin a hormone that induces drowsiness and decreases cell activity

LINK 8C IMPROVING SLEEP–WAKE PATTERMS AND MENTAL WELLBEING

VIDEO 7C–2 BIOLOGICAL MECHANISMS REGULATING SLEEP

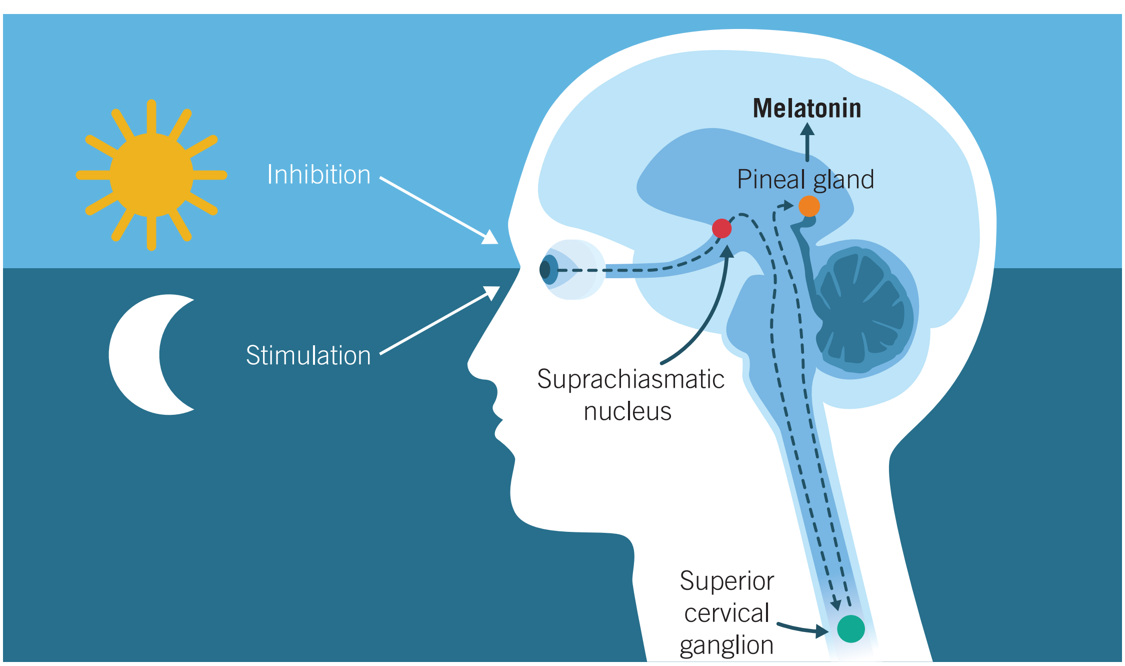


Figure 7C–4 The suprachiasmatic nucleus detects the amount of incoming light and signals to the pineal gland whether to release melatonin or not.

ISBN 978-1-009-25416-8 Gallagher et al

With light cues from the Sun reliably cycling every 24 hours, the circadian rhythm can undergo daily resetting that keeps a person's sleep–wake cycle aligned to a 24-hour day. However, if these light cues are absent, the circadian rhythm tends to run free and can cycle for a little longer than 24 hours, resetting on average every 24.25 hours. Variations in the circadian rhythm may explain some of the individual differences in those who are a 'morning lark' and feel more wakeful in the morning, or those who are a 'night owl' and feel more wakeful in the evening.

Table 7C–1 shows how wakefulness and sleepiness are regulated in four different scenarios.

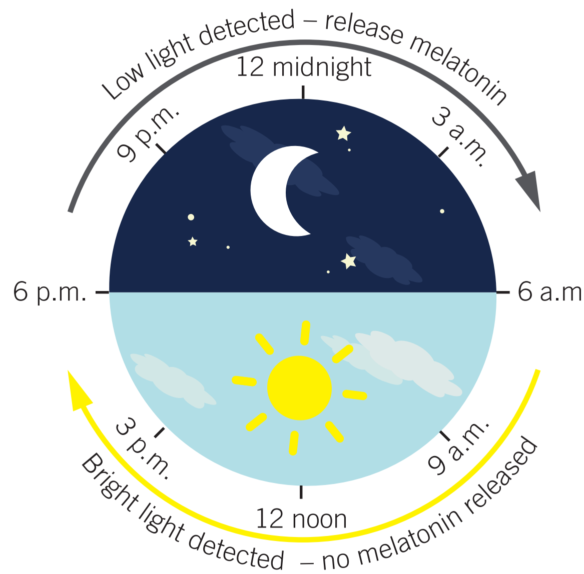
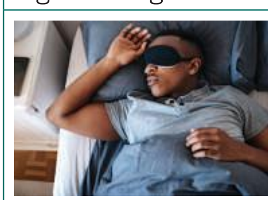


Figure 7C–5 The circadian rhythm is closely aligned with the 24-hour day–night cycle because the suprachiasmatic nucleus detects light in the external environment and signals this to the pineal gland.

8C IMPROVING SLEEP–WAKE PATTERNS AND MENTAL WELLBEING LINK

Table 7C–1 The role of the suprachiasmatic nucleus and melatonin in four scenarios of wakefulness

Scenario	Suprachiasmatic nucleus	Melatonin	Effect on wakefulness
 Driving at night	Detects low light	Increased melatonin secretion	Sleepiness
 Getting up in the night with lights on	Detects bright light	Decreased melatonin secretion	Wakefulness
 In bed during the day with a sleep mask	Detects low light	Increased melatonin secretion	Sleepiness
 Flying in daylight	Detects bright light	Decreased melatonin secretion	Wakefulness

ISBN 978-1-009-25416-8

Check-in questions – Set 1

1 What are a circadian rhythm and an ultradian rhythm?
2 What is the role of the suprachiasmatic nucleus in the sleep-wake cycle?
3 What is the name of the hormone that induces sleepiness and decreases cell activity in the body?

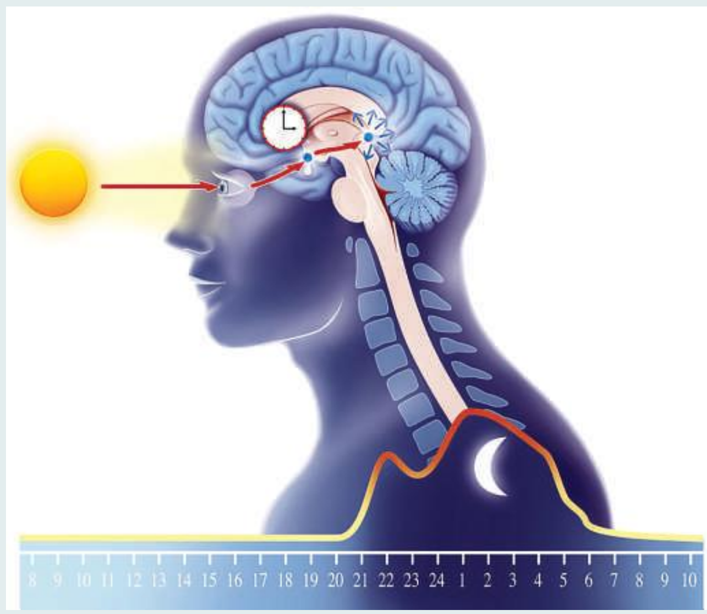
DOCUMENT 7C–1 REGULATION OF THE SLEEP–WAKE CYCLE

ACTIVITY 7C–1 REGULATION OF THE SLEEP–WAKE CYCLE

Access a copy of the diagram in the Interactive Textbook, or redraw it including the main features.

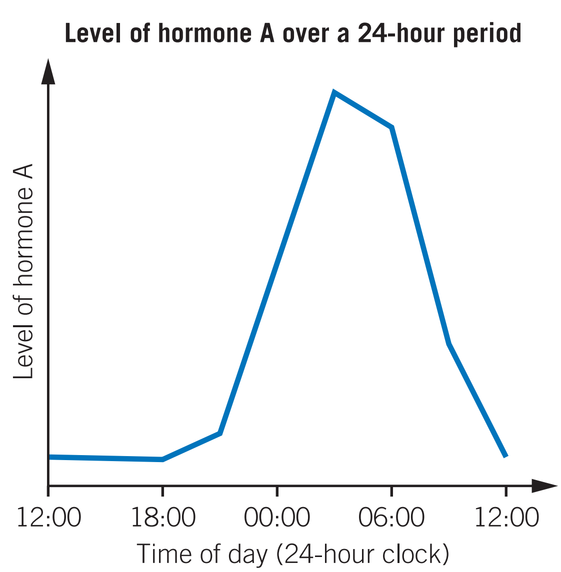
Label and annotate the diagram to explain the circadian rhythm regulation of the sleep–wake cycle, referring to the following key terms:

- suprachiasmatic nucleus
- light
- melatonin
- pineal gland.



Section 7C questions

1 Identify an example of a sleep-related biological process that follows a circadian rhythm and a process that follows an ultradian rhythm.
2 Explain the interaction between the role of the suprachiasmatic nucleus and melatonin in the regulation of a person's sleep–wake patterns.
3 Explain why dark lighting conditions are ideal for sleep.
4 The graph to the right demonstrates some recordings for a patient in a sleep study over a 24-hour period. Identify hormone A, and provide a reason for the shape of the curve.



ISBN 978-1-009-25416-8 Gallagher et al

7D Sleep across the life span

Study Design:
Differences in, and explanations for, the demands for sleep across the life span, with reference to total amount of sleep and changes in a typical pattern of sleep (proportion of REM and NREM)

Glossary:
Life span

ENGAGE

Tracking sleep through smart technology

Smart technology is enabling people to use simple affordable devices to collect data about their own sleep. Wearable technology including bracelets, watches and headbands can record a person's sounds, movement, heart rate and breathing rate during sleep, which can indicate sleep patterns and proportions of types of sleep. Smartphone apps allow immediate and easy access to this data.

Figure 7D–1 Smart devices can monitor your sleep.

A benefit of using smart technology is that it can collect data without interrupting your sleep. Many devices now can also determine the best time frame for waking you by identifying when you are in light sleep, rather than waking you at a set time when you might be in the deepest stage of sleep.

One study by technology giant Garmin tested the accuracy of wearable devices to estimate sleep stages. The study found that actigraphy (a method of measuring levels of rest and activity) and optical heart rate sensors can estimate sleep stages of users to nearly 70% accuracy.

These devices provide an opportunity for users to learn about their sleep and help them develop good habits around sleep hygiene, ultimately improving sleep and wellbeing.

EXPLAIN

Sleep across the life span

There is no one theory that alone can describe a single primary function of sleep. Instead, it is accepted that several theories provide different explanations for our need to sleep. Research has determined that sleep is necessary for repair and restoration of the body and mind, including repairing tissues, replenishing neurotransmitters and removing waste products. Sleep serves an adaptive function by giving us time to conserve energy and remain safe during times of potential danger, such as night-time for humans. Additionally, sleep allows for information acquired throughout the day to be processed and consolidated, aiding in memory and preparing us for the new day to come.

ISBN 978-1-009-25416-8 Gallagher et al

The need for sleep and the patterns of sleep change as a person ages. Sleep also varies among individual people because of a wide range of biological, psychological or social reasons. As a person ages through the **life span**, their need for, and experience of, sleep changes in the following ways:

- The total amount of sleep decreases.
- The proportion of REM sleep decreases significantly from birth until 2 years old.
- The amount of N3 sleep decreases, replaced mostly by N2 sleep.
- A circadian phase delay occurs during adolescence (preference for going to sleep later).
- After adolescence, a shift to a circadian phase advance occurs (preference for going to sleep earlier).
- Awakenings during sleep increase from adulthood to old age.
- Sleep efficiency (the percentage of the time in bed that is spent asleep) reduces.

Figure 7D–2 There are many changes in the patterns of sleep across different ages of the life span.

Life span the period of time a person is alive

Table 7D–1 outlines changes in the circadian rhythm over the life span.

Table 7D–1 Outline of circadian rhythm changes across the life span

Newborn	Infant	Adolescent	Adult	Older adult
				
Newborns do not have an established circadian rhythm. Their sleeping patterns are erratic, with their sleep distributed across the full 24-hour day.	From about 4 months, an infant's sleep becomes more nocturnal. As they continue to develop and experience rapid physiological changes, children begin to have a fairly consistent circadian rhythm.	Adolescents experience a shift in their circadian rhythm; they may not feel tired until later in the evening. This can result in a delayed sleep phase syndrome.	After adolescence, the circadian rhythm returns to more normal timing, and most healthy adults experience a consistent circadian rhythm if they are following a regular routine with relatively stable bedtimes and wake times.	Older adults may prefer an earlier bedtime and therefore an earlier waking in the morning.

LINK 7C INTERNAL BIOLOGICAL MECHANISMS THAT REGULATE SLEEP–WAKE PATTERNS

LINK 8B CIRCADIAN RHYTHM SLEEP DISORDERS

ISBN 978-1-009-25416-8 Gallagher et al

7A SLEEP AS A NATURALLY OCCURRING ALTERED STATE OF CONSCIOUSNESS LINK

While the ideal amount of sleep may vary among different people of the same age, sleep recommendations for each age group can help us achieve healthy sleep behaviours and reduce problems associated with sleep deprivation. The Australian Government Department of Health has produced the 24-Hour Movement Guidelines, which specify the recommended hours of sleep for different age groups across the life span. Research has also found differences in the approximate REM and NREM proportions for sleep at different age groups, although the reasons for these differences are sometimes unclear.

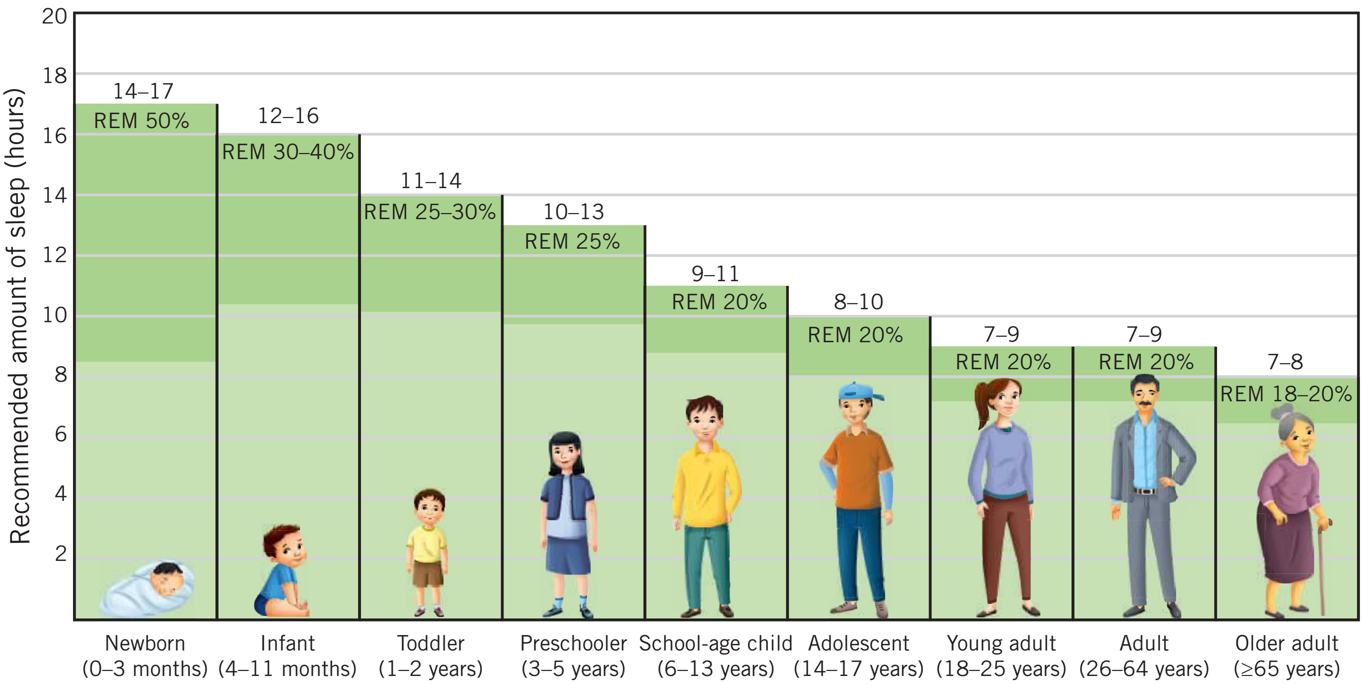
Table 7D–2 Differences in, and explanations for, sleep across a person's life span

Stage of life span and age	Total recommended hours of sleep and typical proportion of REM and NREM	Explanations for sleep patterns
Newborn 0–3 months 	14–17 hours REM 50% NREM 50%	Newborns require the highest amount of total sleep for rapid growth and development. Newborns experience the highest proportion of REM sleep, as REM sleep may boost brain growth and development, and help consolidate learning and memory. Muscle twitches that occur during periods of complete relaxation and immobility in REM sleep may help newborns develop their sensorimotor system, coordinating sensory experiences (e.g. seeing, hearing) with motor actions (e.g. reaching, touching).
Infant 4–11 months 	12–16 hours REM 30–40% NREM 60–70%	Infants begin to sleep for longer periods at a time as their circadian rhythm develops a more regular sleep pattern following day–night cycles.
Toddler 1–2 years 	11–14 hours REM 25–30% NREM 70–75%	By the time a person is a toddler, the proportion of REM sleep has had its greatest decline, and only decreases a small amount over the rest of the life span.
Preschooler 3–5 years 	10–13 hours REM 25% NREM 75%	During the preschool years, the timing of the circadian rhythm may advance, and sleep shifts to earlier in the evening as children begin to drop their daytime naps.
School-age children 6–13 years 	9–11 hours REM 20% NREM 80%	From the early to late childhood years, the timing of the circadian rhythm gradually delays, and sleep shifts to later in the evening.

ISBN 978-1-009-25416-8 Gallagher et al

Table 7D–2 *(Continued)*

Stage of life span and age	Total recommended hours of sleep and typical proportion of REM and NREM	Explanations for sleep patterns
Adolescent 14–17 years 	8–10 hours REM 20% NREM 80%	Adolescents experience a delay in the circadian rhythm because of a hormonally determined shift in melatonin release to 1–2 hours later than other age groups. This can cause a preference for a later bedtime, resulting in fewer hours of sleep than needed because of early waking for school. In this age group, increasing school-related requirements, increasing independence and easy access to constant entertainment and social networks also contribute to delayed bedtime. LINK 8B CIRCADIAN RHYTHM SLEEP DISORDERS
Young adult 18–25 years 	7–9 hours REM 20% NREM 80%	Sleep patterns in young adults can alter because of psychosocial factors such as tertiary study, work requirements, social schedules and increased independence. A circadian phase advance begins towards the end of this stage, resulting in a preference for earlier sleep time. Melatonin concentrations also begin to decline after puberty. LINK 7C INTERNAL BIOLOGICAL MECHANISMS THAT REGULATE SLEEP–WAKE PATTERNS
Adult 26–64 years 	7–9 hours REM 20% NREM 80%	Adult sleep patterns can alter as a result of lifestyle changes such as caring for infants and children, changing work and social requirements, development of health problems and changing family dynamics like balancing work with parenthood. Later in this stage, N3 sleep begins to decline and is replaced by N2 sleep. Melatonin concentrations continue to decline over adulthood.
Older adult ≥65 years 	7–8 hours REM 18–20% NREM 80–82%	Sleep patterns in older adults can alter because of lifestyle changes such as retirement, increased health issues including sleep disorders, physical inactivity, decreased social interactions, increased medication use, change of living arrangements and bereavement. A circadian phase advance occurs, and less sleep may be achieved if a person resists the body's preference for an earlier bedtime and earlier awakening. Amount of N3 sleep continues to decline and may not occur at all, replaced with N2 sleep. During older adulthood there is an increase in sleep latency (the time taken to fall asleep) and multiple awakenings occur. Melatonin concentrations continue to decline. The shorter total sleep in this stage may be due to the impaired ability to obtain sleep, rather than a reduced need for sleep.



PPS

Figure 7D–3 The recommended hours of sleep and typical proportions of REM and NREM sleep across the life span

VIDEO 7D–1 SKILLS: COMPARING KEY TERMS

WORKSHEET 7D–1 COMPARING SLEEP ACROSS THE LIFESPAN

WORKSHEET 7D–2 REM SLEEP DATA ANALYSIS

7D SKILLS

Comparing key concepts

The ability to compare key concepts is a skill required in VCE Psychology. A question may ask you to outline a difference or compare how two people or concepts differ. When providing a comparison, you must select one key point and describe how it is different for the two people or concepts.

Question:

Provide one difference between the sleep patterns of a newborn and an older adult. (2 marks)

Attempted answer:

A newborn experiences 50% of their total sleep in REM sleep. An older adult sleeps about 7 hours each night.

Marking comments:

Although this answer has correctly identified a feature of the sleep patterns of a newborn and an older adult, it has not provided a comparison between a newborn and an older adult, and would only receive 1/2 marks.

To correctly answer this question:

- First select one key difference point you know for the two stages of the life span, such as the proportion of REM sleep, or total amount of sleep, or timing of the sleep–wake cycle.
- Then describe this factor for each person to show how they differ.
- In between each description, use a contrast conjunction such as 'whereas', 'although', 'while', 'in comparison to', or 'however'.

Suggested answer for full marks:

A newborn experiences 50% of their total sleep in REM sleep, whereas an older adult experiences 20% of their total sleep in REM sleep.

ISBN 978-1-009-25416-8 Gallagher et al

7D KEY SCIENCE SKILLS

VIDEO 7D–3 KEY SCIENCE SKILLS: ANALYSING DATA

LINK 2A PROCESSING AND ANALYSING DATA

Analysing data qualitatively

Data collected from an investigation needs to be analysed in terms of its quality before any decisions can be made based on the data and the investigation concluded. Data can be analysed for accuracy, precision, repeatability, reproducibility, true value, validity, errors, certainty, outliers and contradictory or incomplete data.

In VCE Psychology, these analyses are done visually, and you are not required to do quantitative calculations.

The following investigation provides an example of how some of these analyses are considered.

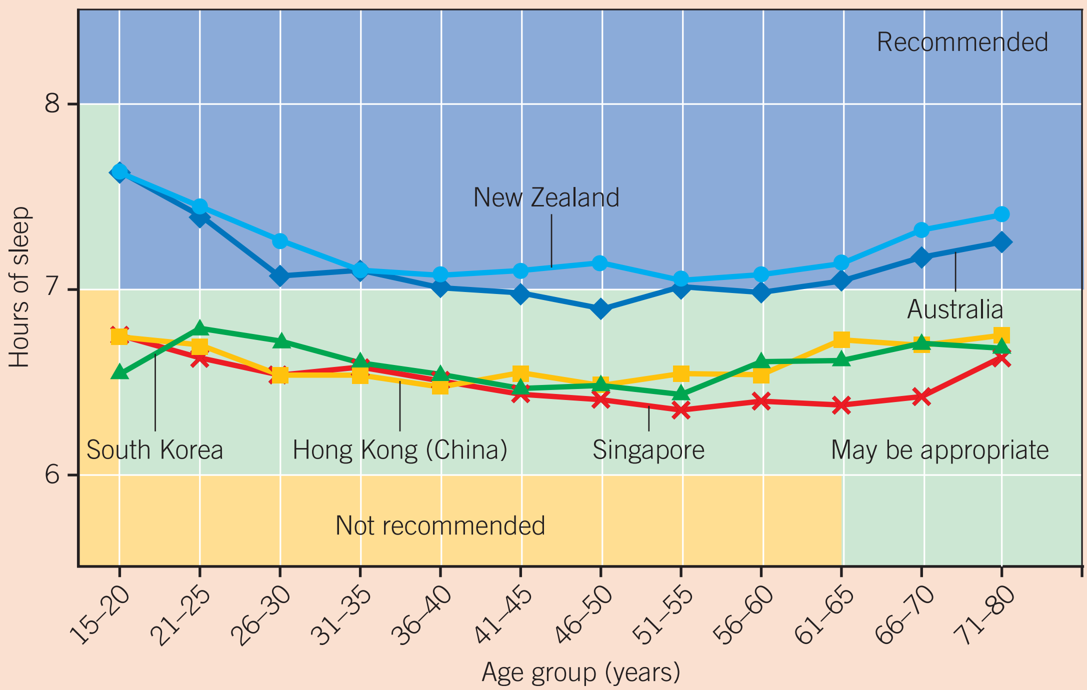
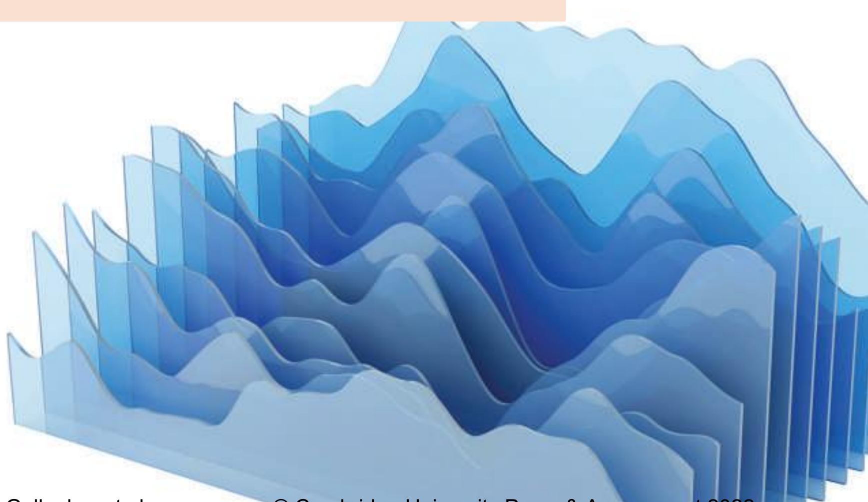


Figure 7D–4 Sleep duration by age group and country

A study analysed large-scale sleep data from smart watch users in five territories located within two geographical regions: Oceania (Australia and New Zealand) and East Asia (Singapore, Hong Kong (China) and South Korea). The results are graphed in Figure 7D–4 and the researchers' observations of data quality are shown in Table 7D–3 on the following page.



ISBN 978-1-009-25416-8 Gallagher et al

Table 7D–3 Data analysis for quality as applied to the data in the sleep duration study

Data quality aspect	Definition of data quality aspect	Observations of data quality in the research article	Explanation of the observation
Accuracy	How close a measurement is to the true value of the quantity being measured.	'Recent validation studies in adolescents and adults found that the fitness trackers showed high sensitivity for sleep detection (96–97%) when compared to gold-standard polysomnography measures.'	The fitness tracker's ability to detect sleep was compared with other valid methods of detecting sleep and they were found to be appropriately accurate.
External validity	Whether the results of the research can be applied to similar individuals in a different setting.	'A limitation concerns representativeness of the sample. Users who purchase wearables typically fall in the medium to high socio-economic range, and are generally concerned about their health.'	The participants in the sample may not be representative of the wider population in terms of their socio-economic status and concern about health, so the external validity may be low.
Internal validity	Whether a study investigates what it sets out or claims to investigate.	'Only major sleep periods were analysed, as the devices did not automatically detect sleep periods less than one hour'.	If the study claimed to measure total sleep across different regions, but the device was unable to detect short sleep periods such as naps, then the internal validity may be low.
Precision	How closely a set of measurement values agree with each other.	'Accuracies are likely to be lower for individuals with sleep disorders and those with a higher proportion of wake after sleep onset due to poorer specificity for wake detection in these devices.'	As the device poorly detects when an individual wakes up during sleep, the precision of an individual's multiple data values may not be high.
Repeatability	How close successive measurements are when they are carried out under the same conditions.	A specific brand of fitness tracker wristwatch was used in this study.	As this study used a specific brand of fitness tracker, if this study were to be repeated with this sample, it would need to ensure the same devices were being used to track sleep.
Reproducibility	How close measurements of the same quantity are when carried out under changed conditions.	'Bed and wake times were automatically determined based on movement data using a proprietary algorithm.'	If this study was repeated using a device that measures brain waves to determine sleep, and similar results were obtained, then the study would be deemed credible and replicable.
Errors	Systematic errors affect the accuracy of a measurement, by causing readings to differ from the true value by a consistent amount or by the same proportion each time a measurement is made.	'Recent validation studies in adolescents and adults found that the fitness trackers showed only slightly overestimated total sleep time by 8–9 min compared to gold-standard polysomnography measures.'	If the fitness trackers consistently recorded total sleep time as 8–9 min longer than the true value, then a systematic error may have occurred.
Outliers and contradictory or incomplete data	Outliers are values that lie a long way from other results.	'Users with less than ten weekday nights (Mon–Thu) and four weekend nights (Fri–Sat) [N = 4733] were excluded.'	The researchers removed data that was deemed as incomplete if the participant did not meet the minimum requirements for the number of nights recorded over the month.

Check-in questions – Set 1

1 Identify two expected changes in sleep patterns from birth until 2 years old.
2 What is the proportion of REM sleep for a newborn?
3 At what age does the proportion of REM sleep stabilise?
4 Identify two common features of sleep for older adults.

ACTIVITY 7D–1 LIFE SPAN TIMELINE

Create a life span timeline that includes the main life span stages from birth until old age. On your timeline, use key words, pictures, drawings or diagrams to identify:

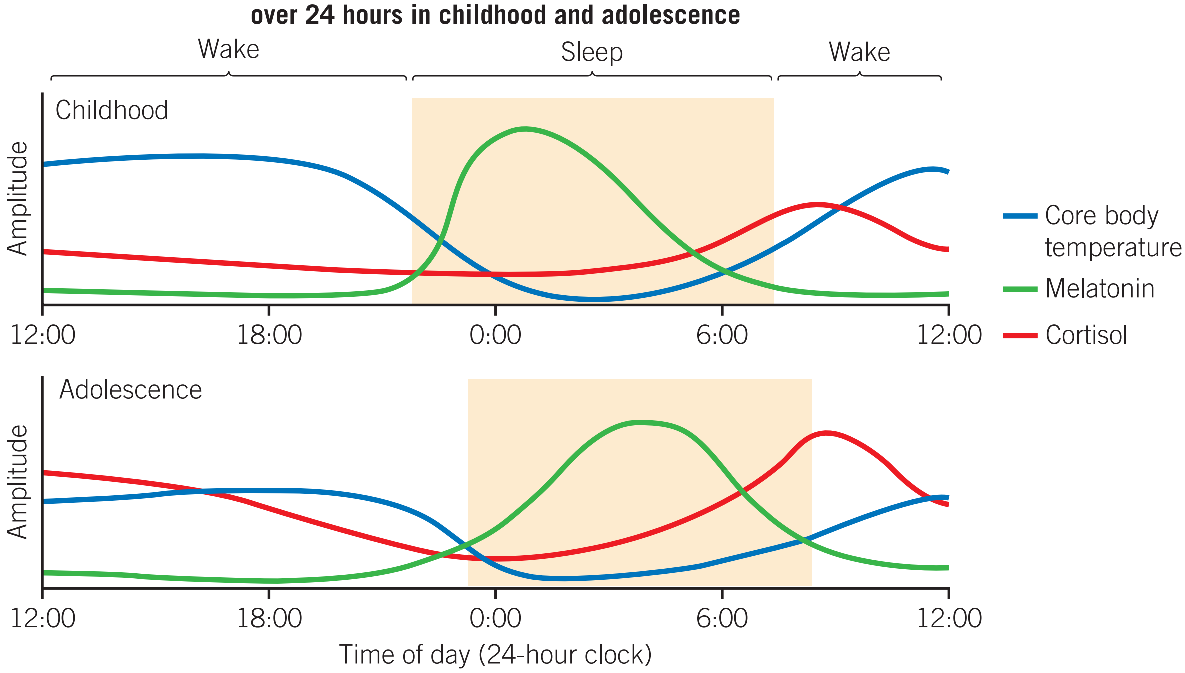
- the recommended amount of sleep for each stage
- some of the main factors that cause reduced sleep quality or quantity at different age groups
- some strategies that a person in the different life span stages could implement to achieve the best possible sleep.

Section 7D questions

1 Michael is 17 years old. He lives with his mother Angela, who is 47 years old, and his grandmother Phyllis, who is 70 years old.
   a Compare the recommended hours of sleep for Michael and Phyllis.
   b Which family member would likely experience the least amount of N3 deep sleep?
   c Identify one similarity in the sleep patterns for all three family members.
   d Identify the family member who is most likely to experience a phase delay in their sleep–wake cycle.

2 The following two graphs display some changes that occur in a typical sleep–wake cycle during childhood and adolescence. Compare the release of melatonin over these two stages of the life span and explain how this can account for the typical times that each age group prefers to sleep.

Amplitude of temperature, melatonin and cortisol levels over 24 hours in childhood and adolescence

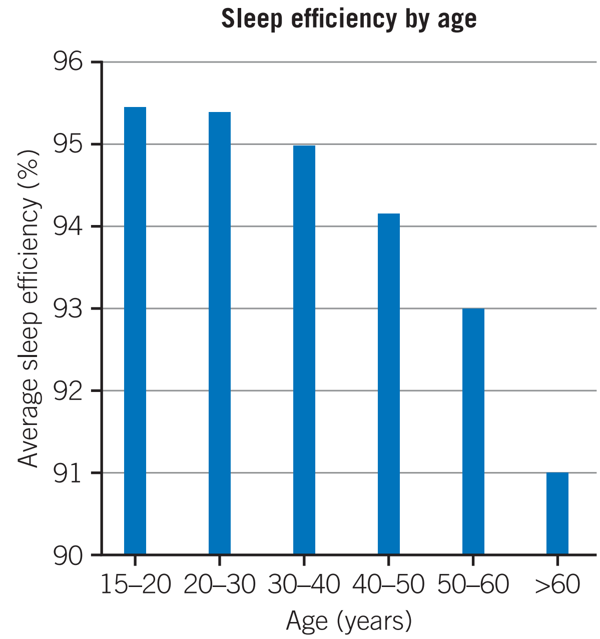


ISBN 978-1-009-25416-8 Gallagher et al

3 Provide two reasons for an older person to achieve less sleep than other age groups.

4 Identify the proportion of sleep that a newborn will spend in REM sleep and provide a reason for this.

5 A US company is interested in improving athletic performance. They collected sleep data on one million athletes, including the athletes' sleep efficiency. They mapped sleep efficiency according to age, and found a gradual decline in sleep efficiency as people get older.



   a Describe the external validity of this data by stating whether the company's results on sleep efficiency and age could be applied to the overall general US population of athletes.
   b The company is based in the United States but is interested in reaching a more global market. In order to provide their Australian customers with accurate and relevant information, they need to collect more data on Australian participants. Describe whether this situation demonstrates repeatability or reproducibility, and what results the company would be hoping to find.

6 Two brothers Sam (aged 10) and Paolo (aged 15) have both reported sleep troubles and their parents organise for an at-home sleep study to be conducted over two nights.
   a One device used to measure features of their sleep was an EEG.
   The electroencephalography indicated that Paolo fell asleep at 10.34 p.m., but in his self-report sleep diary, Paolo said he fell asleep at 10.25 p.m. Describe the accuracy of each measure used to determine Paolo's sleep onset time.
   b Upon waking after the second night of the study, Sam noticed that one of the EEG electrode wires had fallen off and was no longer connected. When his results were shown to him later, his total sleep time showed only 3 hours of sleep, despite his sleep diary entry and the previous night's EEG recording noting he slept the recommended amount of hours for his age. Identify and describe the type of error that has occurred during Sam's data collection.
   c Determine whether this recording would be considered an outlier if it was included among the rest of Sam's data.
   d Describe how the EEG electrode wires falling off would affect the precision of Sam's two nights of sleep recordings and explain why this would be problematic.

ISBN 978-1-009-25416-8 Gallagher et al

Chapter 7 review

Summary

Create your own set of summary notes for this chapter on paper or in a digital document. A model summary is provided in the Teacher Resources, which can be used to compare with yours.

Checklist

In the Interactive Textbook, the success criteria are linked from the review questions and will be automatically ticked when answers are correct. Alternatively, print or photocopy this page and tick the boxes when you have answered the corresponding questions correctly.

Success criteria – I am now able to:		Linked question
7A.1	Compare and contrast the features of normal waking consciousness and altered states of consciousness	9a☐
7A.2	Describe the features of sleep as a naturally occurring altered state of consciousness	1☐
7A.3	Describe and compare the features of REM and NREM sleep	5☐, 8☐
7B.1	Describe the use of electroencephalography (EEG), electromyography (EMG), and electro-oculography (EOG) in measuring the physiological responses associated with sleep	9b☐, 11☐
7B.2	Describe the use of sleep diaries and video monitoring in measuring sleep	11☐
7B.3	Determine an appropriate technique for measuring sleep in different situations	11☐
7C.1	Explain the role of circadian rhythms in regulating sleep–wake patterns	12☐
7C.2	Explain the role of the suprachiasmatic nucleus and melatonin in regulating sleep–wake patterns	3☐, 10☐
7C.3	Explain the interaction of internal biological mechanisms that regulate sleep–wake patterns	10☐
7C.4	Explain the role of ultradian rhythms in regulating sleep–wake patterns of REM and NREM Stages 1–3 sleep	2☐, 14b☐
7D.1	Provide differences in the total amount of sleep required for different ages across the life span	4☐, 13☐, 14a☐
7D.2	Provide differences in the typical pattern of sleep as highlighted by the proportion of REM and NREM sleep experienced in different ages across the life span	2☐, 14a☐
7D.3	Explain reasons for the differences in the total amount of sleep required for different ages across the life span	6☐, 13☐, 15b☐
7D.4	Explain reasons for the typical pattern of sleep as highlighted by the proportion of REM and NREM sleep experienced for different ages across the life span	14a☐
7D.5	Apply my understanding of the differences in sleep experienced across the life span to real-world examples	8☐, 15b☐

ISBN 978-1-009-25416-8

Key Science Skills

Skills	Questions and Skills boxes
Process quantitative data using appropriate mathematical relationships and units, including calculations of percentages, percentage change and measures of central tendency (mean, median, mode), and demonstrate an understanding of standard deviation as a measure of variability	7D Key Science Skills 7D Section questions – 5a, b Chapter review – 15a, b, c
Identify and analyse experimental data qualitatively, applying where appropriate concepts of: accuracy, precision, repeatability, reproducibility and validity; errors; and certainty in data, including effects of sample size on the quality of data obtained	7D Key Science Skills 7D Section questions – 5a, b 6a, b, d Chapter review – 7, 15d
Identify outliers and contradictory or incomplete data	7D Key Science Skills 7D Section questions – 6c Chapter review – 15c

Multiple-choice questions

1 What is a situation that would be considered a naturally occurring altered state of consciousness?
- **A** drug-induced state
- **B** dreaming while asleep
- **C** participating in meditation
- **D** experiencing hypnosis

2 Clare is 5 years old. What would be her likely pattern of sleep?
- **A** Clare's sleep would include five cycles and would begin with N1.
- **B** Clare's sleep would begin with a period of REM and last around 10 hours.
- **C** Clare's sleep would have an equal proportion of REM and NREM.
- **D** Clare's sleep would include more NREM than REM and would begin with a period of REM.

3 Which environmental cue is most likely to influence the functioning of the suprachiasmatic nucleus?
- **A** light from a mobile phone
- **B** eating a dinner of roast beef and vegetables
- **C** talking on the phone
- **D** playing three games of table tennis

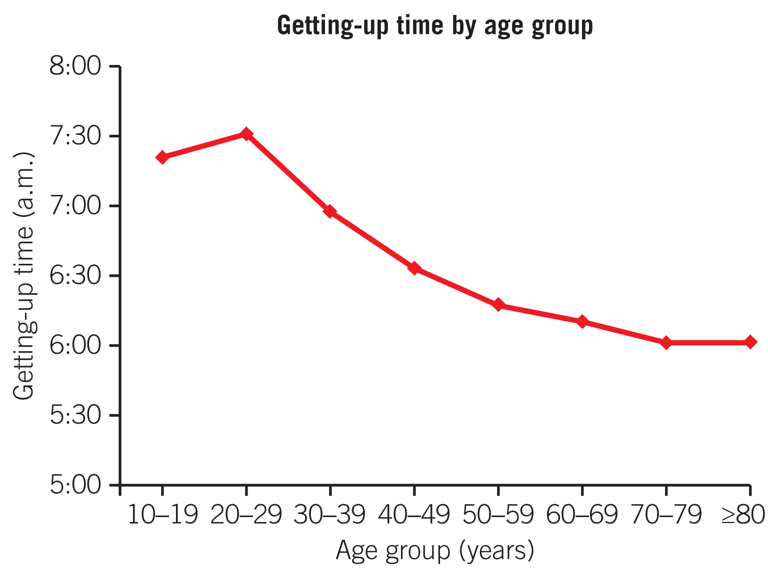
4 Regina is 15 years old and her sister Ingrid is 3 years old. Which of the following would be most correct for their expected sleeping patterns?
- **A** Ingrid experiences fewer hours of NREM sleep than Regina.
- **B** Regina needs less NREM Stage 2 (N2) and sleeps longer than Ingrid.
- **C** Ingrid needs about 12 hours of sleep whereas Regina needs around 9 hours of sleep each night.
- **D** Regina needs about 8 hours of sleep and experiences more REM, whereas Ingrid needs about 13 hours of sleep and experiences less REM.

ISBN 978-1-009-25416-8 Gallagher et al

5 Which of the following would not be expected for REM sleep?
A REM sleep is when the most vivid and memorable dreams occur.
B More REM sleep occurs in the second half of the night than the first half of the night.
C During REM sleep, voluntary muscles appear to be paralysed.
D Periods of REM get shorter as the night progresses

The following information relates to Questions 6 and 7.

A study collated data on the time people get out of bed across different ages of the life span. Each morning, participants used a sleep diary to record the time they got out of bed. This data is displayed in the following graph.



6 Which of the following does not provide an explanation for the data shown in the graph?
A The later get-up time for the 20s age group can be explained by a preference for later bedtimes at this age.
B There is a tendency for later get-up times as we age over the life span.
C There is minimal change in get-up times as a person progresses from their 70s to their 80s.
D A tendency to wake up earlier in the 30s than in the 20s age group may be due to increased responsibilities such as parenthood.

7 The researchers were uncertain whether the results for people in their 20s were accurate, so they decided to collect more data for this age group. The new data they gathered displayed a similar feature of a delayed get-up time compared to other age groups, as was found in the initial data collection period. What does this information suggest about the study?
A The study displayed good repeatability by gathering more data that was consistent with the initial findings.
B The study displayed poor reproducibility because the data for the other age groups was found to not be consistent with the data from the 20s age group.
C The study has poor internal validity because it was not measuring what was intended by the researchers.
D The study was found to have poor precision and accuracy because the new data was similar to the initial data collected.

ISBN 978-1-009-25416-8 Gallagher et al

8 18-year-old Clark went to a party on Saturday night and was out quite late. He had to get up early for basketball training in the morning, so he only slept for a few hours. What might Clark notice when he goes to basketball training?

- **A** Clark will be very clumsy and will not catch passes from his teammates, due to receiving a lack of REM sleep.
- **B** Clark may find it difficult to make quick decisions about who to pass the ball to, due to receiving a lack of REM sleep.
- **C** Clark may find he performs better at training than he usually does, due to receiving the required amount of NREM sleep.
- **D** Clark will forget his teammates' names, due to a lack of NREM sleep.

Short-answer questions

9 Quinn is in detention completing some homework. His attention is shifting between completing the work and daydreaming about being allowed to go home.

- **a** Identify the state of consciousness that Quinn is experiencing when he is paying attention to completing homework, and his state of consciousness when he is daydreaming. (2 marks)
- **b** Quinn briefly falls asleep at his desk. Describe the difference between the recordings an electroencephalography would show while Quinn is asleep compared to when Quinn is awake and completing his homework. (2 marks)

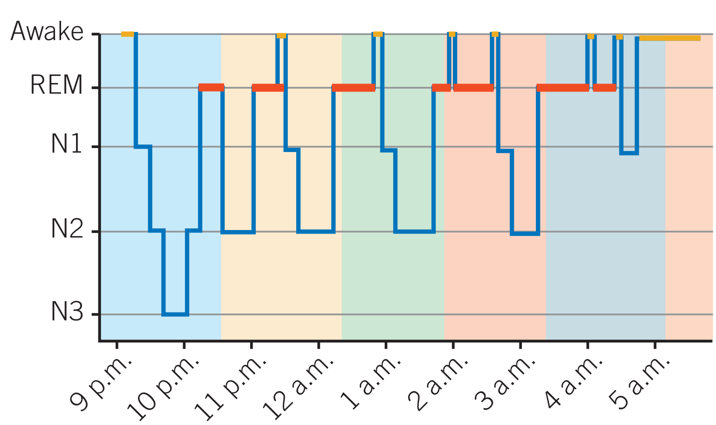
10 Explain how the suprachiasmatic nucleus and melatonin work to regulate the sleep–wake cycle. (4 marks)

11 Describe how electro-oculography would be more useful than video monitoring to detect the types and stages of sleep during one sleep cycle. (3 marks)

12 Explain the importance of light in regulating the circadian rhythm. (3 marks)

13 Describe the trend in the recommended hours of sleep as a person ages, and provide a reason for this trend. (3 marks)

14 The following hypnogram displays the sleep patterns of a person over one night of sleep.



- **a** Identify the stage of the life span this person is likely to be in and justify your answer by providing three pieces of evidence. (4 marks)
- **b** Justify whether this hypnogram is displaying data of a circadian rhythm or ultradian rhythms. (3 marks)

ISBN 978-1-009-25416-8 Gallagher et al

15 A study collected data on sleep across different ages of the life span. The following table displays this data for two age groups.

Age (years)	Number of participants	Mean total sleep time (minutes)	Total sleep time standard deviation (minutes)	Sleep efficiency (percentage of time in bed spent asleep)
10–19	1314	663.4	7.3	94%
80–89	13 806	444.7	1.4	88%

a Provide an interpretation for the standard deviations for each age group. (2 marks)

b Describe the percentage change experienced in sleep efficiency over the life span, and provide a reason for this change. (2 marks)

c With reference to outliers, explain whether the mean total sleep time is an appropriate measure of central tendency for these two age groups. (3 marks)

d The researchers needed to remove one participant's data from the results because the sleep-recording device malfunctioned and consistently recorded the participant's sleep onset 45 minutes later than actually occurred.
Explain how one type of error is affecting the internal validity of the sleep onset measurement for this participant. (3 marks)

ISBN 978-1-009-25416-8 Gallagher et al

UNIT 4 HOW IS MENTAL WELLBEING SUPPORTED AND MAINTAINED?

CHAPTER 8 IMPORTANCE OF SLEEP TO MENTAL WELLBEING

Introduction

Sleep is a complex process and researchers are still discovering its exact mechanism and purpose. Some people feel that sleeping is ‘wasted’ time and they do not make it a priority. However, research has consistently shown that we need the right amount of sleep. It has generally been accepted that there is not just one explanation for sleep, but that sleep has many functions and is necessary for many biological reasons, including energy conservation, repair and restoration of cells, hormone regulation, memory consolidation and physical growth. This myriad of purposes shows that spending a third of our day asleep is time well spent for our health and mental wellbeing.

Chapter 7 discussed the mechanics of REM and NREM sleep and the ways that sleep changes across the life span. This chapter delves into what occurs when we do not meet those sleep recommendations, when we experience sleep deprivation and sleep disorders, and explores ways that we can improve our sleep–wake patterns and mental wellbeing.

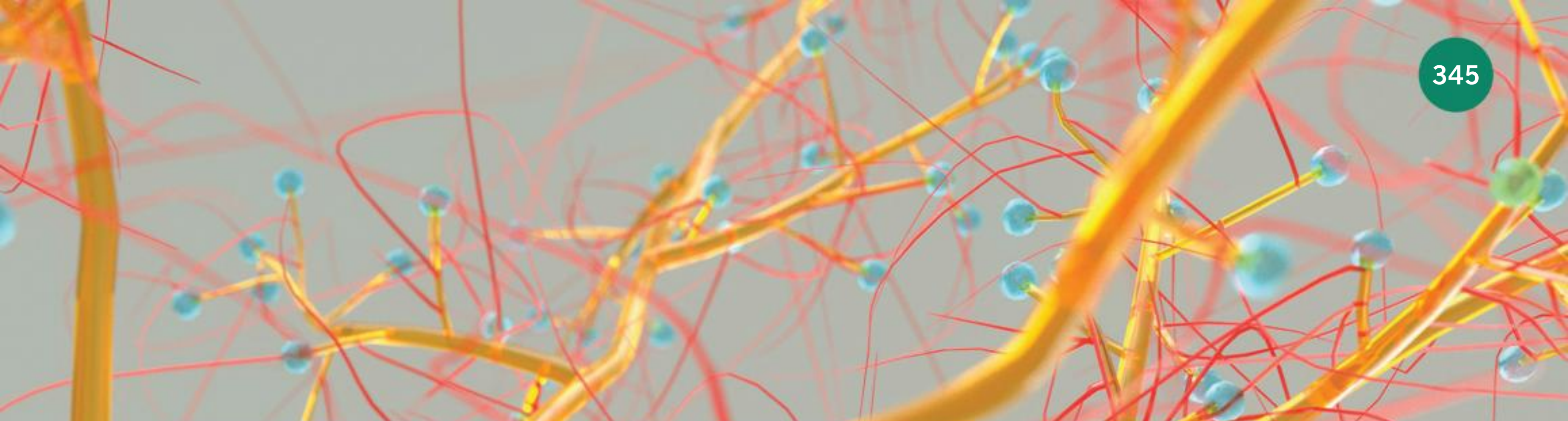
Curriculum

Area of Study 1

How does sleep affect mental processes and behaviour?

Study Design:	Learning intentions – at the end of this chapter I will be able to:
• The effects of partial sleep deprivation (inadequate sleep either in quantity or quality) on a person’s affective, behavioural and cognitive functioning, and the affective and cognitive effects of one night of full sleep deprivation as a comparison to blood alcohol concentration readings of 0.05 and 0.10	**8A The effects of partial sleep deprivation** **8A.1** Define ‘partial sleep deprivation’ in terms of inadequate quantity or quality of sleep **8A.2** Describe the effects of partial sleep deprivation on a person’s affective, behavioural and cognitive functioning **8A.3** Explain and compare the affective and cognitive effects of a full night’s sleep deprivation to those of blood alcohol concentration readings of 0.05 and 0.10 **8A.4** Apply my understanding of sleep deprivation to real-world examples

ISBN 978-1-009-25416-8



Study Design:	Learning intentions – at the end of this chapter I will be able to:
• Changes to a person's sleep-wake cycle that cause circadian rhythm sleep disorders (Delayed Sleep Phase Syndrome (DSPS), Advanced Sleep Phase Disorder (ASPD) and shift work) and the treatments of circadian rhythm sleep disorders through bright light therapy	**8B Circadian rhythm sleep disorders** **8B.1** Describe the features of a circadian rhythm sleep disorder **8B.2** Describe the changes to a person's sleep–wake cycle due to Delayed Sleep Phase Syndrome, Advanced Sleep Phase Disorder and shift work circadian rhythm sleep disorder **8B.3** Describe the consequences and effects of Delayed Sleep Phase Syndrome, Advanced Sleep Phase Disorder and shift work **8B.4** Explain how circadian rhythm sleep disorders can be treated through bright light therapy **8B.5** Apply my understanding of circadian rhythm sleep disorders to real-world examples
• Improving sleep hygiene and adaptation to zeitgebers to improve sleep–wake patterns and mental wellbeing, with reference to daylight and blue light, temperature, and eating and drinking patterns	**8C Improving sleep–wake patterns and mental wellbeing** **8C.1** Describe effective sleep hygiene measures to improve sleep–wake patterns and mental wellbeing **8C.2** Describe the influence of the zeitgebers of daylight, blue light, temperature, and eating and drinking patterns on sleep–wake patterns **8C.3** Describe how the adaptation to zeitgebers of daylight, blue light, temperature, eating and drinking patterns can improve sleep–wake patterns and mental wellbeing **8C.4** Apply my understanding of the influence of zeitgebers on sleep–wake patterns and mental wellbeing to real-world examples

Key Science Skills

- Repeat experiments to ensure findings are robust
- Evaluate investigation methods and possible sources of error or uncertainty, and suggest improvements to increase validity and to reduce uncertainty

Glossary

Advanced Sleep Phase Disorder (ASPD)
Affective functioning
Behavioural functioning
Blood alcohol concentration (BAC)
Blue light
Bright light therapy
Circadian rhythm sleep disorders
Cognitive functioning
Daylight
Delayed Sleep Phase Syndrome (DSPS)
Partial sleep deprivation
Shift work
Sleep hygiene
Zeitgebers

ISBN 978-1-009-25416-8 Gallagher et al

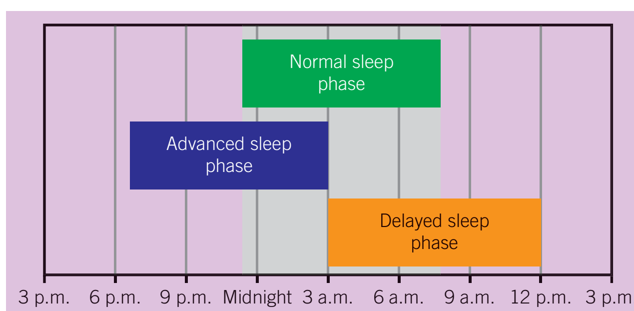
Concept map

How sleep deprivation affects a person's affective, behavioural and cognitive functioning, with comparison to blood alcohol concentration readings

8A The effects of partial sleep deprivation

Changes to the sleep–wake cycle due to circadian rhythm disorders

8B Circadian rhythm sleep disorders



Improving sleep–wake patterns and mental wellbeing through sleep hygiene and adaptation to the zeitgebers of light, temperate and eating and drinking patterns

8C Improving sleep–wake patterns and mental wellbeing

See the Interactive Textbook for an interactive version of this concept map interlinked with all concept maps for the course.

ISBN 978-1-009-25416-8 Gallagher et al

8A The effects of partial sleep deprivation

Study Design:
The effects of partial sleep deprivation (inadequate sleep either in quantity or quality) on a person's affective, behavioural and cognitive functioning, and the affective and cognitive effects of one night of full sleep deprivation as a comparison to blood alcohol concentration readings of 0.05 and 0.10

Glossary:
Affective functioning
Behavioural functioning
Blood alcohol concentration (BAC)
Cognitive functioning
Partial sleep deprivation

ENGAGE

Sleeping in on the weekend doesn't counter sleep deprivation accumulated during the week

The effects of sleep deprivation on different bodily mechanisms are well documented. They include disrupted regulation of energy intake and altered circadian rhythm timing. Many people sleep in on the weekend to help replenish the sleep they lost throughout the week because of school, work or social commitments. But does sleeping in on the weekend really help to reduce the effects of sleep deprivation experienced during the week?

Figure 8A–1 Sleep deprivation has many effects on the body and may result from school or work commitments.

A recent study aimed to investigate how self-selected weekend recovery sleep (i.e. sleeping in) following insufficient sleep during the week affected various bodily mechanisms, including circadian timing, energy intake, body weight and insulin sensitivity.

Participants were randomly assigned to one of three groups:

- a control condition (9-hour sleep)
- sleep restriction without weekend recovery sleep (5-hour sleep)
- sleep restriction with weekend recovery sleep (insufficient sleep for 5-day work week, then 2 days of weekend recovery, then 2 nights of insufficient sleep).

Results showed that participants in the third condition slept an extra 1.1 hours during weekend recovery compared to the baseline. Participants tended to eat more snacks after dinner, body weight increased, insulin sensitivity was reduced, and the timing of the internal circadian clock was delayed during the second period of insufficient sleep after the weekend recovery sleep.

These findings suggest that benefits of weekend recovery sleep are predominantly short term and that weekend recovery sleep is not an effective strategy to prevent metabolic dysregulation that is associated with recurrent insufficient sleep.

Figure 8A–2 Sleeping in at the weekend does not necessarily help to reduce the effects of sleep deprivation during the week.

ISBN 978-1-009-25416-8 Gallagher et al

EXPLAIN

Effects of partial sleep deprivation on functioning

If sleep is thought to repair our body and mind, consolidate information and provide time to conserve energy, it makes sense that a lack of sleep reduces the opportunities for these processes to take place, and a lack of sleep will therefore be detrimental to our daily functioning.

Partial sleep deprivation the experience of achieving inadequate sleep in terms of quantity or quality

Partial sleep deprivation is the experience of achieving inadequate sleep in terms of quantity or quality. Sleep quantity refers to the duration of sleep, or the number of hours you sleep. Sleep quality refers to how well you sleep, such as whether you were woken up in the night or how deep and restful your sleep is. You need to consider both of these factors because even though you may be getting enough total hours of sleep for your age, your sleep may be disrupted, resulting in poor-quality sleep.

Many factors contribute to sleep deprivation (Figure 8A–3). These factors vary from person to person and include:

- consuming caffeine, food, drugs or alcohol
- work or school requirements
- failing to wind down before bed
- stress
- medical conditions
- an uncomfortable sleeping environment
- social influences.

Figure 8A–3 Some examples of contributors to sleep deprivation

Sleep deprivation can have many negative effects on a person's affective, behavioural and cognitive functioning. These three areas of functioning also interact. For example, poor concentration (cognitive) may lead to increased clumsiness (behavioural), which may lead to increased frustration (affective).

ISBN 978-1-009-25416-8 Gallagher et al

Affective functioning refers to a person's experience of their emotions. When sleep deprived, you may have trouble regulating or controlling your emotions. You may experience mood swings or emotional outbursts, feel sad or depressed, be more irritable or cry for no apparent reason. For example, when very sleep deprived, you may get overly annoyed when your parent asks you to do a regular household chore.

Behavioural functioning refers to a person's observable actions. When sleep deprived, you may have trouble controlling your behaviour, participate in more risk-taking or impulsive behaviour, take longer to finish tasks, have reduced productivity and work efficiency, be reluctant to get out of bed in the morning or be more accident prone. Children may show hyperactive behaviour and increased misbehaviour. For example, a child who is sleep deprived may have trouble following rules in class and may show more 'naughty' behaviour.

Affective functioning a person's experience of their emotions

Behavioural functioning a person's observable actions

Figure 8A–4 When a person does not receive enough good-quality sleep, they experience partial sleep deprivation, which affects how they function.

Figure 8A–5 Affective functioning is how you experience your emotions, and may be impaired by sleep deprivation.

Cognitive functioning refers to a person's mental processing. When sleep deprived, you may experience with these cognitive functioning issues:

- trouble with memory
- decreased alertness
- poor concentration
- impaired problem solving, decision making
- poor judgement
- lack of motivation
- trouble coping with change or stress
- difficulty learning new concepts
- slower thinking
- a shortened attention span.

For example, if you are sleep deprived, you may have difficulty concentrating and remembering theory when completing a Maths test at school.

Cognitive functioning a person's mental processing

Figure 8A–6 Sleep-deprived people may have trouble controlling their behaviour.

Figure 8A–7 Sleep deprivation can impair your cognitive functioning – your mental processing.

ISBN 978-1-009-25416-8 Gallagher et al

WORKSHEET 8A–1 USING CAFFEINE TO FIGHT SLEEP DEPRIVATION

Blood alcohol concentration (BAC) the percentage of alcohol in the bloodstream

Comparing sleep deprivation and blood alcohol concentration

The detrimental effects of alcohol on the brain and body are well documented. Research in this area has guided governments and state transport departments to make laws for the **blood alcohol concentration (BAC)** (the percentage of alcohol in the bloodstream) allowed when driving cars and other motor vehicles. This ensures people are in a safe condition to drive. In Victoria, the legal BAC for driving a car is under 0.05%. It has been determined that a BAC level above this limit has negative and detrimental effects on a person's functioning, including their affective (emotional regulation) and cognitive (mental processing) functioning. These negative effects increase as BAC increases.

Figure 8A–8 The negative effects of 17 hours of sleep deprivation on a person's cognition, concentration and mood are equivalent to the effects of a blood alcohol concentration (BAC) of 0.05%.

A study found similarities between the effects of alcohol intoxication and the effects of sleep deprivation (Figure 8A–8). The study concluded that the effects of 17 hours of sustained wakefulness (meaning that a person has been awake for 17 hours; for example, from 7 a.m. until midnight) are equivalent to the effects of a BAC of 0.05%.

Additionally, the effects of 24 hours of sustained wakefulness (for example, being awake from 7 a.m. Saturday until 7 a.m. Sunday) are equivalent to the effects of a BAC of 0.10%, which is above the legal BAC limit for driving in Australia.

These conclusions have been supported by a subsequent study showing that after sustained wakefulness of 17–19 hours, performance levels were so low that many countries would consider them to be incompatible with safe driving.

The study found that the detrimental effects on cognitive functioning include poorer concentration, attention, decision making and problem-solving ability. The effects on affective functioning include poorer emotional regulation, increased irritability and emotional outbursts.

ISBN 978-1-009-25416-8

The results of these studies indicate the importance of community understanding of the dangers of driving while sleep deprived, which in many places is not as widely promoted as the dangers of driving while intoxicated, despite their similar effects to cognitive and affective functioning.

In particular, sustained wakefulness for longer than 17 hours is of concern because the effects of these longer periods of sleep deprivation are deemed to be worse than those of the legal BAC limit of 0.05% for driving in Australia.

Figure 8A–9 Studies looking at the effects of sleep deprivation have concluded that there is a need to increase public awareness about the dangers of driving while sleep deprived.

Check-in questions – Set 1

1 What is partial sleep deprivation?
2 Identify one example of a change to affective, behavioural and cognitive functioning due to partial sleep deprivation.
3 State two facts that compare the effects of BAC and sleep deprivation.

8A SKILLS

VIDEO 8A–1 SKILLS: THE RIGHT NUMBER OF ANSWERS REQUIRED

Providing the right number of answers

In the VCE Psychology exam, a question may ask for a certain number of responses when there are multiple possible answers. If a question specifies a certain number of answers, then only this many answers can be considered for marks.

Question:

Describe how sleep deprivation could affect one type of functioning during a driver's licence test. (2 marks)

Attempted answer:

Sleep deprivation can result in decreased emotional functioning and a distorted cognitive functioning such as decreased concentration.

Marking comments:

The question asks for one type of functioning, but the attempted response includes two answers. So only the first type will be marked. In this case, the response would receive 0 marks out of 2 marks, because the first part of the answer stating 'decreased emotional function' uses incorrect language. The second part of the answer is correct, but it cannot be considered.

Suggested answer:

Sleep deprivation can result in a distortion of cognitive functioning, such as an inability to concentrate, which would make it hard for a person to maintain their focus on all the rules they need to follow during the driving test.

ISBN 978-1-009-25416-8 Gallagher et al

DOCUMENT 8A–1 EFFECTS OF PARTIAL SLEEP DEPRIVATION

ACTIVITY 8A–1 THE EFFECTS OF PARTIAL SLEEP DEPRIVATION

Identify whether the following scenarios are examples of affective, behavioural or cognitive functioning, and determine whether they could be an example of someone who is sleep deprived. Construct a table with the following column headings and nine rows, and insert the scenarios below in the first column. Or use the blank table provided in the Interactive Textbook.

Scenario	Type of functioning (Tick one)			Example of partial sleep deprivation? (Yes/No)
	Affective	Behavioural	Cognitive	

- Johnny is always on time to work.
- Kennedy feels angry at his younger brother for taking and returning his phone charger from his room.
- Boris didn't remember to call his grandma for her birthday.
- Patty is playing basketball and yells at the referee's incorrect decision.
- Constanza worked out a disagreement with a friend while remaining calm and rational.
- Sarah keeps skipping the first period of the school day.
- Marcello arrives at the train station, reads the train timetable and chooses the correct train to get him to the city.
- Dmitry is unable to keep his focus on the presenter in morning assembly at school.
- Amelia drops her pencil on the floor and immediately starts crying.

Section 8A questions

1 Compare features of behavioural functioning and cognitive functioning.
2 With reference to an example, explain the effect of partial sleep deprivation on the affective functioning of a Year 7 teacher.
3 In the past, sleep deprivation has been used by police and military units as a controversial interrogation technique to help extract information from prisoners. The technique is regarded as a form of torture, causing disordered and irrational thought, emotional breakdown, incoherent speech, false memory, hallucinations and false confessions.
   a From the information provided, identify an example of each type of functioning that is impaired by sleep deprivation.
   b With reference to cognitive functioning, explain why it is unjust for a prisoner to be interrogated while sleep deprived.
4 Explain why research into the comparison between BAC level and sleep deprivation may be useful for a community.
5 Yvette is travelling to South Korea for a holiday. She learned some Korean while she was in school, but has not practised for several years. Despite this, she thinks she will be able to get by with the little language she knows. Yvette is not able to sleep much on her flight, so when she arrives in South Korea, she feels quite sleep deprived. When she arrives at her hotel, she has a lot of difficulty talking with the person at the front desk to check in. Yvette is usually calm and composed; however, she quickly becomes frustrated and very upset that she is having so much trouble speaking Korean. Explain Yvette's reaction, with reference to the effects of partial sleep deprivation.

ISBN 978-1-009-25416-8 Gallagher et al

8B Circadian rhythm sleep disorders

Study Design:
Changes to a person's sleep–wake cycle that cause circadian rhythm sleep disorders (Delayed Sleep Phase Syndrome (DSPS), Advanced Sleep Phase Disorder (ASPD) and shift work) and the treatments of circadian rhythm sleep disorders through bright light therapy

Glossary:
Advanced Sleep Phase Disorder (ASPD)
Bright light therapy
Circadian rhythm sleep disorders
Delayed Sleep Phase Syndrome (DSPS)
Shift work

ENGAGE

A common approach to describing and diagnosing mental disorders

The *Diagnostic and Statistical Manual of Mental Disorders* (DSM) is a handbook used by healthcare professionals to help them diagnose mental disorders in patients. The DSM was created in 1952 to satisfy a need for a common and consistent approach to diagnosing mental disorder as it contains descriptions of the different diagnostic categories.

The first edition of the DSM did not include diagnosable sleep disorders as we know them today; however, sleep-related symptoms such as sleepwalking, insomnia (difficulty falling or staying asleep) and hyposomnia (decreased sleep duration) were listed as common symptoms of other disorders such as major depression.

Over the years, the DSM has been revised several times in consultation with experts and professional organisations using the latest research understanding. The most recent edition is DSM-5-TR, which was published in 2022.

A comparison of the original and current edition of the DSM illustrates how far research has come in understanding mental health issues since the 1950s. The fifth edition is much larger, as the brief descriptions of disorders have evolved into more systematically presented reference entries with clear diagnostic criteria based on research evidence and scientific-based studies. In particular, thresholds are stated for when the number, severity and variety of symptoms become sufficient for a diagnosis.

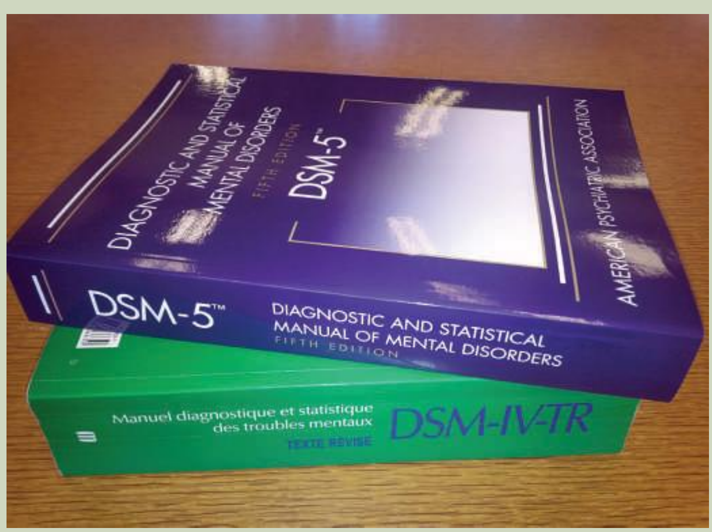


Figure 8B–1 The *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5-TR) is the handbook that healthcare professionals use when diagnosing mental issues.

ISBN 978-1-009-25416-8 Gallagher et al

EXPLAIN

Types of circadian rhythm sleep disorders

7C INTERNAL BIOLOGICAL MECHANISMS THAT REGULATE SLEEP–WAKE PATTERNS LINK

The DSM-5-TR categorises all sleep–wake disorders into 10 disorders or disorder groups, including insomnia disorder, breathing-related sleep disorders, substance/medication-induced sleep disorder, and circadian rhythm sleep–wake disorders. In this course, you will only study circadian rhythm sleep disorders.

Figure 8B–2 Changes to a person's sleep–wake cycle can cause their circadian rhythm to become out of sync with their external environment.

Sudden changes to a person's sleep–wake schedule can cause their circadian rhythm to become out of sync with the external environment. This can happen if a person works night shifts or at the beginning or end of daylight saving. When a significant misalignment occurs and a person's body cannot readjust, it may cause them distress or dysfunction and a circadian rhythm sleep disorder can be diagnosed.

Circadian rhythm sleep disorders are a category of sleep disorders characterised by a persistent pattern of sleep disruption due to a misalignment between the circadian rhythm and the sleep–wake schedule required by a person. The misalignment causes excessive sleepiness, insomnia, distress or impairment of a person's functioning. These disorders may cause a person to be unable to sleep and wake at the appropriate times needed to attend school, go to work or participate in social activities.

We will look at three different circadian rhythm sleep disorders in this section: Delayed Sleep Phase Syndrome, Advanced Sleep Phase Disorder and shift work.

Circadian rhythm sleep disorders a category of sleep disorders in which sleep is disrupted because the circadian rhythm and a person's sleep–wake schedule are misaligned

Bright light therapy a therapy to treat a sleep disorder in which the person is exposed to a bright light to reset the sleep–wake cycle

Circadian rhythm sleep disorders can be treated with the use of **bright light therapy**, which involves exposing a person to light for a specific amount of time to reset the sleep–wake cycle. The strategic exposure to light prompts the wake-inducing biological mechanisms involving the circadian rhythm and suprachiasmatic nucleus, and delays the release of melatonin, which promotes wakefulness. The light source may be a safe but artificial source from a specifically designed light box, desk lamp, floor lamp, visor hat with attached light, or dawn simulator light, or the light may be natural sunlight if deemed reliable. The ideal length and timing of light exposure depends on the circadian rhythm sleep disorder being treated, and will be discussed alongside each of the disorders in this section.

8C IMPROVING SLEEP–WAKE PATTERNS AND MENTAL WELLBEING LINK

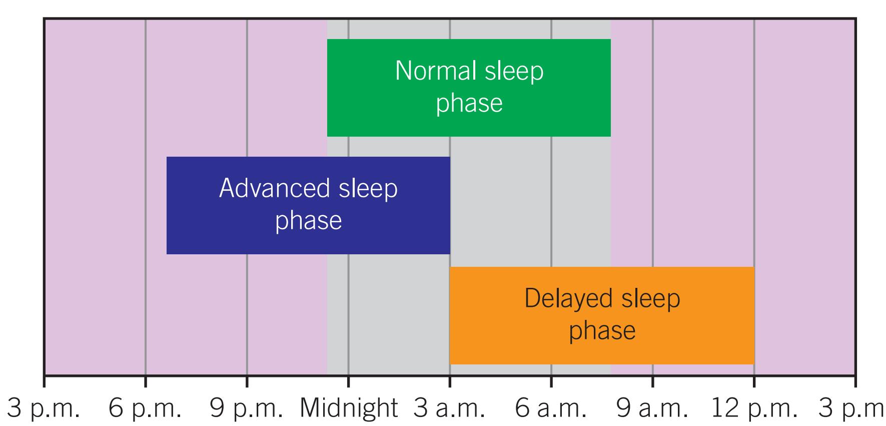


Figure 8B–3 Circadian rhythm sleep disorders occur when there is a misalignment between the circadian rhythm and the sleep–wake cycle that is desired. The circadian rhythm may be advanced or delayed compared to the desired schedule.

ISBN 978-1-009-25416-8 Gallagher et al

Delayed Sleep Phase Syndrome

Delayed Sleep Phase Syndrome (DSPS) is a circadian rhythm sleep disorder characterised by a delay in the timing of sleep onset and awakening, compared with the timing that is desired. The delay is usually for two or more hours, with a person falling asleep later than what is required or conventionally accepted. This then causes a need to wake up later than required if a person is to achieve an adequate amount of sleep. For example, instead of a sleep schedule of 10 p.m. until 6 a.m., a person may sleep from 2 a.m. until 10 a.m.

The delay in sleep onset contributes to a sleep disorder when a person is unable to achieve their recommended amount of sleep because they need to wake in the morning for work, school or other commitments. For example, a university student who needs to sleep from 11 p.m. until 7 a.m. to achieve the required amount of sleep may not be able to fall asleep until 3 a.m. If they need to wake up at 7 a.m. for university, they are achieving far less sleep than is necessary for proper functioning.

A person with DSPS usually cannot fall asleep at an earlier, more acceptable time due to their shifted circadian rhythm. In order to be diagnosed with DSPS, a person needs to experience symptoms for more than three months.

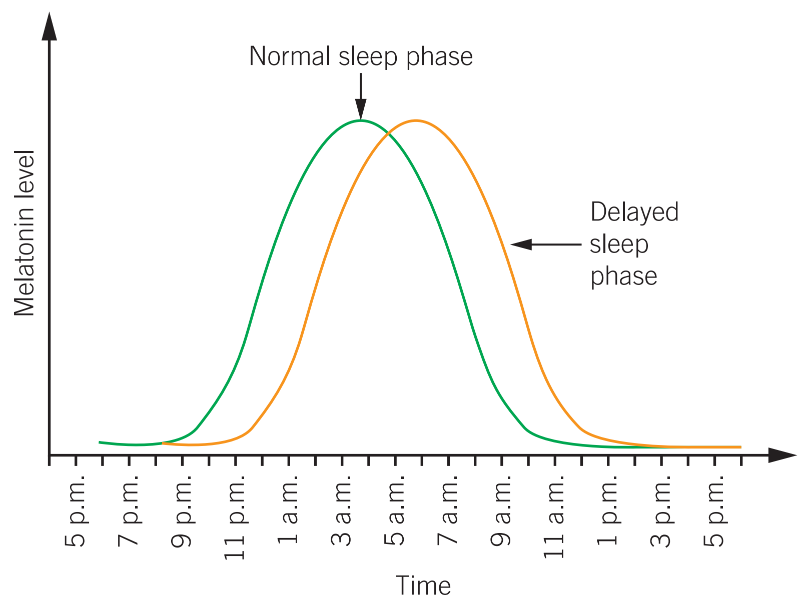


Figure 8B–4 This graph shows 24-hour melatonin levels for normal sleep phase and Delayed Sleep Phase Syndrome. Delayed sleep occurs when the sleep–wake cycle is shifted later than is desired; for example, you fall asleep at midnight instead of 9 p.m.

Other than age, some predisposing risk factors for DSPS include a longer than average circadian period and an increased sensitivity to light. A person who is more sensitive to light present in the evening might have a delayed night-time signal to the suprachiasmatic nucleus, which delays melatonin release by the pineal gland, resulting in fewer signals to the body that it is time to sleep. Conversely, a person who is less sensitive to morning light upon waking has a lack of light cues to the suprachiasmatic nucleus to signal a reduction in melatonin release by the pineal gland.

People with Delayed Sleep Phase Syndrome who can adjust their lifestyle to suit their particular sleep schedule tend to experience less sleep deprivation and symptoms. If that is not possible, they can help shift their circadian rhythm to a more appropriate time by using bright light therapy.

VIDEO 8B–1 CIRCADIAN RHYTHM SLEEP DISORDERS

Delayed Sleep Phase Syndrome (DSPS) a circadian rhythm sleep disorder characterised by a delay in the timing of sleep onset and awakening compared with the timing that is desired

LINK **7D** SLEEP ACROSS THE LIFE SPAN

LINK **7C** INTERNAL BIOLOGICAL MECHANISMS THAT REGULATE SLEEP–WAKE PATTERNS

LINK **8C** IMPROVING SLEEP–WAKE PATTERNS AND MENTAL WELLBEING

ISBN 978-1-009-25416-8 Gallagher et al

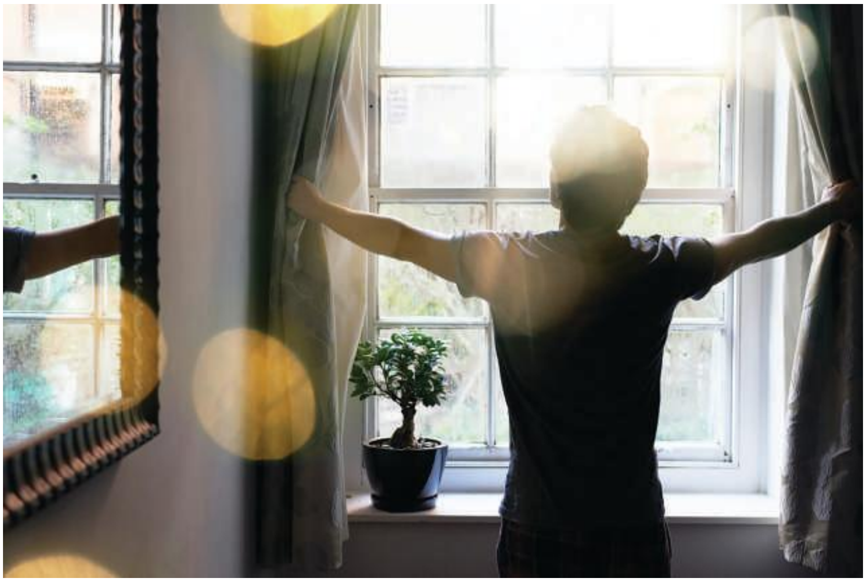


Figure 8B–5 Exposure to light in the early morning and limiting light exposure in the evening can help shift a person's delayed sleep–wake cycle to an earlier phase.

Exposure to light in the early morning can help reset the sleep–wake cycle by reducing melatonin release earlier in the morning. This resets the circadian rhythm, prompting the suprachiasmatic nucleus to trigger melatonin release at a more appropriate earlier time of the evening, and therefore advances sleepiness. This therapy also includes limiting night-time light exposure and gradually going to bed earlier each night over several weeks.

Advanced sleep phase disorder

Advanced Sleep Phase Disorder (ASPD) is a circadian rhythm sleep disorder characterised by an advance in the timing of sleep onset and awakening compared to the timing that is desired. A person may fall asleep usually two or more hours earlier than what is needed or acceptable, resulting in them then experiencing an earlier waking time than is desired. For example, instead of a sleep schedule of 10 p.m. until 6 a.m., a person may sleep from 8 p.m. to 4 a.m. When a person with ASPD attempts to adhere to a more reasonable, later bedtime, they will continue to have an early wake time due to the shift in their circadian rhythm.

Advanced Sleep Phase Disorder (ASPD) a circadian rhythm sleep disorder characterised by an advance in the timing of sleep onset and awakening compared to the timing that is desired

7C INTERNAL BIOLOGICAL MECHANISMS THAT REGULATE SLEEP–WAKE PATTERNS LINK

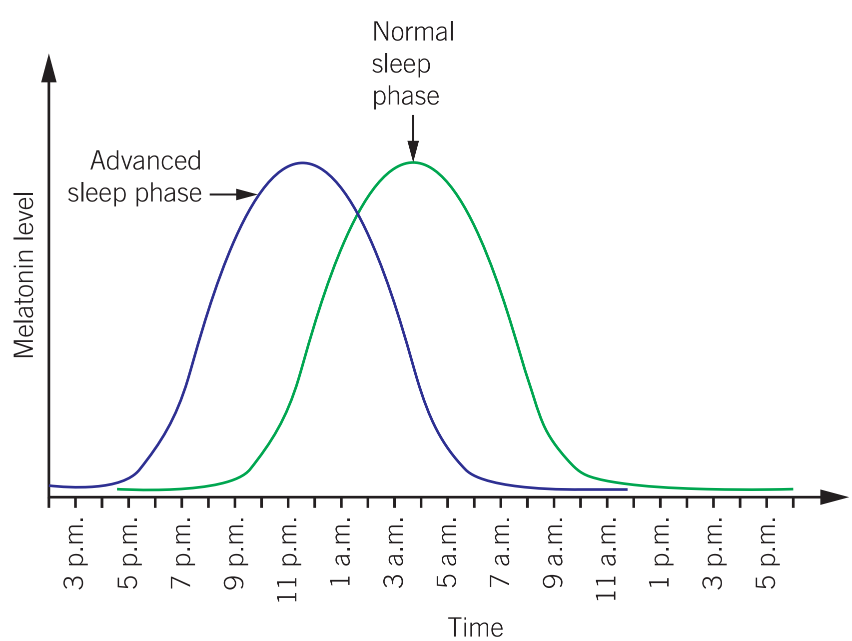


Figure 8B–6 This graph shows 24-hour melatonin levels for normal sleep phase and Advanced Sleep Phase Disorder, which occurs when the sleep–wake cycle is shifted earlier than is desired, such as falling asleep at 6 p.m. instead of 9 p.m.

ISBN 978-1-009-25416-8 Gallagher et al

A person's adverse exposure to light can maintain their undesired advanced circadian rhythm. By going to bed early and then waking early, a person is not exposed to the regular evening low light and morning bright light signals, which then perpetuates the advanced circadian rhythm cycle, maintaining the disorder.

Figure 8B–7 A person with an ASPD can help shift their sleep–wake cycle by using bright light therapy in the evening to delay the onset of sleep to a more appropriate time.

Different people experience different symptoms for ASPD but symptoms get more severe when work or social demands require a schedule that does not match the person's natural sleep–wake cycle. For example, a person working in hospitality may need to work late into the evening beyond when their body is ready for sleep, or a person who is awake at 4 a.m. one morning then feels too tired for social events in the evening.

LINK 8C IMPROVING SLEEP–WAKE PATTERNS AND MENTAL WELLBEING

When a person can adjust their daytime commitments to sleep and wake at their own schedule, they tend to have a stable sleep pattern and reduction in symptoms. If that is not possible, people with ASPD can help shift their circadian rhythm to a more appropriate time by using bright light therapy. Exposure to light in the early evening results in later melatonin release, and therefore delays sleepiness until a more appropriate later time of the evening. This can help reset the sleep–wake cycle to a more conventional timing.

Shift work work that regularly takes place outside of normal business hours, particularly at night and the very early morning; can cause a circadian rhythm sleep disorder

Shift work

Shift work can cause a circadian rhythm sleep disorder when a person regularly works outside of normal business hours, particularly at night and the very early morning. This can include a consistent night shift or a rotating schedule, in round-the-clock professions such as health care, hospitality, factory work, transport and travel. Shift work can put a person's sleep–wake schedule in direct opposition to the regular day–night environmental hours, resulting in distress and dysfunction due to excessive sleepiness at work and impaired sleep at home after their shift. For example, a nurse working a night shift needs to sleep during the day, but their sleep may be disrupted due to noise from outside traffic, family members, visitors or bright light shining through curtains. This may result in sleep deprivation and then excessive sleepiness while they are working the following night.

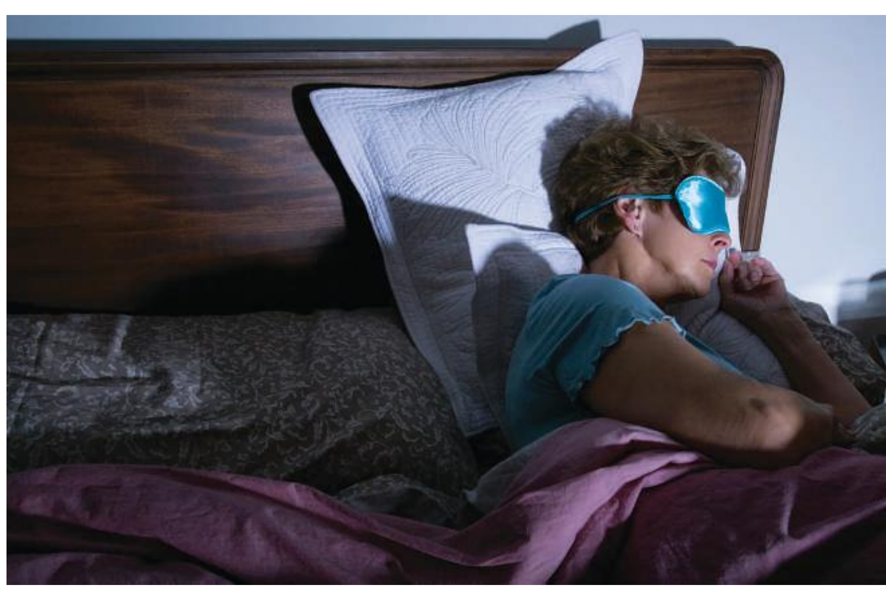


Figure 8B–8 Shift workers need to sleep when the external environment is not ideal for sleep, such as when it is daylight or noisy or when others are awake.

ISBN 978-1-009-25416-8 Gallagher et al

This disorder affects 5–10% of the population who work during nights, particularly at the middle-aged stage of the life span, in jobs that involve shift work such as paramedics, airline flight crews, bakers, bartenders and police officers. Diagnosis depends on how severe the symptoms are and the level of distress experienced by the person.

Figure 8B–9 Many different jobs require people to work in shifts, such as in health care, hospitality and construction.

7C INTERNAL BIOLOGICAL MECHANISMS THAT REGULATE SLEEP–WAKE PATTERNS LINK

The consequences for a circadian rhythm sleep disorder caused by shift work include poor performance at work, interpersonal problems, increased risk of accidents and poor mental wellbeing, which can even lead to other mental disorders such as depression and substance use disorders. Research has consistently found a link between prolonged shift work and physical health problems such as gastrointestinal disorders, cardiovascular disease, diabetes and cancer.

A person's symptoms reduce when they can spend longer on one shift rotation before changing. Where rotating schedules are required, they should ideally shift forward, such as from morning shift, to afternoon shift, to evening shift, to allow a person the best chance to adjust. If a person working night shifts can commit to a more nocturnal routine for their social and other commitments, it may help their sleep–wake cycle become more consistent, and reduce symptoms. When a person returns to a typical, consistent daytime shift routine, then their symptoms can also resolve.

8C IMPROVING SLEEP–WAKE PATTERNS AND MENTAL WELLBEING LINK

WORKSHEET 8B–1 CIRCADIAN RHYTHM SLEEP DISORDERS DOC

People with a disorder caused by shift work can also help adjust their circadian rhythm to suit their work schedule by using bright light therapy. Exposure to light before an evening or night-time shift can help delay the release of melatonin, helping a person feel more awake during their shift, and then sleepy when the shift is finished in the morning and it is their time to sleep.

Check-in questions – Set 1

1 What are circadian rhythm sleep disorders?
2 What is the difference between a Delayed Sleep Phase Syndrome and an Advanced Sleep Phase Disorder?
3 Describe shift work as a cause of circadian rhythm sleep disorder.
4 Which sleep disorders can bright light therapy treat?

ISBN 978-1-009-25416-8 Gallagher et al

8B SKILLS

VIDEO 8B–2
SKILLS: APPLYING THEORY TO SCENARIOS

Applying theory to scenarios

When you answer VCE Psychology exam questions, it is important to include key terms and theory, as well as a direct reference to the scenario. A reference to the scenario should provide support and evidence for your answer, and should be more than just stating the name of the person from the scenario. The reverse is also true, and your response should not only repeat information from the scenario without including key terms and theory.

Question:

Recently, June has had trouble getting to sleep at night. She attempts to go to bed at a reasonable time, but is unable to fall asleep for several hours. She usually drifts off to sleep about 3 a.m. June is a barista and needs to be up early each morning to open the café. This results in June only getting about 3 hours of sleep each night. At the start of her morning shift, June is very slow at completing the morning tasks in the cafe and makes many mistakes each day. She has been getting in trouble with the café owner for her errors and is now at risk of being fired. June finally decides she needs to see her doctor for help.

Justify whether June would be diagnosed with a circadian rhythm sleep disorder.

(3 marks)

Attempted answer:

June would be diagnosed with a circadian rhythm sleep disorder because she is unable to fall asleep for several hours.

Marking comments:

This response has only repeated information from the scenario, without providing any other key terms and theory. The command term 'justify' requires you to provide a reason for your answer. This response would receive 1/3 marks, for correctly identifying that June is experiencing a circadian rhythm sleep disorder.

Suggested answer:

June is probably going to be diagnosed with a circadian rhythm sleep disorder because she is experiencing a misalignment between her circadian rhythm and the sleep–wake schedule she requires. June's circadian rhythm does not allow her to fall asleep until 3 a.m.; however, the sleep–wake cycle she requires for work is one that requires her to wake up early in the morning.

ACTIVITY 8B–1 DEBATE: SHOULD THE SCHOOL DAY START LATER?

Conduct a debate on the topic of 'Should the school day start later?'

Working with a partner, take either the 'For' or 'Against' side of the debate, and determine some persuasive arguments addressing the topic.

Alternatively, create a list of 'For' and 'Against' arguments yourself and then compare with a partner or small group.

ISBN 978-1-009-25416-8 Gallagher et al

Section 8B questions

1 Mary is 15 years old and recently has been finding it difficult to fall asleep. She is also having trouble staying asleep and she is waking for no obvious reason. Mary's sleep–wake cycle demonstrates a preference for going to sleep at 4 a.m. and then waking at 12 p.m. This has obvious implications for Mary attending school. Mary visits the doctor, who diagnoses her with delayed sleep phase syndrome and suggests she attend a sleep clinic to help with treatment. Here she is prescribed a medication that acts like melatonin to help her get to sleep earlier. The sleep clinic implements a strict lights-out bedtime routine, with all patients having lights turned off at 9 p.m., and lights turned back on at 6 a.m. On the first night, Mary falls asleep at 2 a.m. without medication, and wakes at 6 a.m. when the lights are turned on. The following night, with medication, she falls asleep at midnight. Over the next few nights, Mary begins falling asleep a little earlier, before reaching a more consistent sleep time of 10 p.m.

- a Explain why Mary was diagnosed with Delayed Sleep Phase Syndrome.
- b Explain how the hospital's bedtime routine involving lights would have aided Mary's sleep.

2 Thien is 72 years old and has been feeling sleepy much earlier in the evening than he used to, and has been going to bed at about 7:30 p.m. Thien does not tend to do much in the evenings anyway, but after going to sleep so early he then wakes up very early, at about 4 a.m. Thien babysits his grandchildren two days a week, and by the time they get dropped at his house at 8 a.m., he already feels tired and sluggish from waking up early.

- a Identify the circadian rhythm sleep disorder that Thien appears to be experiencing.
- b How could Thien use bright light therapy to adjust his circadian rhythm?

3 Mila and Kayden both work in road construction and have recently been working on the same new project. Mila has chosen to work a permanent night shift, beginning at 9 p.m. every night for the duration of the project. Kayden has chosen to work a rotating schedule, where he works three night shifts, then three morning shifts, then three afternoon shifts, repeating this schedule over the duration of the project.

- a Justify whether Mila's or Kayden's shift schedule would likely be better for their sleep.
- b Suggest a strategy for Mila's mobile phone use that could help Mila achieve a better sleep during daylight hours.

ISBN 978-1-009-25416-8 Gallagher et al

8C Improving sleep–wake patterns and mental wellbeing

Study Design:
Improving sleep hygiene and adaptation to zeitgebers to improve sleep–wake patterns and mental wellbeing, with reference to daylight and blue light, temperature, and eating and drinking patterns

Glossary:
Blue light
Daylight
Sleep hygiene
Zeitgeber

ENGAGE

The effect of light on people with blindness

If light exposure to the eyes is the primary environmental cue for the sleep–wake cycle, what happens to the circadian rhythms of people who are blind or have low vision? Research into the effect of visual impairment on the circadian rhythm is useful to both understand the mechanisms of the visual systems in regulating the circadian rhythm and investigate intervention options for people with visual impairment.

Figure 8C–1 If a person has no perception of light, then they may not be able to maintain a normal circadian rhythm.

Studies have shown that people without eyes (caused by a developmental disorder or surgical removal), cannot maintain the circadian rhythm to the usual 24-hour day–night pattern. People with eyes but who are totally blind with no perception of light also experience similar circadian rhythm desynchrony, whereby their sleep–wake patterns do not coincide with external cues from light exposure. In both cases, light is unable to reach the suprachiasmatic nucleus, so there is no signal for melatonin release. This results in a free-running circadian rhythm of more than 24 hours, which does not match the 24 hour environmental day–night cycle. Consequences include disturbed sleep, poor sleep quality, sleep disorders and daytime dysfunction. Interestingly, if a person with blindness still has some light perception, then they tend to have a circadian rhythm that functions according to the day–night cycle.

An effective treatment for blind people with a circadian rhythm sleep disorder is a daily administration of a synthetic form of melatonin. The use of melatonin acts as a cue to sleep, as it usually would naturally in the body. This can be used at appropriate times to help shift the person's sleep–wake cycle to match the environmental day–night cycle.

EXPLAIN

Improving sleep hygiene and adaptating to zeitgebers

Eating a healthy diet, getting regular exercise and achieving an appropriate quality and quantity of sleep are considered the three pillars of health, and research has shown that improving all three components may be beneficial for sustaining physical and mental wellbeing in people at risk of neuropsychiatric disorders.

Poor sleep patterns have been consistently linked in a bidirectional way to serious physical health concerns such as diabetes, weight problems, hypertension, cardiovascular disease and mental health concerns, including depression, bipolar disorder, anxiety disorders and schizophrenia. Despite this, many people don't prioritise sleep as much as healthy eating and exercise, and poor sleep continues to affect the physical and mental wellbeing of many people.

Sleep is a complicated process, and although we may not have full control over our circadian rhythm, there are many ways to improve sleep hygiene. There are also several environmental factors we can work with to influence and improve our sleep–wake patterns and therefore our mental wellbeing.

Sleep hygiene the sleep-related behaviours and environmental conditions that are beneficial for sleep

Sleep hygiene refers to the sleep-related behaviours and environmental conditions that are beneficial for sleep. We can make many simple changes to our bedtime routine to promote sleep:

- avoid the use of devices and caffeine before bed
- follow a wind-down bedtime routine
- avoid 'watching the clock'
- minimise light and noise
- ensure a cool temperature
- have comfortable bedding.

Figure 8C–2 Minimising light and noise and avoiding the use of screens at bedtime are beneficial for sleep.

ISBN 978-1-009-25416-8 Gallagher et al

If you follow recommendations for good sleep hygiene consistently, you may be more likely to fall asleep faster as well as remain asleep, maximising both sleep quantity and quality and overall promoting wellbeing. Many sleep hygiene practices consider important sleep-related zeitgebers.

Zeitgebers are environmental cues, such as light, temperature and eating patterns that can synchronise and regulate the body's circadian rhythm. These cues have different abilities to shift a person's 24-hour sleep–wake cycle, and so can be purposefully used by a person to improve their sleep–wake cycle and therefore their mental wellbeing.

Zeitgeber
an environmental cue such as light, temperature and eating patterns that can synchronise and regulate the body's circadian rhythm

Light

Daylight includes all direct and indirect sunlight during the daytime, and is considered the primary zeitgeber for the human circadian rhythm. As discussed in Chapter 7, light has the greatest influence on the sleep–wake cycle because its detection by the suprachiasmatic nucleus in the brain directly influences the release of melatonin by the pineal gland (refer again to Figure 7C–4). If the amount of light detected increases, melatonin production is suppressed, which promotes wakefulness. If the amount of light detected decreases, more melatonin is released, thereby promoting sleepiness.

LINK 7C INTERNAL BIOLOGICAL MECHANISMS THAT REGULATE SLEEP–WAKE PATTERNS

Daylight
all direct and indirect sunlight during the daytime

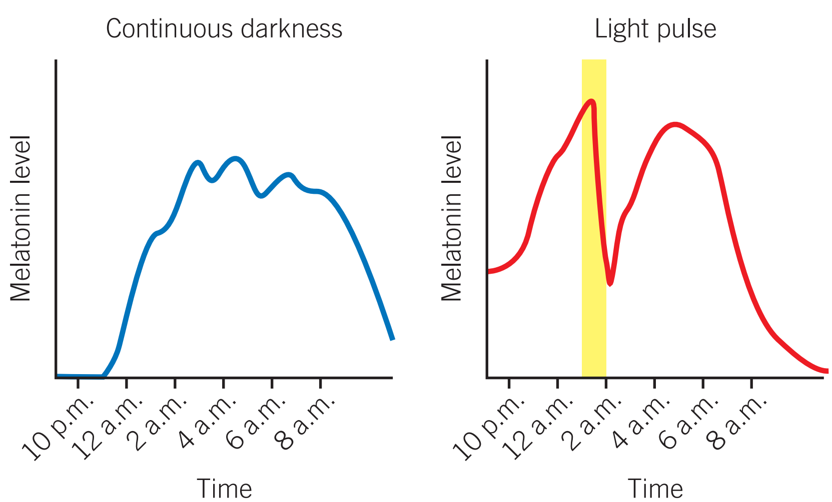


Figure 8C–3 Under normal day–night conditions, melatonin is released in the evening and continues to be released over the night. If the eyes are exposed to light at night-time, melatonin production is suppressed.

The ability of the circadian system to resynchronise daily to keep in sync with the external environment is an evolutionary benefit. However, since the invention of artificial lighting, our light exposure is no longer just from the Sun during daylight hours. The 24-hour access to light means we can undertake activities at night-time that were previously restricted to daylight hours. However, this can be at the expense of our wellbeing.

Although all wavelengths of light can shift the sleep–wake cycle, blue light is of particular concern. **Blue light** is a range of the visible light spectrum that is emitted from smartphone screens, computer monitors, televisions, LED and fluorescent light bulbs, as well as the Sun. Blue light has the most influence on the circadian rhythm through its powerful inhibition of melatonin. Ultimately, exposure to blue light at the wrong times can reduce the quality and quantity of sleep. Therefore, blue light exposure contributes to many types of sleep disorders and poor mental and physical wellbeing.

Blue light
a part of the visible light spectrum that is emitted from smartphone screens, computer monitors, televisions, LED and fluorescent light bulbs, as well as sunlight

ISBN 978-1-009-25416-8 Gallagher et al

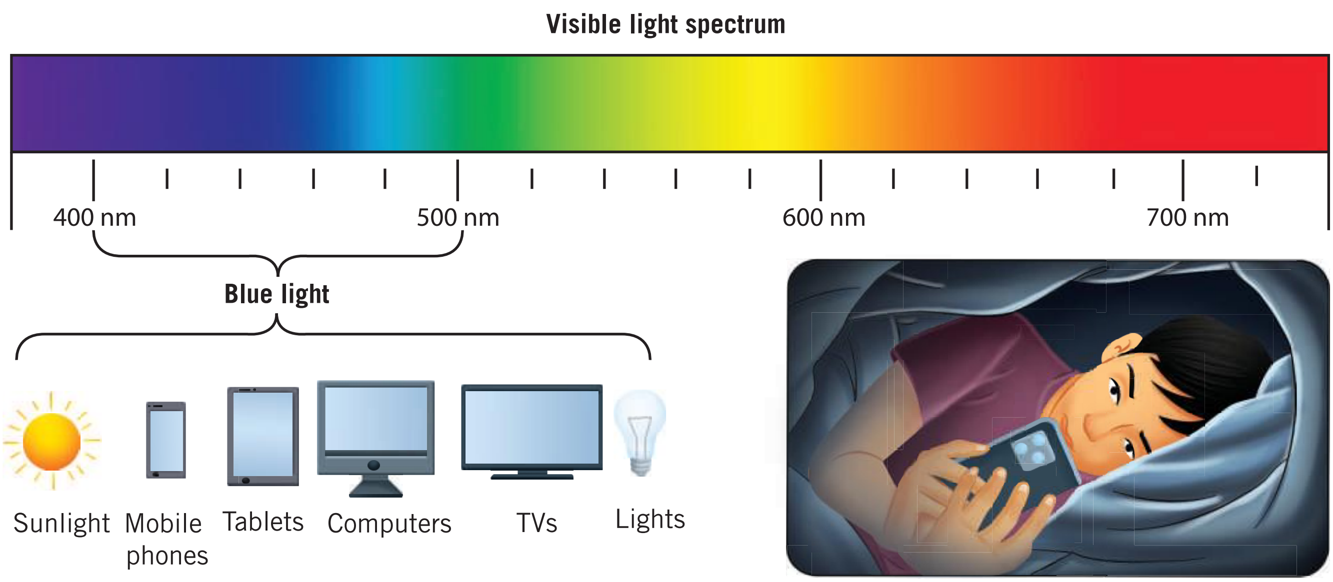


Figure 8C–4 The blue light wavelengths of the visible light spectrum are emitted by many sources, especially electronic devices with screens. Blue light has been found to be particularly harmful to sleep because of its powerful ability to inhibit melatonin release.

Fortunately, people can have a lot of influence over their exposure to light and they can adapt and use this zeitgeber to shift a disrupted sleep–wake cycle and improve their mental wellbeing. It is recommended that healthy people with no sleep disorders expose themselves to natural daylight in the morning and throughout the day, and then block out artificial light, particularly blue light, at night before sleep. A consistent exposure to light at appropriate times can help reinforce a regular sleep–wake cycle.

Some ways to avoid blue light from electronic devices in the evenings is to use in-built screen filters and 'night mode' settings, reduce screen brightness levels, or, most effectively, do not use screens before bed at all. Dimming LED room lights, using red or orange lamps, or using glasses that block blue light also help to reduce sleep disturbances and their detrimental effects on wellbeing.

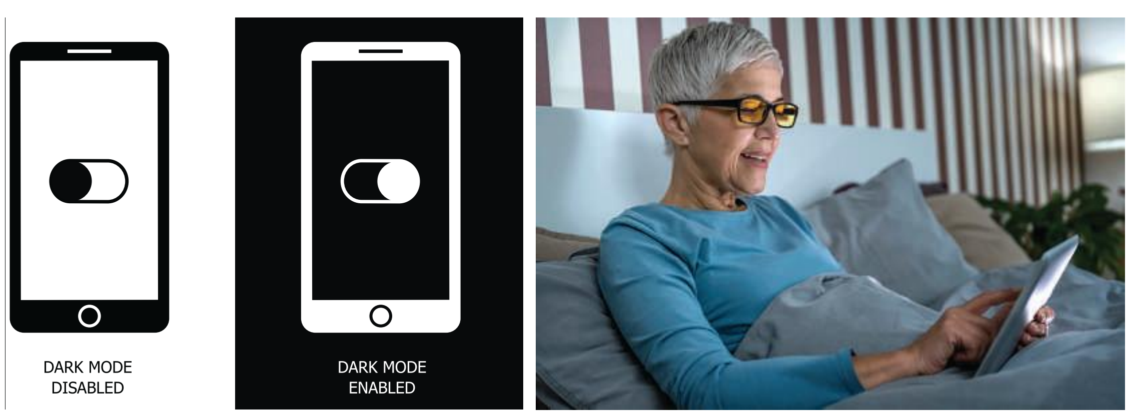


Figure 8C–5 Advances in technology have allowed people to limit their exposure to light, including blue light, to improve sleep.

8B CIRCADIAN RHYTHM SLEEP DISORDERS LINK

People who experience circadian rhythm sleep disorders can use light strategically to help reduce symptoms and even shift the circadian rhythm to the desired time. For example, night shift workers can increase the blue portion in artificial light during night-time hours while at work and then minimise daylight exposure while sleeping.

Blue light can also be used purposely to improve wellbeing. Blue light can keep a person alert while improving performance and mood. Increasing the blue portion of artificial light during appropriate times such as daylight hours could improve student learning in schools, the performance of indoor employees or the mood of people in hospitals and nursing homes.

We should consider several aspects of light exposure to help improve our wellbeing, including the duration, intensity, colour of light and time of day. Overall, exposure to daylight during waking times and minimising blue light or using it in strategic ways can be a powerful regulating influence on the sleep–wake cycle. This can result in a more restful sleep and can have a positive impact on mental wellbeing Additionally, there are emerging theories describing an effect of light on other brain areas that regulate mood, independent of the effects of light on the sleep–wake cycle.

Figure 8C–6 Light can be used as a zeitgeber to enhance sleep and mental wellbeing; for example, by increasing light exposure including blue light when awake.

Temperature

People can use the zeitgeber of temperature to improve their sleep–wake cycle by implementing daily behaviours that support the link between temperature and the mechanisms of sleep.

Body temperature is another biological mechanism that is regulated on a 24-hour circadian rhythm controlled by the suprachiasmatic nucleus, and it is linked to the sleep–wake cycle. Body temperature begins to decrease in the early evening, with sleep onset occurring when core body temperature is at its greatest rate of decline. An increase in blood flow to the skin results in skin warming and so heat is lost from the body and body temperature drops. The lowest body temperature occurs at about 2 hours after sleep onset. The idea that skin warming helps to initiate sleep is supported by behavioural evidence of using bedding to provide warmth before and during sleep. It is also evident in animals curling up for sleep or building and using nests.

LINK **7C** INTERNAL BIOLOGICAL MECHANISMS THAT REGULATE SLEEP–WAKE PATTERNS

Research has also shown that there is a link between the neural pathways promoting NREM sleep and the neural pathways for body cooling. In addition, an increase in melatonin in the body coincides with the decrease in core body temperature leading up to the onset of sleep (Figure 8C–7).

LINK **7A** SLEEP AS A NATURALLY OCCURRING ALTERED STATE OF CONSCIOUSNESS

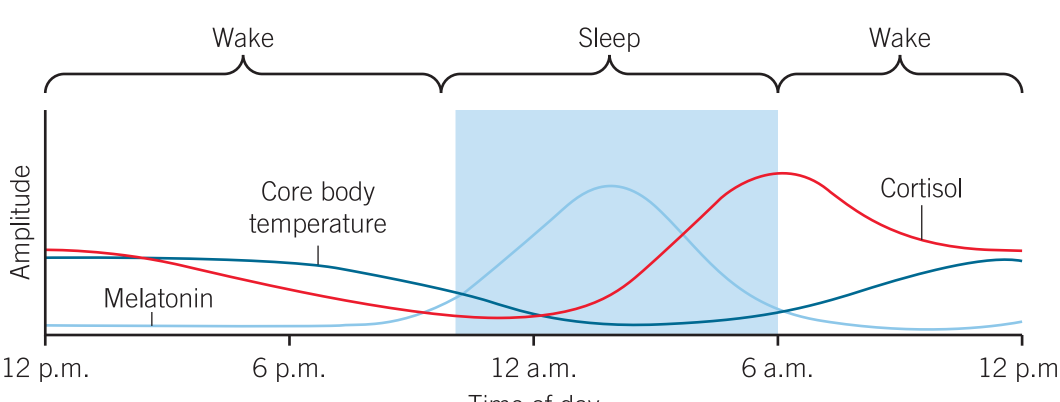


Figure 8C–7 Temperature, melatonin and cortisol levels during the sleep–wake cycle in adults. A decrease in core body temperature is linked with an increase in melatonin levels, which shows that there is a relationship between body temperature and sleep.

ISBN 978-1-009-25416-8 Gallagher et al

Research has determined that the ideal room temperature for sleep onset is 19–21°C. However, the ideal skin and bed microclimate is 31–35°C for people during sleep. This means that the combination of a cool room and warm bedding is an easy way that most people can promote sleep, with the simple use of windows, fans, appropriate bedding, sleepwear, curtains, and appropriate mattress and pillow.

These strategies may be of particular use to the elderly age group because they typically have more trouble with normal thermoregulation. Research has shown that subtle skin warming significantly restored the age-related decrease in deep sleep and reduced early morning awakening. Regulating temperature can help a person to initiate sleep quickly and maintain sleep throughout the night, improving consistency of the sleep–wake cycle and therefore mental wellbeing.

Figure 8C–8 You can use temperature as a zeitgeber to promote sleep and mental wellbeing by following research-based recommendations on the ideal temperatures during sleep.

7C INTERNAL BIOLOGICAL MECHANISMS THAT REGULATE SLEEP–WAKE PATTERNS LINK

Eating and drinking patterns

As previously discussed, the suprachiasmatic nucleus is the primary circadian rhythm keeper in the body and is most strongly influenced by light. The suprachiasmatic nucleus is not largely influenced by the timing of meals, provided enough food is ingested. However, the suprachiasmatic nucleus is affected by long-term severe food deprivation, calorie restriction and perceived starvation. Acting alongside the suprachiasmatic nucleus, other peripheral body clocks exist in almost all other body tissues. These secondary clocks receive daily resetting signals from the suprachiasmatic nucleus. They are also influenced by other zeitgebers, particularly the timing of meals.

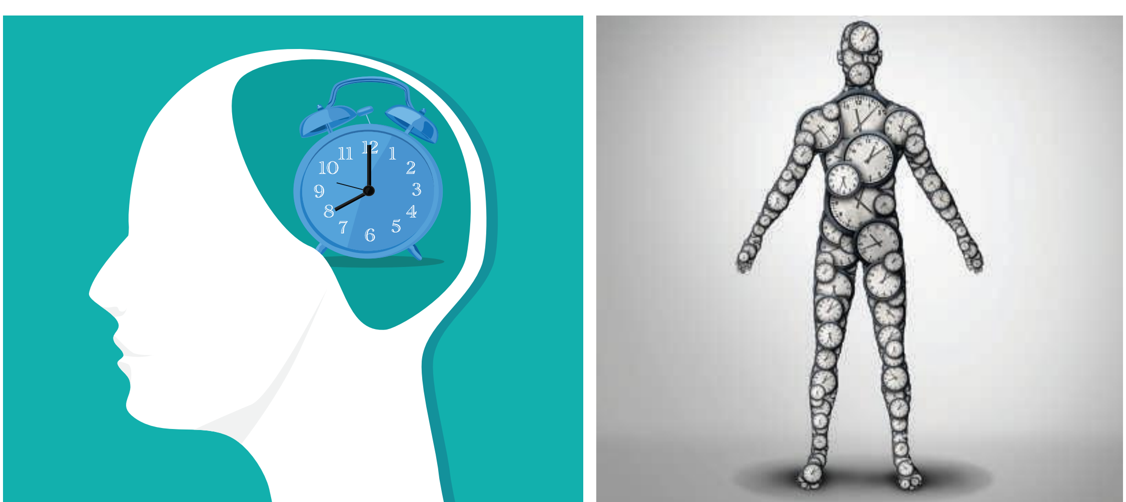


Figure 8C–9 The suprachiasmatic nucleus in the brain is the master body clock but there are peripheral clocks in almost all other tissues of the body.

ISBN 978-1-009-25416-8 Gallagher et al

The suprachiasmatic nucleus maintains the 24-hour cycle, keeping a daily rhythm for food intake and allowing for variation in energy metabolism and insulin sensitivity over the day. So for optimal energy balance, the peripheral clocks should be synchronised with the suprachiasmatic nucleus.

For most people who routinely consume food during the active, daylight phase of the 24-hour cycle, the suprachiasmatic nucleus and peripheral clocks remain synchronised, allowing for a consistent and appropriate sleep–wake cycle. But if a person begins to alter the timing, amount and composition of their meals to the inactive, dark phase of the 24-hour cycle, the mealtimes are now in misalignment with the routine light–dark cycle of the day. This influences the peripheral clock timing, and leads to an uncoupling of the peripheral clocks from the suprachiasmatic nucleus. Therefore, the presence of a mealtime zeitgeber outside the usual time, particularly during the inactive phase of the day–night cycle, can disrupt and cause a shift in normal functioning of the body clock. In this case, the suprachiasmatic nucleus remains entrained to the daylight cycle, but food is not being consumed when the regular circadian endocrine responses to food intake are being conducted.

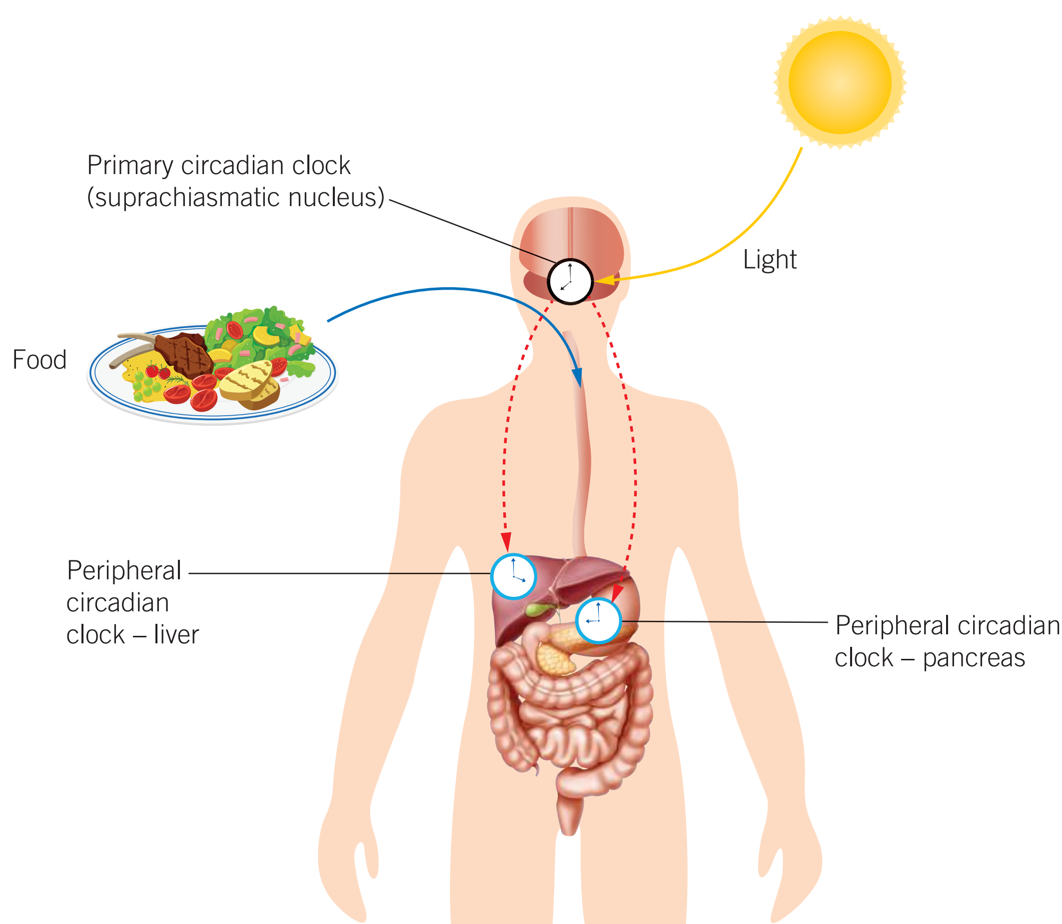


Figure 8C–10 Light is the primary zeitgeber that acts upon the suprachiasmatic nucleus master body clock, which in turn sets the peripheral circadian clocks, represented by the red dotted lines. However, food and meal timing can influence the timing of the peripheral clocks in other organs, such as those of the liver and pancreas. This results in these peripheral clocks becoming out of sync with the master clock.

ISBN 978-1-009-25416-8 Gallagher et al

For example, if a person starts to regularly stay awake until the early hours of the morning and eats large meals very late at night during their usual inactive phase, the messages being sent to their peripheral clocks will now be at odds with the suprachiasmatic nucleus, which is still trying to maintain a consistent sleep–wake cycle according to light. Effectively, the peripheral clocks act as though it is daytime because of food consumption, but the suprachiasmatic nucleus acts as though it is night-time because of the low light exposure. This shifts the circadian rhythm out of the day–night cycle.

8B CIRCADIAN RHYTHM SLEEP DISORDERS LINK

At particular risk are shift workers who constantly change the timing of their meals based on what time of the day they are awake and at work. Other people may be affected by conflicting meal consumption zeitgebers because of influences of a modern lifestyle – constant food availability, reduced overall sleep, longer active hours, and socially dictated rhythms of behaviour. Research has found that this desynchronisation of the body clock due to food timing is related to the development of metabolic disorders, including weight gain, obesity and type 2 diabetes.

Figure 8C–11 Shift workers on rotating shifts are constantly changing the timing of their meals, and this desynchronisation has contributes to the development of health-related disorders.

In addition to non-ideal timing of meals, several researchers have also shown that eating meals within 3–4 hours of the onset of sleep can negatively affect sleep quality, increase sleep onset time and increase awakenings. The effects of caffeine on sleep are also well documented; increased caffeine consumption correlates with increased sleep problems, including morning tiredness, increased awakenings, restless sleep and reduced sleep quality. One study into the timing of caffeine before sleep indicated that caffeine may still affect sleep if consumed up to 6 hours before sleep.

WORKSHEET 8C–1 SPELLING KEY TERMS RELATING TO SLEEP

WORKSHEET 8C–2 ZEITGEBERS FOR GOOD SLEEP

VIDEO 8C–1 ZEITBERGERS INFLUENCING SLEEP

Fortunately, meal timing is another zeitgeber that most people can easily adjust, and dietary interventions can help reduce the development of health problems and improve the sleep–wake cycle. Limiting caffeine intake later in the day and not eating right before sleep can help sleep onset and quality. Bringing mealtimes back to a normal schedule during the active, light phase of the day, as well as leaving a sufficiently long fasting window during the circadian inactive phase of night, will allow the peripheral clocks to resynchronise with the suprachiasmatic nucleus. These daily habits, particularly when used alongside appropriate light exposure, can help provide an additional signal to form a consistent sleep–wake cycle, protect against physical health problems and aid in mental wellbeing.

ISBN 978-1-009-25416-8 Gallagher et al

8C KEY SCIENCE SKILLS

VIDEO 8C–2
KEY SCIENCE SKILLS: EVALUATING INVESTIGATION METHODS

LINK CHAPTER 2

Evaluating investigation methods

There are many ways to collect data in psychological research. In Chapter 2, you were introduced to the different investigation methodologies. In addition, there are other methods including different sampling procedures and investigation designs, that can be chosen for a study. Each of these methodologies and methods have their own strengths and weaknesses, and there is not a 'one-size-fits-all' approach to research. So how do you know which one to choose for an investigation?

You should select methodology and procedures for a new investigation on the basis of the specific need and circumstances of that investigation. Additionally, you can evaluate the methods of proposed or completed investigations. You can analyse investigation methods according to their appropriateness to the research context, as well as for any possible sources of error or uncertainty. Then you can provide suggestions for how to improve the validity of the investigation and reduce any uncertainty around their findings.

When evaluating an investigation, first determine which methodology and methods were used, and then consider the strengths and limitations of each. You should consider the:

- methodologies used: case study; classification and identification; controlled experiment; correlational study; fieldwork; literature review; modelling; product, process or system development; simulation
- investigation design in a controlled experiment: within subjects, between subjects or mixed design
- sampling techniques: random, stratified or neither
- sample size
- allocation technique
- data collections methods: who collected the data and what methods or equipment they used
- any ethical concerns raised.

Question:

Researchers at a university are planning to examine the impact of protective factors designed to improve sleep quantity and quality. A sample of 500 participants will be randomly selected from all students enrolled at the university. All participants will complete a self-report sleep diary for two weeks, rating features of their sleep such as bedtime, total amount of sleep and any disruptions experienced.

Participants will be randomly allocated to one of three conditions for 6 months:

- Participants complete a nightly meditation before bed.
- Participants will be coached on exercise and nutrition to support sleep.
- Participants will receive 'no treatment'.

Evaluate the proposed design for this study, considering the method and procedures of the investigation, and the effect of these on the interpretation of results and possible conclusions that may be drawn.

ISBN 978-1-009-25416-8 Gallagher et al

Suggested answer:

Sampling technique: random sampling from the population of university students allows for a good representativeness of the population.

Sample size: 500 participants is an appropriately large sample size compared with the university population, allowing for good representativeness of the population.

Investigation design: a mixed design was used, with a within subjects element of the two-week sleep diary entries, and a between subjects design element of allocation to one of three conditions. The use of a mixed design improves validity by reducing some extraneous variables for participant variables, but there may be other extraneous variables due to the repetitive completion of the sleep diary.

Allocation: random allocation of participants to the three conditions allows for good representativeness of the population in each condition. The use of a control group allows for a baseline comparison to the two experimental conditions.

Validity of the data collection methods: self-report sleep diary is a subjective measure and the accuracy and precision of this data should be investigated before conclusions can be drawn.

Check-in questions – Set 1

1 Define 'sleep hygiene'.
2 Identify three zeitgebers that a person can use to improve their sleep and mental wellbeing.
3 Which wavelength of light has the greatest influence on the circadian rhythm?
4 Which zeitgeber has a strong influence on the body's peripheral clocks?

8C SKILLS

VIDEO 8C–3 SKILLS: LINKING KEY KNOWLEDGE

Linking key knowledge across multiple Areas of Study

As you progress through the four Areas of Study in VCE Psychology, you will cover new concepts that link back to key knowledge that you have previously learned. Some key concepts such as neurotransmission are built upon over the year and are seen with new applications in two or more Areas of Study.

7C INTERNAL BIOLOGICAL MECHANISMS THAT REGULATE SLEEP–WAKE PATTERNS LINK

8C IMPROVING SLEEP–WAKE PATTERNS AND MENTAL WELLBEING LINK

For example, the neurotransmitter GABA is first discussed in Chapter 3 on the functioning of the nervous system, and then applied to the development of a specific phobia in Chapter 10. In Section 7C *Internal biological mechanisms that regulate sleep–wake patterns,* the biological mechanism involving the effect of light on melatonin release is introduced and is then extended upon in this section, 8C *Improving sleep–wake patterns and mental wellbeing*. To display such connections, this textbook uses orange link icons, like the one shown here, in the margin of sections that cover related content. Furthermore, in the Interactive Textbook these are hyperlinks, allowing quick navigation between related sections.

As you learn throughout the year, it is helpful to recall and take note of where concepts have been covered previously. Making these links back to previous topics is a good technique for forming and strengthening long-term memory.

ACTIVITY 8C–1 TIPS FOR SLEEP SUCCESS

Design an eye-catching poster that promotes some useful sleep hygiene tips and advice for achieving adequate sleep and reducing sleep deprivation.

Decide the target audience for your poster, such as secondary school students, children, adults or families. Ensure your language and design are appropriate for your audience and include pictures and diagrams.

Section 8C questions

1 Describe the ideal timing of meals to allow for the best sleep.

2 Colson is getting ready for bed on a Sunday night. He has been binge-watching a television show in bed for the last few hours and each time an episode finishes, he thinks 'just one more!' and plays the next one. He suddenly realises it is 2.30 a.m. and he needs to get up for school in the morning. Colson opens his bedroom window to let in some air because his room had become quite hot during the afternoon.

- a Identify one zeitgeber that is influencing Colson's sleep in a positive way, and one zeitgeber that is influencing his sleep in a negative way. Explain the effect they are having on Colson's sleep–wake cycle.
- b Describe three sleep hygiene practices that Colson could implement to improve his sleep.

3 Describe the effect of eating dinner at midnight on a person's circadian rhythm.

4 With reference to the zeitgeber of temperature, explain why it is often suggested that we have a warm bath or shower before bedtime, but not complete strenuous exercise right before bed.

5 An Australian appliance company wants to conduct research into the ideal room temperature for sleeping so they can design their new home cooling systems accordingly. Based on some background reading, they decide to test four temperatures to see which one best enables a person to fall asleep quickly and stay asleep during the warmer summer months. The company sends out an email to their Queensland customers asking for volunteers for the study, and 120 customers respond. Each participant is sent an accelerometer that can be worn to detect sleep onset through movement. The participants will experience all four temperature conditions, using the device to determine and record their sleep data for one week for each temperature condition.

- a Evaluate this investigation by considering the methods and possible sources of error or uncertainty.
- b Evaluate the appropriateness of the sample for the external validity of their conclusions.
- c Explain the benefit of repeating this investigation with further participants.

ISBN 978-1-009-25416-8 Gallagher et al

Chapter 8 review

Summary

Create your own set of summary notes for this chapter on paper or in a digital document. A model summary is provided in the Teacher Resources, which can be used to compare with yours.

Checklist

In the Interactive Textbook, the success criteria are linked from the review questions and will be automatically ticked when answers are correct. Alternatively, print or photocopy this page and tick the boxes when you have answered the corresponding questions correctly.

Success criteria – I am now able to:		Linked question
8A.1	Define 'partial sleep deprivation' in terms of inadequate quantity or quality of sleep	11a☐
8A.2	Describe the effects of partial sleep deprivation on a person's affective, behavioural and cognitive functioning	1☐, 3☐, 11b☐
8A.3	Explain and compare the affective and cognitive effects of a full night's sleep deprivation to those of blood alcohol concentration readings of 0.05 and 0.10	2☐
8A.4	Apply my understanding of sleep deprivation to real-world examples	1☐, 3☐, 11b☐
8B.1	Describe the features of a circadian rhythm sleep disorder	12a☐, 13d☐
8B.2	Describe the changes to a person's sleep–wake cycle due to Delayed Sleep Phase Syndrome, Advanced Sleep Phase Disorder and shiftwork circadian rhythm sleep disorder	5☐, 12c☐, 13a☐, c☐
8B.3	Describe the consequences and effects of Delayed Sleep Phase Syndrome, Advanced Sleep Phase Disorder and shift work	6☐, 13c☐
8B.4	Explain how circadian rhythm sleep disorders can be treated through bright light therapy	4☐
8B.5	Apply my understanding of circadian rhythm sleep disorders to real-world examples	6☐, 12c☐
8C.1	Describe effective sleep hygiene measures to improve sleep–wake patterns and mental wellbeing	12b☐
8C.2	Describe the influence of the zeitgebers of daylight, blue light, temperature, and eating and drinking patterns on sleep–wake patterns	10☐
8C.3	Describe how the adaptation to zeitgebers of daylight, blue light, temperature, and eating and drinking patterns can improve sleep–wake patterns and mental wellbeing	13b☐
8C.4	Apply my understanding of the influence of sleep hygiene and zeitgebers on sleep–wake patterns and mental wellbeing to real-world examples	12b☐, 13c☐

ISBN 978-1-009-25416-8 Gallagher et al

Key Science Skills

Skills	Questions and Skills boxes
Repeat experiments to ensure findings are robust	8C Section questions – 8c Chapter review questions – 8
Evaluate investigation methods and possible sources of error or uncertainty, and suggest improvements to increase validity and to reduce uncertainty	8C Key Science Skills 8C Section questions – 8a, b Chapter review – 7, 8, 9, 11c

Multiple-choice questions

The following information relates to Questions 1 and 2.

Ishir is 18 years old and is very concerned about his younger sister's recent health problems. Ishir finds it very stressful and worries that one night his sister will get sick in the middle of the night. Ishir finds that his constant thoughts about what could go wrong are preventing him from falling asleep. It often takes him more than two hours to finally fall asleep, even though he is trying to. Ishir then thinks that he will never fall asleep and decides to scroll through a video-sharing app on his phone to see if that could help make him tired.

1 What is a cognitive change that Ishir may be experiencing when he goes to school the following day after experiencing little sleep?

A Ishir may 'act out' in class and talk back to the teacher.
B Ishir may start crying uncontrollably when his best friend asks if he is all right.
C Ishir may have difficulty joining in with a ball game during lunchtime because of increased clumsiness.
D Ishir may find it hard to focus in Science class and he may not remember the details of an upcoming assignment.

2 In the following months, Ishir successfully passes his driver's licence test. Ishir knows that while on his P plates, he must have a BAC level of 0.00, meaning he cannot drink any alcohol before driving. Which of the following is correct in terms of the effects of partial sleep deprivation?

A If Ishir was sleep deprived for 17 hours, his driving would be worse than if he had a BAC level of 0.03.
B If Ishir is sleep deprived for 24 hours, his driving would be less affected than if he had a BAC level of 0.05.
C Ishir's driving would be similarly affected if he had 17 hours of sleep deprivation or a BAC level of 0.10.
D Ishir's driving would be more affected if he had 24 hours of sleep deprivation than if he had a BAC level of 0.10.

3 Patricia has been having mental health concerns recently and went to see her doctor. Her doctor recommended some ways for her to get a better sleep. How might good-quality sleep help improve Patricia's mental wellbeing?

A Good-quality sleep would allow Patricia to better regulate her emotions, reducing irritability and improving her overall mood.
B Better sleep will help Patricia cope better with stress.
C Patricia will be better able to concentrate and solve everyday problems with adequate sleep.
D All of the above.

ISBN 978-1-009-25416-8 Gallagher et al

4 A person experiencing an Advanced Sleep Phase Disorder can use bright light therapy to shift their sleep–wake cycle to a more desired time. When would be the best time for a person with an Advanced Sleep Phase Disorder to be exposed to light?

- **A** at midday when melatonin levels are at their highest
- **B** in the evening when they are feeling most tired, so that melatonin release can occur earlier
- **C** in the morning when they wake up, so that melatonin release can occur earlier and they can fall asleep at an acceptable time
- **D** in the early evening when they are beginning to feel tired, so that melatonin release is delayed until a more appropriate time

5 Gabriel finds that when she goes to bed at 10 p.m. she cannot fall asleep until midnight. Which of the following would not be a possible diagnosis for Gabriel?

- **A** Delayed Sleep Phase Syndrome
- **B** Advanced Sleep Phase Disorder
- **C** sleep disorder due to shift work
- **D** circadian rhythm sleep disorder

6 Fiona is a baker who works a very early morning shift in a bakery and has recently been showing symptoms of a shift work sleep disorder. Which of the following is not a possible consequence of a shift work sleep disorder for Fiona?

- **A** burning herself on the oven
- **B** accurately conducting a stock-take of ingredients required for the next day
- **C** dozing off while driving home from work
- **D** miscounting how many loaves of bread she makes

The following information relates to Questions 7–9.

A technology company is designing a new alarm clock that can wake a person through a bright light as well as an alarm.

7 Which of the following investigation methodologies would first be used by the company?

- **A** correlational study because they are determining the relationship between light and waking time
- **B** product, process or system development because they are designing a new product to meet a need
- **C** classification and identification because they need to classify the types of light that would best suit the clock
- **D** fieldwork because they need to determine how the clock would go in a natural setting

8 When the clock is ready for testing, a prototype is given to 10 company employees to trial. The employees use the clock for a week, writing down in a journal the time they wake up and how they feel upon awakening. Which of the following would be recommended to improve the validity of the research's findings and conclusions?

- **A** Repeat the study using another 10 different employees.
- **B** Repeat the study using a different self-report method.
- **C** Repeat the study using a large sample of participants from the wider community.
- **D** Repeat the study with the same 10 employees for a longer time.

9 Which of the following is not a possible source of error in this investigation?

- **A** The employees use a self-report method for recording their own sleep data.
- **B** There may be a systematic error by one employee misusing the clock on the first night.
- **C** The wrong time zone is shown on the clock, resulting in recordings being out by one hour each time.
- **D** A power outage resulted in the clock turning off for several minutes during the night and resetting the programmed settings.

ISBN 978-1-009-25416-8 Gallagher et al

10 Which of the following is most correct for zeitgebers?

- **A** Light is the zeitgeber with the strongest influence on the circadian rhythm.
- **B** Meal timing has a greater effect on the circadian rhythm than light.
- **C** Temperature has a smaller effect on the other peripheral clocks around the body.
- **D** Temperature, meal timing and light are not zeitgebers that can shift the circadian rhythm.

Short-answer questions

11 A study by Sundelin and team in 2017 investigated whether people avoid others who appear to be sleep deprived. To 122 participants (raters), they showed photographs of 25 people who had been deprived of sleep for two days. The raters were asked how much they would like to socialise with the people in the photographs, as well as rating the attractiveness, health, sleepiness and trustworthiness of the people in the photographs. The findings showed that the raters were less inclined to socialise with individuals who had not received sufficient sleep, and these individuals were also perceived to be less attractive, less healthy and more sleepy.

- **a** Explain how the researchers may have given the 25 people partial sleep deprivation. (1 mark)
- **b** The raters were less inclined to socialise with the sleep-deprived people. Identify which type of functioning this describes, and provide an example of how this type of functioning may be affected in one of the people with partial sleep deprivation. (2 marks)
- **c** The researchers want to increase the external validity of their study to see whether their findings can be relevant for a population of shift workers. Suggest two changes to the investigation methods to help improve the external validity. (2 marks)

12 Atticus is a protective services officer (PSO) who works to monitor train services and ensure the safety of commuters. PSOs are required to work shifts to ensure that all train services are covered, with shifts starting any time from 3 p.m. to 7 p.m., and lasting 8–10 hours. The next shift that Atticus works will be starting at 7 p.m. and finishing at 5 a.m.

- **a** Explain why a shift work sleep disorder is considered a circadian rhythm sleep disorder. (2 marks)
- **b** Provide an example of a sleep-related challenge for Atticus, and suggest how he could overcome this challenge through improving his sleep hygiene. (2 marks)
- **c** Explain why Atticus may develop a sleep disorder due to shift work, but another PSO who works a shift from 3 p.m. until 11 p.m. may not. (4 marks)

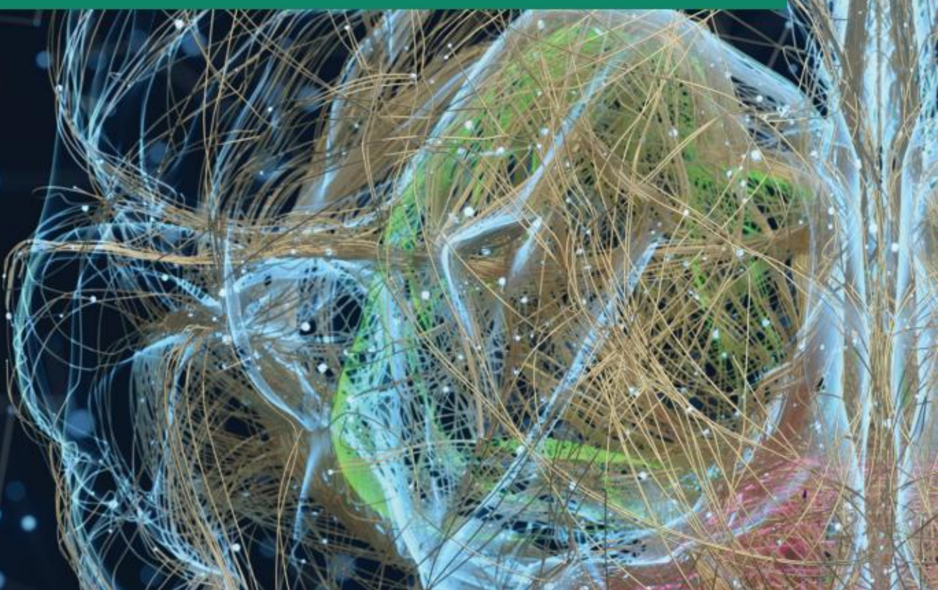
13 Caelan is 17 years old and has been experiencing mood and sleep problems for more than 12 months. His symptoms of irritability, impulsivity, low mood and poor concentration have been making it difficult for him at school, and so he often skips classes, instead choosing to sleep in and play video games. His family notice that his symptoms are present during school days but not on weekends or holidays, which makes his parents question whether his troubles are school-related. Caelan finally agrees to see a doctor who asks him some questions about his sleep. Caelan describes himself as a 'night owl' because in the evening he feels unable to fall asleep for 'hours' even though his bedroom is dark, comfortable and quiet. Because he takes so long to fall asleep, Caelan then has a lot of trouble waking up on time to get the bus to school. When he does manage to get out of bed, Caelan experiences the symptoms mentioned, which make him less likely to want to attend school the following day.

- **a** Identify the circadian rhythm sleep disorder that Caelan is likely experiencing. (1 mark)
- **b** Suggest one strategy related to the zeitgeber of temperature that could help Caelan fall asleep. (1 mark)
- **c** Explain why Caelan's family do not see his symptoms on the weekends. (2 marks)
- **d** Compare the timing of the release of melatonin for Caelan and the release of melatonin for his parents. (2 marks)

ISBN 978-1-009-25416-8 Gallagher et al

UNIT 4 HOW IS MENTAL WELLBEING SUPPORTED AND MAINTAINED?

CHAPTER 9 MENTAL WELLBEING



Aboriginal and Torres Strait Islander readers should be aware that this chapter contains images of people who have, or may have, passed away.

Introduction

Australia is often regarded as having one of the highest levels of health in the world when statistics such as life expectancy are considered. However, mental health conditions or low levels of mental wellbeing are surprisingly common. Close to 50% of the population will experience a mental disorder at some stage in their lives, and over a 12-month period almost one in five Australians will experience a mental disorder.

Beyond Australia, the numbers rise significantly, with the World Health Organization reporting that, worldwide, some 450 million people suffer from mental or behavioural disorders. In this chapter, you will learn what mental wellbeing is and the factors that influence it.

The World Health Organization, the global body that promotes optimal health and wellbeing, describes mental health (and wellbeing) as 'a state of emotional and social wellbeing in which individuals realise their own abilities, can cope with the normal stresses of life, can work productively and can contribute to their community'. Mental wellbeing can be thought of as a continuum: people can be mentally healthy, have mental health problems or experience a mental disorder. In this chapter, we touch on these aspects of the continuum with a particular focus on promoting mental wellbeing.

ISBN 978-1-009-25416-8 Gallagher et al

Curriculum

Area of Study 2

Outcome 2: What influences mental wellbeing?

Study Design	Learning intentions – at the end of this chapter I will be able to:
• Ways of considering mental wellbeing, including levels of functioning; resilience, as the ability to cope with and manage change and uncertainty; and social and emotional wellbeing (SEWB), as a multidimensional and holistic framework for wellbeing that encapsulates all elements of being (body, mind and emotions, family and kinship, community, culture, Country, spirituality and ancestors) for Aboriginal and Torres Strait Islander peoples	**9A Ways of considering mental wellbeing** **9A.1** Understand that there are a range of characteristics that contribute to mental wellbeing **9A.2** Identify key characteristics of mental wellbeing **9A.3** Describe key characteristics of someone with high levels of mental wellbeing **9A.4** Distinguish between key characteristics of mental wellbeing and apply key characteristics of mental wellbeing **9A.5** Understand social and emotional wellbeing (SEWB), as a multidimensional and holistic framework for wellbeing that encapsulates all elements of being (body, mind and emotions, family and kinship, community, culture, Country, spirituality and ancestors) for Aboriginal and Torres Strait Islander peoples
• Mental wellbeing as a continuum, with an individual's mental wellbeing influenced by the interaction of internal and external factors and fluctuating over time, as illustrated by variations for individuals experiencing stress, anxiety and phobia	**9B Mental wellbeing as a continuum and the factors that influence it** **9B.1** Understand that mental wellbeing is on a continuum **9B.2** Understand that mental wellbeing is influenced by internal and external factors – both risk and protective **9B.3** Identify internal and external factors that influence mental wellbeing **9B.4** Distinguish between internal and external factors that influence mental wellbeing **9B.5** Describe internal and external factors that influence mental wellbeing **9B.6** Apply internal and external factors that influence mental wellbeing, including to stress, anxiety and phobia **9B.7** Describe stress, anxiety and phobia **9B.8** Distinguish between stress, anxiety and phobia

ISBN 978-1-009-25416-8 Gallagher et al

Study Design	Learning intentions – at the end of this chapter I will be able to:
• The application of a biopsychosocial approach to maintaining mental wellbeing, with reference to protective factors including adequate nutritional intake and hydration and sleep (biological), cognitive behavioural strategies and mindfulness meditation (psychological) and support from family, friends and community that is authentic and energising (social)	**9C The biopsychosocial approach to maintaining and protecting mental wellbeing** **9C.1** Understand there are a range of biological, psychological and social factors that maintain and protect mental wellbeing and that they interrelate **9C.2** Identify the biological, psychological and social factors that maintain and protect mental wellbeing **9C.3** Describe the biological, psychological and social factors that maintain and protect mental wellbeing **9C.4** Explain the biological, psychological and social factors that maintain and protect mental wellbeing **9C.5** Apply the biological, psychological and social factors that maintain and protect mental wellbeing
• Cultural determinants, including cultural continuity and self-determination, as integral for the maintenance of wellbeing in Aboriginal and Torres Strait Islander peoples	**9D Cultural determinants of mental wellbeing** **9D.1** Understand and identify a range of cultural determinants that are integral for the maintenance of wellbeing in Aboriginal and Torres Strait Islander peoples **9D.2** Describe and explain a range of cultural determinants that are integral for the maintenance of wellbeing in Aboriginal and Torres Strait Islander peoples **9D.3** Apply a range of cultural determinants that are integral for the maintenance of wellbeing in Aboriginal and Torres Strait Islander peoples

Key Science Skills

- Evaluate data to determine the degree to which the evidence supports the aim of the investigation, and make recommendations, as appropriate, for modifying or extending the investigation
- Evaluate data to determine the degree to which the evidence supports or refutes the initial prediction or hypothesis
- Use reasoning to construct scientific arguments, and to draw and justify conclusions consistent with the evidence and relevant to the question under investigation
- Identify, describe and explain the limitations of conclusions, including identification of further evidence required
- Discuss the implications of research findings and proposals, including appropriateness and application of data to different cultural groups and cultural biases in data and conclusions

Glossary

Anxiety
Biological factor
Biological risk factor
Cultural continuity
Cultural determinant of wellbeing
Culture
Disorganised insecure attachment
Emotional wellbeing
External factor
Genetic vulnerability
High level of functioning
Internal factor
Life stressor
Mental disorder
Mental health and wellbeing
Mental health problem
Mentally healthy
Mindfulness meditation
Phobia
Protective factor
Psychological factor
Psychological risk factor
Resilience
Rumination
Self-determination
Self-efficacy
Social factor
Social risk factor
Social wellbeing
Stigma
Stress
Wellbeing

ISBN 978-1-009-25416-8 Gallagher et al

Concept map

Mental wellbeing can be considered in many different ways, depending on the context

9A Ways of considering mental wellbeing

Each individual is at a unique point on the mental wellbeing continuum, and this will fluctuate throughout their life

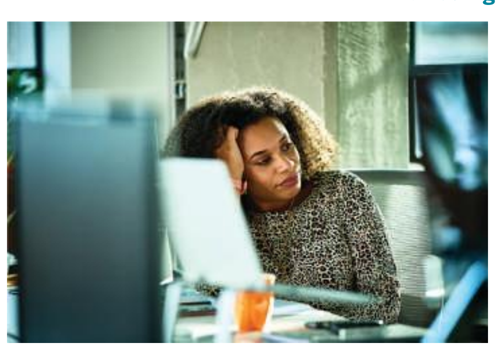
Biological, social and psychological factors play a role in mental wellbeing

9B Mental wellbeing as a continuum and the factors that influence it

9C The biopsychosocial approach to maintaining and protecting mental wellbeing

Culture plays a significant role in the maintenance of wellbeing for Aboriginal and Torres Strait Islander peoples

9D Cultural determinants of mental wellbeing



See the Interactive Textbook for an interactive version of this concept map interlinked with all concept maps for the course.

ISBN 978-1-009-25416-8 Gallagher et al

9A Ways of considering mental wellbeing

Study Design:
Ways of considering mental wellbeing, including levels of functioning; resilience, as the ability to cope with and manage change and uncertainty; and social and emotional wellbeing (SEWB), as a multidimensional and holistic framework for wellbeing that encapsulates all elements of being (body, mind and emotions, family and kinship, community, culture, Country, spirituality and ancestors) for Aboriginal and Torres Strait Islander peoples

Glossary:
Emotional wellbeing
High level of functioning
Life stressor
Mental disorder
Mental health and wellbeing
Mental health problem
Mentally healthy
Resilience
Social wellbeing
Wellbeing

ENGAGE

Why is mental wellbeing important?

In this chapter, we will discuss what mental wellbeing means and how to attempt to maintain it. But why should you care about your mental wellbeing? Is it important? The Australian Government has stated that almost half of all Australian adults – 7.3 million people – will experience mental ill-health at some point, and that the estimated cost to the Australian economy is up to $220 billion each year.

It is encouraging to know that many factors that adversely affect mental wellbeing are preventable and therefore we can take action to prevent mental disorders and to promote high levels of mental wellbeing. Keep reading and you will discover how you can ensure that you are doing your best to achieve optimal levels of mental wellbeing.

EXPLAIN

What is mental wellbeing and what is a high level of mental wellbeing?

The **mental health and wellbeing** of an individual falls on a spectrum, or continuum, from high to low. Each person is at a unique point on the spectrum, or continuum (Figure 9A–1), and this will change throughout their life, depending on the experiences they have and their **resilience** – their ability to cope with their experiences including adverse ones.

Mental health and wellbeing a beneficial emotional state in which a person realises their abilities, copes with the normal stresses of life, works productively and contributes to their community

Resilience the ability to recover from adversity

Mentally healthy the state of not having difficulty with everyday activities and displaying resilience

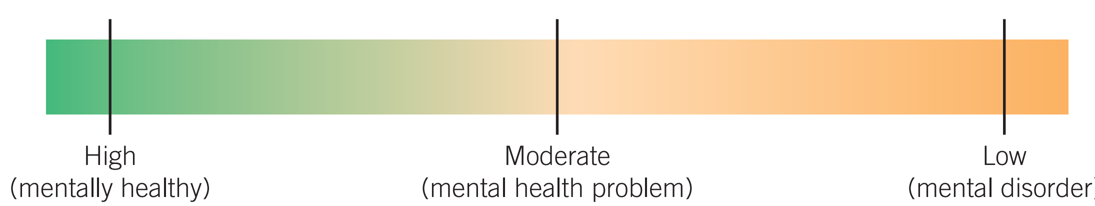


Figure 9A–1 Mental health and wellbeing is a continuum from high to low.

At the mentally healthy point on the continuum, or high level of mental wellbeing, a person has no mental impairment. However, this state is more than an absence of illness or disease. **Mentally healthy** people also:

- have a high level of functioning
- manage their feelings and emotions (high level of emotional wellbeing)

ISBN 978-1-009-25416-8 Gallagher et al

- can form positive relationships with others (high level of social wellbeing)
- cope with the normal stresses that arise every day; that is, they have the resilience to cope with and manage change and uncertainty
- think logically and problem solve
- have reasonable levels of confidence in their abilities and self-esteem.

The ability to maintain a high level of mental wellbeing is fundamental to our ability to go about everyday activities, such as attending work or school. As mentioned, people who are considered to have a high level of mental wellbeing have a range of characteristics, including:

- a high level of functioning
- social and emotional wellbeing
- resilience to life stressors.

Figure 9A–2 People who are mentally healthy can typically form positive relationships with others.

VIDEO 9A–1 MENTAL WELLBEING

High level of functioning

To determine whether you have the characteristics of a mentally healthy individual, you first need to consider the following.

- What is a **high level of functioning**?
- How does someone know if they have a high level of functioning?
- Is there a tool that can be used to assess this across different cultures and settings?

In collaboration with international experts, the World Health Organization (WHO) has developed and modified a scale over many years that can assess a person's level of functioning. The scale is based on six major life domains. The domains that form part of the WHO Disability Assessment Schedule 2.0 (WHODAS 2.0) are:

- cognition – understanding and communicating
- mobility – moving and getting around
- self-care – hygiene, dressing, eating and staying alone
- getting along – interacting with other people
- life activities – domestic responsibilities, leisure, work and school
- participation – joining in community activities.

Figure 9A–3 Assessing the level of functioning of a person using a questionnaire in an interview setting

High level of functioning the ability to carry out a wide range of daily activities, attend to self-care, maintain interpersonal relationships and demonstrate resilience in the face of everyday challenges

The assessment is a 36-item questionnaire designed to measure the level of functioning in adults aged 18 years and over (see Table 9A–1). The questions use the following scoring system:

0 = no difficulty

1 = mild difficulty

2 = moderate difficulty

3 = severe difficulty

4 = extreme difficulty or cannot do.

ISBN 978-1-009-25416-8 Gallagher et al

Table 9A–1 The World Health Organization Disability Assessment Schedule (WHODAS 2)

Reference no.	Question: Subject's ability to carry out these actions
Understanding and communicating	
D1.1	Concentrating on doing something for 10 minutes?
D1.2	Remembering to do important things?
D1.3	Analysing and finding solutions to problems in day-to-day life?
D1.4	Learning a new task, for example, learning how to get to a new place?
D1.5	Generally understanding what people say?
D1.6	Starting and maintaining a conversation?
Getting around	
D2.1	Standing for long periods such as 30 minutes?
D2.2	Standing up from sitting down?
D2.3	Moving around inside your home?
D2.4	Getting out of your home?
D2.5	Walking a long distance such as a kilometre (or equivalent)?
Self-care	
D3.1	Washing your whole body?
D3.2	Getting dressed?
D3.3	Eating?
D3.4	Staying by yourself for a few days?
Getting along with people	
D4.1	Dealing with people you do not know?
D4.2	Maintaining a friendship?
D4.3	Getting along with people who are close to you?
D4.4	Making new friends?
D4.5	Sexual activities?
Life activities	
D5.1	Taking care of your household responsibilities?
D5.2	Doing your most important household tasks well?
D5.3	Getting all the household work done that you needed to do?
D5.4	Getting your household work done as quickly as needed?
D5.5	Your day-to-day work/school?
D5.6	Doing your most important work/school tasks well?
D5.7	Getting all the work done that you need to do?
D5.8	Getting your work done as quickly as needed?
Participation in society	
D6.1	How much of a problem did you have in joining in community activities (for example, festivities, religious or other activities) in the same way as anyone else can?
D6.2	How much of a problem did you have because of barriers or hindrances in the world around you?
D6.3	How much of a problem did you have living with dignity because of the attitudes and actions of others?
D6.4	How much time did you spend on your health condition, or its consequences?
D6.5	How much have you been emotionally affected by your health condition?
D6.6	How much has your health been a drain on the financial resources of you or your family?
D6.7	How much of a problem did your family have because of your health problems?
D6.8	How much of a problem did you have in doing things by yourself for relaxation or pleasure?

ISBN 978-1-009-25416-8 Gallagher et al

The WHODAS 2.0 is one method that can be used to assess whether or not a person has a high level of functioning. From such assessments, we can surmise that a mentally healthy person will typically demonstrate high levels of functioning in most areas of life, which may include:

- activities of daily living; for example, self-care and personal hygiene
- work or occupational settings; for example, productive and achieving targets
- school settings; for example, participating and getting along with others
- within interpersonal relationships; for example, developing and maintaining friendships and relationships.

In addition to this, a person with a high level of mental wellbeing can typically maintain their high level of functioning when they encounter everyday challenges. Therefore, they are often referred to as adaptive or resilient because these everyday challenges do not significantly impair their functioning.

Figure 9A–4 Mentally healthy people can typically engage in daily work.

Social and emotional wellbeing

There are many aspects of **wellbeing**. The Australian Psychological Society refers to six 'wellness' domains, including both social and emotional. It is important to note that wellness is often considered to be a holistic concept that is difficult to break into separate areas because there is interplay between the different domains. However, mentally healthy people typically display traits associated with social and emotional wellbeing.

Wellbeing a complex combination of a person's physical, social, emotional, mental and spiritual health that is linked to happiness and life satisfaction

ISBN 978-1-009-25416-8 Gallagher et al

Social wellbeing relates to the connections you make with other people and your ability to get along with people in a community

Emotional wellbeing relates to the ability to feel a range of emotions and express them in a positive way

Social wellbeing relates to the connections you make with other people and your ability to get along with them in a community. It can relate to your ability to form meaningful relationships with friends, family, co-workers and intimate partner. Examples of high levels of social wellbeing are:

- developing positive relationships with family and friends
- respecting and interacting appropriately with people from different ethnic and cultural backgrounds
- being able to work as part of a team, such as at work or in a sports team
- contributing to society in some way such as through a volunteer organisation.

Figure 9A–5 Social wellbeing includes making a contribution to society, such as through volunteer work.

Emotional wellbeing refers to the ability to feel a range of emotions and express them in a positive way. Everyone experiences different emotions from time to time, and it is the ability to manage these emotions and share them in an appropriate way that is the measure of good emotional wellbeing. Examples of high levels of emotional wellbeing are:

- expressing a range of emotions relevant to the context
- controlling different emotions and responding to them in a positive manner
- acting in a positive manner and having a positive outlook
- identifying emotions in others and responding appropriately
- responding with appropriate emotions to setbacks.

Figure 9A–6 Emotional wellbeing relates to being able to share emotions in an appropriate way.

Resilience to life stressors

Resilience is the ability to respond or 'bounce back' to previous normal functioning when faced with adversity. Even people with high levels of mental wellbeing experience challenges that may cause grief, anger and despair; however, it is the capacity to adapt to or overcome stressful circumstances and continue with day-to-day life that demonstrates resilience. Some stressors that might require resilience are relationship breakdowns, experiencing a natural disaster and losing a home, the death of a loved one, work challenges, and failing a test or assessment.

Figure 9A–7 Resilience relates to your ability to bounce back from setbacks.

ISBN 978-1-009-25416-8 Gallagher et al

A person who is mentally healthy may encounter a **life stressor** and feel equipped to cope with it, demonstrating resilience. However, someone who is not mentally healthy may not feel that they can deal with such a stressor. The resources required to cope with stressors and promote resilience include strong social support, high levels of self-efficacy, being able to problem solve, and being able to make plans and carry them out. Therefore, the impact of a life stressor on mental wellbeing depends on one's resilience. Many of these factors can be learned and developed, so you can work to improve your level of resilience.

Life stressor an everyday or conceivable event, such as a relationship breakdown, work challenge or failing a test

WORKSHEET 9A–1 MENTAL WELLBEING SCENARIOS

Check-in questions – Set 1

1 How does the WHO define mental health (and wellbeing)?
2 List three characteristics you would expect a mentally healthy person to demonstrate.
3 What tool does the WHO recommend for determining someone's level of functioning?
4 Explain the difference between social wellbeing and emotional wellbeing.

ACTIVITY 9A–1 RESILIENCE IN THE NEWS

Look through a newspaper or an online news site. You will probably see a number of stories in which people demonstrate resilience to life stressors. Read some of these stories and see if you can identify examples of social and emotional wellbeing as well as other characteristics of a mentally healthy person.

Mental health problems and mental disorders

Mental health problems

A person in the middle of the mental wellbeing continuum may have a **mental health problem**. This is typically recognised by the disruption that it causes to everyday functioning. These problems typically do not last as long as mental disorders and may result in mild and temporary impairment. When a person is experiencing a mental health problem, there is often some disruption to their usual level of social and emotional wellbeing, which may be due to a range of reasons, including relationship stressors or work stressors.

Mental health problem a relatively short-term disruption that impacts on a person's everyday functioning

Mental health problems can be considered as natural responses to negative events in life that most people experience at some stage. Characteristics that indicate that someone may be experiencing a mental health problem include:

- increased or decreased sleep and appetite
- loss of energy and motivation
- difficulty concentrating
- difficulty focusing/completing work or study tasks
- irritability
- becoming withdrawn.

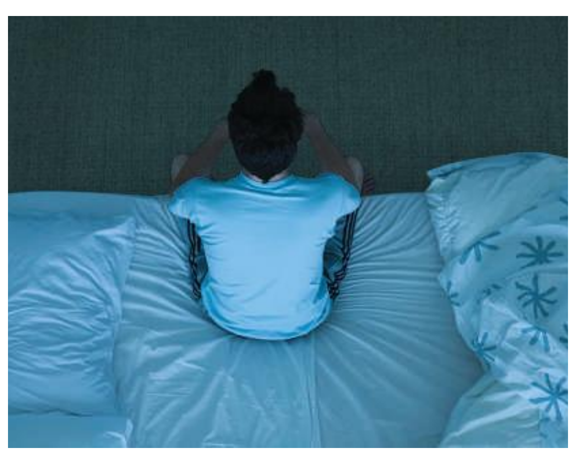


Figure 9A–8 People with mental health problems may have increased or decreased sleep.

ISBN 978-1-009-25416-8 Gallagher et al

Mental disorder a condition that affects mood, thinking and behaviour and is typically long lasting

Mental disorders

Approximately 20% of Australians will experience a **mental disorder** in any given 12-month period. These disorders usually affect mood, thinking and behaviour and are typically diagnosed using set criteria. Mental disorders include conditions such as major depression and schizophrenia, and often lead to a person experiencing the three D's: distress, dysfunction and deviance.

Figure 9A–9 People with mental disorders often find it difficult to complete daily activities.

In mental disorder:

- distress typically refers to the unpleasant experience of the person with the disorder or their family and friends, such as unpleasant or upsetting emotions like sadness, anxiety or feeling overwhelmed
- dysfunction refers to the impact the condition has on the person's ability to complete daily activities and cope with everyday life, such as attending work or school, and participating in events with family and friends
- deviance relates to thoughts and behaviours that are inconsistent with the person's culture or society, including actions such as speaking out of turn, lashing out at others and socially withdrawing.

In addition to distress, dysfunction and deviance, characteristics that indicate someone may be experiencing a mental disorder include:

- reduced levels of day-to-day functioning
- reduced ability to cope with and manage change and uncertainty
- impaired ability to engage in social relationships
- significant changes in thoughts, feelings and behaviours or a lack of interest (apathy)
- serious or prolonged changes in typical character
- impaired ability to function independently, such as taking care of oneself at home.

Table 9A–2 Characteristics of mental wellbeing across the continuum

Mentally healthy	Mental health problems	Mental disorders
• High level of functioning • Form positive relationships with others (high level of social wellbeing) • Manage feelings and emotions (high level of emotional wellbeing) • Cope with day-to-day stresses; that is, cope with and manage change and uncertainty • Think logically and problem solve • Have reasonable level of confidence in their abilities and self-esteem	• Have increased or decreased sleep and appetite • Experience loss of energy and motivation • Have difficulty concentrating • Have difficulty focusing/ completing work or study tasks • Experience irritability • Become withdrawn	• Have reduced level of day-to-day functioning • Have reduced ability to cope with and manage change and uncertainty • Have impaired ability to engage in social relationships • Experience significant changes in thoughts, feelings, behaviours or lack of interest (apathy) • Show serious or prolonged changes in typical character • Have impaired ability to function independently, such as taking care of oneself at home

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 2

1 Describe what it means for mental wellbeing to be represented on a continuum.
2 Explain the difference between mental health problems and mental disorders.

Aboriginal and Torres Strait Islander peoples' social and emotional wellbeing framework

A further aspect of mental wellbeing is to consider how it is viewed by Aboriginal and Torres Strait Islander peoples. As has been introduced in Sections 5D and 6D, Aboriginal and Torres Strait Islander peoples have diverse cultures, social structures and a history of unique, complex knowledge systems. Mental wellbeing is one element of their multidimensional and holistic view of social and emotional wellbeing (SEWB). Broadly speaking, social and emotional wellbeing is the foundation for physical and mental health for Aboriginal and Torres Strait Islander peoples. This is a holistic concept that may change across the life span of an individual; what is important for a child's social and emotional wellbeing may be quite different from what is important to an Elder. Aboriginal and Torres Strait Islander peoples' understanding of social and emotional wellbeing varies between different cultural groups and individuals.

LINK 5D ABORIGINAL AND TORRES STRAIT ISLANDER WAYS OF KNOWING

LINK 6D MNEMONIC DEVICES TO INCREASE ENCODING, STORAGE AND RETRIEVAL

Figure 9A–10 proposes a model for Aboriginal and Torres Strait Islander peoples SEWB with seven overlapping domains: body, mind and emotions, family and kinship, community, culture, Country, and spirituality and ancestors. The seven SEWB domains are sources of wellbeing and connection that support a strong and positive identity.

As the model suggests, at the centre is the individual, who is surrounded by a network of relationships between individuals, family, kin and community. It also recognises the importance of connection to land, culture, spirituality and ancestry, and how these affect the individual.

Figure 9A–10 A model of social and emotional wellbeing for Aboriginal and Torres Strait Islander peoples. *Source: National Strategic Framework for Aboriginal and Torres Strait Islander Peoples' Mental Health and Social and Emotional Wellbeing 2017–2023* © Commonwealth of Australia 2017.

ISBN 978-1-009-25416-8

Table 9A–3 provides a brief description of each of these domains, and examples of risk and protective factors.

Table 9A–3 The social and emotional wellbeing domains

Domain	Description	Examples of risk factors	Examples of protective factors
Connection to body	Physical health – feeling strong and healthy and able to physically participate as fully as possible in life.	• Chronic and communicable diseases • Poor diet • Smoking	• Access to good healthy food • Exercise • Access to culturally safe, culturally competent and effective health services and professionals
Connection to mind and emotions	Mental health – ability to manage thoughts and feelings.	• Developmental/ cognitive impairments and disability • Racism • Mental illness • Unemployment • Trauma including childhood trauma	• Education • Agency: assertiveness, confidence and control over life • Strong identity
Connection to family and kinship	Connections to family and kinship systems are central to the functioning of Aboriginal and Torres Strait Islander societies.	• Absence of family members • Family violence • Child neglect and abuse • Children in out-of-home care	• Loving, stable accepting and supportive family • Adequate income • Culturally appropriate family-focused programs and services
Connection to community	Community can take many forms. A connection to community provides opportunities for individuals and families to connect with each other, support each other and work together.	• Family feuding • Lateral violence • Lack of local services • Isolation • Disengagement from community • Lack of opportunities for employment in community settings	• Support networks • Community controlled services • Self-governance
Connection to culture	Connection to a culture provides a sense of continuity with the past and helps underpin a strong identity.	• Elders passing on without full opportunities to transmit culture • Services that are not culturally safe • Languages under threat	• Contemporary expressions of culture • Attending national and local cultural events • Cultural institutions • Cultural education • Cultural involvement and participation
Connection to Country	Connection to Country helps underpin identity and a sense of belonging.	• Restrictions on access to Country	• Time spent on Country
Connection to spirituality and ancestors	Spirituality provides a sense of purpose and meaning.	• No connection to the spiritual dimension of life	• Opportunities to attend cultural events and ceremonies • Contemporary expressions of spirituality

Source: National Strategic Framework for Aboriginal and Torres Strait Islander Peoples' Mental Health and Social and Emotional Wellbeing 2017–2023 © Commonwealth of Australia 2017

ISBN 978-1-009-25416-8 Gallagher et al

As the SEWB model suggests, mental health and SEWB for Aboriginal and Torres Islander peoples is also influenced by social, historical and political determinants. It should be noted that these determinants do not occur in isolation, but affect SEWB concurrently and cumulatively. Social determinants include socio-economic status and the impact of poverty, unemployment, housing, educational attainment, racial discrimination, exposure to violence, trauma and stressful life events, and access to community resources. Historical determinants refer to the impact of past government policies and the extent of historical oppression and cultural displacement experienced by individuals, families and communities. Political determinants refer to the unresolved issues of land, control of resources, cultural security, and the rights of self-determination and sovereignty, which are recognised as contributing to health and wellbeing and reducing health inequities for Aboriginal and Torres Strait Islander peoples.

A SEWB framework is useful for considering mental wellbeing, particularly for Aboriginal and Torres Strait Islander peoples because it makes it clear that mental health issues are still entwined with the past injustices associated with colonisation. The framework demonstrates that there is an interactive relationship between SEWB and mental health where a person can experience relatively good SEWB and yet still experience mental health problems, or vice versa.

Section 9D continues the discussion of mental wellbeing in relation to Indigenous culture.

LINK 9D CULTURAL DETERMINANTS OF MENTAL WELLBEING

Check-in questions – Set 3

1 List the seven domains that make up the Aboriginal and Torres Strait Islander social and emotional wellbeing framework.
2 Explain why considering mental wellbeing within a social and emotional wellbeing framework may be useful for Aboriginal and Torres Strait Islander peoples.

Section 9A questions

1 Give three characteristics of a mentally healthy person.
2 Define 'resilience'.
3 List three characteristics of a person who has mental health problems.
4 Describe the characteristics of someone demonstrating a high level of functioning.
5 Outline why resilience to stressors might indicate that you are mentally healthy.
6 Describe how the social and emotional wellbeing framework influences the view that Aboriginal and Torres Strait Islander peoples may have of mental wellbeing.
7 Outline how a connection to community may influence mental wellbeing for Aboriginal and Torres Strait Islander peoples.

ISBN 978-1-009-25416-8 Gallagher et al

9B Mental wellbeing as a continuum and the factors that influence it

Study Design:
Mental wellbeing as a continuum, with an individual's mental wellbeing influenced by the interaction of internal and external factors and fluctuating over time, as illustrated by variations for individuals experiencing stress, anxiety and phobia

Glossary:
Anxiety
Biological factor
External factor
Internal factor
Phobia
Psychological factor
Social factor
Stress

ENGAGE

You can influence your mental wellbeing

It is important to realise that you can influence your mental wellbeing. In this section you will learn that there are a range of factors that influence mental wellbeing, and that many of these are under your control, such as nutritional intake and hydration, styles of thinking, exercise levels and relationships. Although many factors that influence mental wellbeing are difficult to control, if you focus on those that you can control, you can approach your mental wellbeing with a sense of mastery. In this way, you may improve your mental wellbeing as well as your general wellbeing.

EXPLAIN

Factors that influence mental wellbeing

There are a range of factors that can cause your mental wellbeing to change. Throughout life, everyone's mental wellbeing will be challenged; however, different people have different abilities to cope with the challenges, depending on the influences in their lives.

Factors that can influence mental wellbeing can be:

- **external factors**, which originate outside a person
- **internal factors**, which come from within a person.

External factor
a factor that influences mental wellbeing and originates from outside a person, such as the physical and social environment

Internal factor
a factor that influences mental wellbeing and originates from within a person, such as genetics and hormones

The biopsychosocial model is based on the idea that an illness does not have a single cause, but results from the close interaction between biological, psychological and social factors. This can be a useful way of thinking about the range of internal and external factors that influence mental wellbeing (this model will be expanded upon later in the chapter).

These three factors can be categorised as internal (biological and psychological) or external (social) as shown in Figure 9B–1.

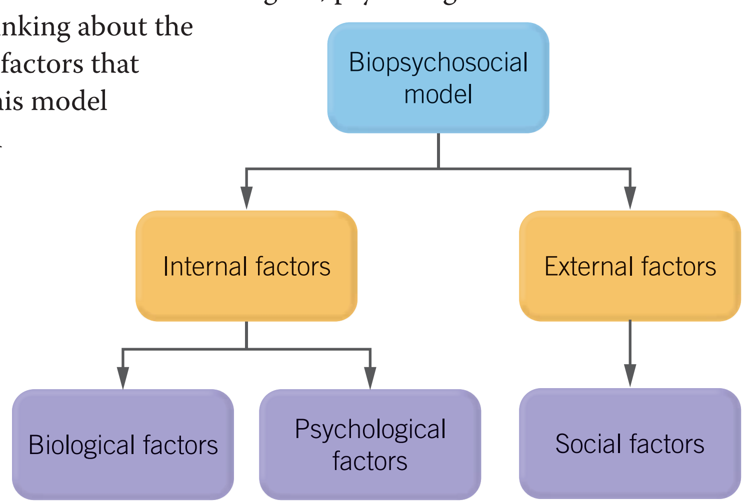


Figure 9B–1 The biopsychosocial model and its links to internal and external factors

ISBN 978-1-009-25416-8 Gallagher et al

Figure 9B–2 Genetics are an example of a biological factor.

Biological factors

The biological component of the biopsychosocial model refers to the functioning of a person's body, which is often outside the control of the individual. Biological factors are considered to be internal factors. Our bodies are complex and made up of systems that work closely together to ensure we can function in day-to-day life. People can be more vulnerable to a disorder at different times because of **biological factors** such as:

- genetics
- sex
- neurotransmitter function
- hormones
- immune function
- nervous system activity
- physical health.

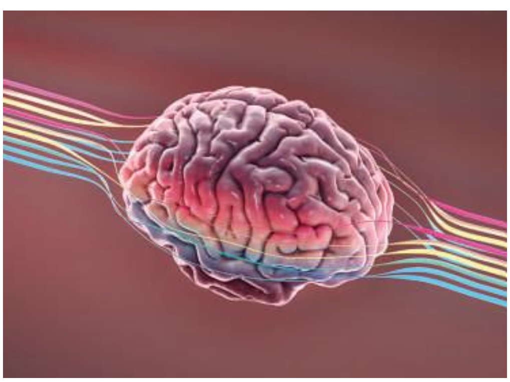


Figure 9B–3 Psychological factors relate the brain and thought processes.

Psychological factors

The psychological component of the biopsychosocial model refers to the influences that come from mental processes and may relate to prior learning experiences and memory. They are considered to be internal factors. **Psychological factors** include:

- styles of thinking
- beliefs and attitudes
- emotions
- learning and memory
- personality traits.

Biological factor a factor that relates to the physiological functioning of the body

Psychological factor a factor that relates to the functioning of the brain and the mind, including cognitive and affective processes such as thought patterns and memory

Social factor a factor that relates to the social components of a person's environment

Social factors

The social component of the biopsychosocial model refers to the conditions in which people live and grow. They are considered to be external factors. Examples of **social factors** are:

- relationships
- early life experience
- education level
- income
- social support
- stability of accommodation
- experience of abuse
- cultural values
- employment
- discrimination.

Figure 9B–4 Social factors include the relationships we have with others.

ISBN 978-1-009-25416-8 Gallagher et al

This framework is a useful way to understand the many factors that interact with each other and can contribute to the mental wellbeing of an individual. Each domain is given equal importance, which is often considered a holistic approach. However, specific factors may have more or less influence on a person's mental wellbeing. In addition, factors often combine and interact in a complex way. Thus, these factors should not be seen as separate and disconnected but rather as interwoven, each influencing each other. For example, being female may place you at risk of sexual discrimination in some societies, or losing your job will increase your level of stress hormones.

Table 9B–1 Internal and external factors that can influence mental wellbeing

Internal factors	External factors
• Genetics • Sex • Neurotransmitter function • Hormones • Immune function • Nervous system activity • Negative thinking • Beliefs and attitudes • Emotions • Learning and memory • Personality traits	• Relationships • Education level • Income • Social support • Homelessness • Experience of abuse • Cultural values • Employment • Discrimination

WORKSHEET 9B–1 FACTORS INFLUENCING MENTAL WELLBEING DOC

4A INTERNAL AND EXTERNAL STRESSORS LINK

Check-in questions – Set 1

1 Describe the difference between internal and external factors that can influence mental wellbeing.

2 Outline how the biopsychosocial model categorises internal and external factors, and explain why this model may be useful in considering the role such factors play in mental wellbeing.

Variations in internal and external factors during stress, anxiety and phobia

A range of internal and external factors may apply to conditions people experience in society, such as stress, anxiety and phobia.

Stress is a state of mental or emotional and physiological tension resulting from factors that are perceived to challenge or threaten our ability to cope.

Anxiety is an emotion akin to worrying and uneasiness that something is wrong or something bad is going to happen, and is usually accompanied by physiological signs.

Figure 9B–5 Many things can contribute to stress.

Stress
a state of mental or emotional and physiological tension, resulting from factors that are perceived to challenge or threaten our ability to cope

Anxiety
an emotion akin to worrying and uneasiness that something is wrong or something bad is going to happen, usually accompanied by physiological signs

ISBN 978-1-009-25416-8 Gallagher et al

It is an adaptive response and is usually helpful in the short term to deal with threats. However, when anxiety is severe, disproportionate to the threat and does not subside, it can be counterproductive and disabling.

The term ‘anxiety disorder’ describes when chronic and/or severe anxiety interferes with someone’s daily life and stops them doing what they want to do. It is usually thought of as a group of disorders with different characteristics.

Figure 9B–6 Objects such as spiders can be a source of a phobia.

Phobia is a persistent, intense, irrational fear of a specific object or event. The person’s fear of the object or event is so intense that they try to avoid the feared stimulus or, if faced with it, experience acute physiological arousal – the flight-or-fight-or-freeze response.

Phobia
a persistent, intense, irrational fear of a specific object or event

Table 9B–2 Characteristics of stress, anxiety and phobia

	Stress	Anxiety	Phobia
When experienced	Typically, people experience this in situations in daily life	Typically, people experience this in situations in daily life	Not experienced by most people in daily life
Whether a mental disorder	May contribute to developing a mental disorder	May contribute to developing a mental disorder	A diagnosed mental disorder
Level of impact	Can impact on day-to-day functioning if not well managed	Can impact on day-to-day functioning if not well managed	Significantly impacts on day-to-day functioning if not well managed
Adaptive or helpful?	Can be adaptive and helpful in some situations	Can be adaptive and helpful in some situations	Not typically adaptive and helpful
Experienced in response to	Can be experienced in response to a wide range of objects/events	Can be experienced in response to a wide range of objects/events	Typically experienced in relation to a specific object/event

There are a range of internal and external factors that may be more likely to apply to people experiencing stress and anxiety, and these are listed in Table 9B–3. Consider the following example of Sandy, and try to identify examples of these factors and how they may be contributing to her stress and anxiety.

ISBN 978-1-009-25416-8 Gallagher et al

Sandy is a 23-year-old university student in her final year of studying medicine. At the beginning of her degree, Sandy would have considered herself to have a high level of mental wellbeing. However, as her degree has progressed, Sandy has found that her levels of stress and anxiety have risen, and consequently, she feels that her level of mental wellbeing has reduced.

As a result of her demanding university degree as well as balancing part-time work and a relationship, Sandy's commitment to regular exercise has been challenged and sometimes weeks pass by without her going for her daily jog. Sandy's diet has deteriorated over the past few years, and she is consuming a lot more 'convenience' foods. As a result of these two lifestyle changes, she has put on quite a few extra kilos in the past couple of years, and she knows she would be considered overweight for the first time in her life.

On most nights, Sandy gets fewer than 6 hours of sleep, because she studies late and also lies awake thinking about whether or not she is happy. Given all of this study, Sandy has also neglected her old high school friends and at times she feels quite lonely. She wonders if becoming a doctor has been worth all of these sacrifices. She also feels stressed about the rest of her life and whether or not she will ever find enjoyment again, because many qualified doctors she has spoken tell her it only gets worse once you graduate.

Table 9B–3 Internal and external factors that may apply to people experiencing stress and anxiety

Internal factors		External factors
Biological	**Psychological**	**Social**
• Genetic vulnerability/predisposition • Poor sleep • Substance use/misuse • Poor response to medication due to genetic factors • Lack of exercise • Disease and injury	• Personality traits such as poor self-efficacy • Rumination • Impaired reasoning and coping skills	• Loss of a significant relationship • Lack of support from family and friends (loneliness) • Poverty

There are a range of internal and external factors that may be more likely to apply to people experiencing a phobia (Table 9B–4). Consider the following example of Arjun and try to identify examples of these factors that he may be experiencing.

Arjun remembers vividly the day he was walking home from school in Year 9 when a neighbour's dog bounded out of their front yard and bit him on the side of his leg. The bite required a few stitches, and Arjun has been petrified of dogs ever since. Following this event, Arjun's parents drove him to and from school each day so that he would not have to walk in the local streets where he knew there were many dogs in front yards.

Now a young adult, Arjun has considered seeing a psychologist about his fear of dogs, but he does not want to be thought of as one of those 'crazy people' who needs to see a 'shrink'. Instead, to manage his fear, Arjun never walks in open streets, but drives or jogs everywhere. If he is in an urban area and sees someone approaching with a dog, he crosses to the other side of the road. This has led to some awkward situations, where he has had to make up excuses for not going on walks with friends, but he would much rather this than endure the overwhelming stress he feels when walking out in the open near dogs. Arjun constantly reminds himself that dogs are born to bite, and that it is only a matter of time until he is bitten again, unless he avoids dogs.

ISBN 978-1-009-25416-8 Gallagher et al

Table 9B–4 Internal and external factors that may apply to people experiencing phobia

Internal factors		External factors
Biological	**Psychological**	**Social**
• Neurotransmitter dysfunction (GABA) • Family history of mental health problems • Gender (more common in females) • The role of stress response • Long-term potentiation (constant pairing of fear + object of fear)	• Developmental stage (specific phobias usually develop in childhood) • Personality traits such as negativity and high inhibition • Traumatic event results in classical conditioning of phobic object and fear (behavioural model) • Avoidance – negative reinforcement/ operant conditioning (behavioural model) • Cognitive bias including memory bias and catastrophic thinking (cognitive model)	• Parental modelling • Family history of mental health problems • Specific environmental trigger • Transmission of threat information • Stigma related to receiving treatment • Family involvement and accommodation

LINK CHAPTER 10

Check-in questions – Set 2

1 What is stress?
2 What is the difference between anxiety and an anxiety disorder?
3 List three characteristics associated with experiencing a phobia.

ACTIVITY 9B–1 MY MENTAL WELLBEING CONTINUUM

Complete this activity in pairs. Individually or with your partner, draw the mental wellbeing continuum. Once you have done this, place a cross on the continuum for where you see yourself today. Think of a time when you and your partner have been at a different point on the continuum and place a cross there also. Take turns to explain to one another what changed in your life to move you up or down the continuum. See if you can link this change to some of the characteristics of mental wellbeing listed in Table 9A–2.

9B SKILLS

VIDEO 9B–1 SKILLS: QUESTIONS ON SCENARIOS

Questions on scenarios

In the VCE Psychology exam, you may be provided with a scenario and asked to identify and apply factors that are internal or external influences on mental wellbeing.

Scenario:

In the lead-up to her VCE exams, Sakura was feeling quite stressed. She had always told herself that she wasn't good at performing well under time pressure, such as in exams, because she often achieved her worst results for a semester in the final exam. She was also stressed because she had left revision to the last minute, as she preferred to work a couple of extra shifts on the weekend at her local café and earn some extra money for schoolies, instead of revising. Sakura also found that she could not concentrate for too long at a time when revising – she typically started feeling drowsy after only 20 minutes. She wonders if this might be because she mostly studies in the evening, just before going to bed.

ISBN 978-1-009-25416-8 Gallagher et al

Question:

Outline an internal and an external factor that may be contributing to Sakura's stress, and therefore mental wellbeing, in the lead-up to her VCE exams.

Attempted answer:

Internally, Sakura believes that she will not do well in her exams, and this may contribute to her feeling stressed about the overall result.

Externally, Sakura has let her part-time work and desire for more money reduce her revision time, which has contributed to greater amounts of stress in the lead-up to her exams.

Suggested answer:

Internal factor – negative thinking: Sakura 'always told herself that she wasn't good at performing well under time pressure', which is an example of negative thinking. This can lead to a cycle of worry in the lead-up to her VCE exams, causing stress and lowering Sakura's mental wellbeing.

External factor – employment: Sakura has 'preferred to work a couple of extra shifts on the weekend at her local café and earn some extra money for schoolies, instead of revising'. This has reduced the available time that Sakura has to prepare her exams, causing stress and lowering her mental wellbeing.

Key points to remember:

- When identifying and applying internal and external factors that influence mental wellbeing, start by stating the category your factor belongs to (internal or external) and then list the examples you have chosen.
- Use quotation marks to clearly provide examples from the scenario that back up your example.
- Make a link from your example to the impact on mental wellbeing.

Section 9B questions

1 Explain why a continuum is a reasonable method of representing mental wellbeing.

2 Justify why external factors that influence mental wellbeing may be easier to modify than internal factors.

3 Read the following example and outline an internal and an external factor that may be contributing to Tom's level of mental wellbeing.
Tom has not been enjoying his job for several months. He feels as though his boss is unfairly 'picking' on him and asking him to do tasks that he knows Tom is not capable of completing. As a result, Tom has been very grumpy, and this recently contributed to him breaking up with his boyfriend of six months. Following the break-up, Tom returned to his old habit of smoking, something he swore he would not take up again. Although the short-term stress relief of a cigarette helps, Tom spends time each night telling himself that 'smoking is dirty' and 'nobody wants to date someone who smokes'. These thoughts often keep him awake into the night, and he is finding that he is only getting about five hours sleep most nights. Tom feels as though his stress is getting on top of him.

4 Using a description of each as your basis, distinguish between stress, anxiety and phobias.

5 Explain how experiencing anxiety could be adaptive and helpful in some situations.

ISBN 978-1-009-25416-8 Gallagher et al

9C The biopsychosocial approach to maintaining and protecting mental wellbeing

Study Design:
The application of a biopsychosocial approach to maintaining mental wellbeing, with reference to protective factors including adequate nutritional intake and hydration and sleep (biological), cognitive behavioural strategies and mindfulness meditation (psychological) and support from family, friends and community that is authentic and energising (social)

Glossary:
Biological risk factor
Disorganised insecure attachment
Genetic vulnerability
Mindfulness meditation
Protective factor
Psychological risk factor
Rumination
Self-efficacy
Social risk factor
Stigma

ENGAGE

Head to Health

By now you probably realise the importance of doing your best to maintain high levels of mental wellbeing. But you may be wondering how you can do this. The Australian Government's Department of Health has set up a website, called *Head to Health*, to integrate many of the digital resources that are available for people to promote their mental health and wellbeing, and this can be accessed by all Australians. *Head to Health* has more than 500 digital resources to support mental health and wellbeing. There are sections on supporting yourself and supporting others, and you can subscribe to their monthly newsletter. Much of the information covered in this section of the chapter on protective factors is included on the website. It would be a good idea to spend some time exploring the *Head to Health* website.

Figure 9C–1 The *Head to Health* website has resources to help you support your own mental wellbeing, as well as tools to support those around you.

ISBN 978-1-009-25416-8

EXPLAIN

Factors contributing to, and protecting from, mental disorders

9A WAYS OF CONSDERING MENTAL WELLBEING LINK

Previously we considered the biopsychosocial model in relation to internal and external factors affecting mental wellbeing. This is also a useful framework for considering the factors that contribute to the development and progression of, as well as protection from, mental disorders. This model suggests that there are biological, psychological and social risk and **protective factors** that all interact and play a role in increasing or decreasing the chance of developing a mental disorder. this section, we shall consider examples of biological, psychological and social risk and protective factors in relation to mental wellbeing.

Protective factor a factor that plays a role in decreasing the chance of developing a mental disorder

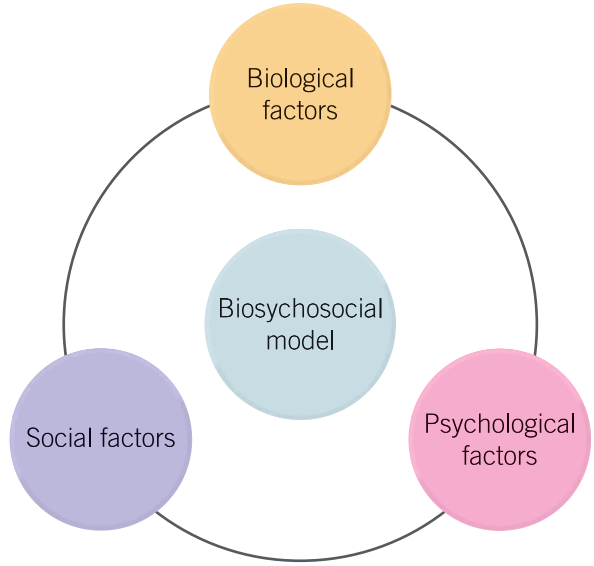


Figure 9C–2 The biopsychosocial model of mental wellbeing

VIDEO 9C–1 PROTECTIVE FACTORS IN MENTAL WELLBEING

Biological risk factors

Biological risk factors are a range of factors that relate to the physiological functioning of the body. Within this range, genetic factors are usually important; other biological factors are biochemical, such as poor response to medication (which may interact with genetic factors), substance abuse and environmental factors affecting physiology, such as light and noise affecting sleep. These are all factors that can contribute to the development and progression of mental disorders.

Biological risk factor a factor that relates to the physiological functioning of the body, and may contribute to mental disorders

Genetic vulnerability an increased likelihood that a person will develop a particular mental disorder because of their DNA

Genetic vulnerability

Genetics refers to the DNA that is passed on from parents to their children and this is outside the control of the individual. A **genetic vulnerability**, also referred to as a genetic predisposition, is an increased likelihood that a person will develop a particular illness or physical characteristic due to the DNA that they carry. There are a range of mental disorders that have a genetic vulnerability, including schizophrenia and autism spectrum disorders.

A genetic vulnerability does not guarantee that an individual will develop a certain condition, but it does predispose them to higher risk.

Poor response to medication

Medication is typically formulated with ingredients that are designed to interact with an aspect of a person's biology. A poor response to medication happens if a person takes a drug to relieve symptoms of a condition, but this does not occur. For example, some antidepressant medications may not alleviate the symptoms of poor sleep, sadness and feeling overwhelmed

Figure 9C–3 A poor response to medication can be a biological risk factor.

ISBN 978-1-009-25416-8 Gallagher et al

in someone with major depression, and could even contribute to worsening the symptoms. Often, people have to try several medications before they find one that works for them.

Everyone's DNA is unique, so some people respond poorly to medication. It may be that their genes affect the absorption, distribution or metabolism of a particular medication.

Poor sleep

Sleep is vital as a restorative process to prepare the body for the rigours of day-to-day life. Poor sleep has a range of physiological impacts on the body, which can contribute to a lack of biological resources to cope with the demands of daily life, which in turn can contribute to developing a mental disorder. Poor sleep can contribute to issues with memory consolidation, inability to restore neurotransmitter levels and reduced resilience. Sleep problems are common in patients with anxiety, depression, bipolar disorder and attention deficit hyperactivity disorder (ADHD).

Substance use

Substance use is a biological factor because the ingredients in the substance interact with an aspect of a person's biology. Substance abuse refers to the harmful use of, or dependence on, psychoactive substances, including alcohol and illicit drugs. Dependence on a particular drug can prevent a person from being able to function in day-to-day life without that drug. Consequently if this drug is not consumed, a person often cannot manage the demands of everyday life, which may contribute to a mental disorder.

Substances that increase the risk of developing a mental disorder can be legal or illegal. Some examples are shown in Table 9C–1.

Table 9C–1 Some substances that increase the risk of developing a mental disorder

Legal substances	Illegal substances
• Tobacco • Alcohol • Codeine • Morphine • Some sleep medications	• Cocaine • Marijuana • Heroin • Amphetamines

Most types of mental disorders, including mood, anxiety, personality and schizophrenia-spectrum disorders, are associated with an increase in co-occurring substance use disorder, when compared to the general population. It has been demonstrated that adults with severe mental disorders have high rates of co-occurring substance use disorders, typically around 50%.

Figure 9C–4 Tobacco use can increase the risk of developing a mental disorder.

Check-in questions – Set 1

1. Explain how risk factors are classified as biological.
2. Describe what genetic vulnerability is in relation to mental disorders.
3. Outline how poor sleep may contribute to the development of a mental disorder.

ISBN 978-1-009-25416-8 Gallagher et al

Psychological risk factors

Psychological risk factor a factor that relates to the functioning of the brain and the mind, which may contribute to mental disorders

Psychological risk factors are a range of factors that relate to the functioning of the brain and the mind, including cognitive and affective processes such as thought patterns and memory. We will look specifically at rumination, impaired memory and reasoning, stress and poor self-efficacy as examples of psychological risk factors contributing to mental disorders.

9A WAYS OF CONSIDERING MENTAL WELLBEING LINK

Figure 9C–5 There are a range of psychological factors that can contribute to developing a mental disorder.

Rumination

Rumination thinking about and focusing on negative thoughts and experiences

Rumination refers to thinking about and focusing on negative thoughts and experiences. This can be dangerous for mental wellbeing because this repeated focus on negative emotional thoughts and experiences can lead to distress and contribute to the development of a mental disorder, or prolong existing ones.

Figure 9C–6 Rumination means continually focusing on negative thoughts.

Support for this idea comes from several observational studies that have shown that people who are more ruminative have higher levels of depressive symptoms than people who are not ruminative.

Rumination also tends to prevent effective problem-solving, partly by making thinking more pessimistic and fatalistic.

Impaired memory and reasoning

Cognitive problems, such as impaired memory and reasoning, may contribute to the development of a mental disorder and are often the result of cognitive bias. This is where a person's own subjective reality results in difficulty with thinking logically, and accurately processing and recalling information.

People who have impaired memory and reasoning often cannot make well thought-through decisions, which could then potentially contribute to a mental disorder.

Stress

Stress is linked to both psychological and biological processes that occur in the body when a person encounters a stimulus, such as a life event, that challenges their coping mechanisms. This appraisal of the stimulus as challenging or exceeding their coping ability can then lead to a stress response that contributes to the development of a mental disorder.

CHAPTER 4 LINK

Everyone has some vulnerability to a stress-related mental disorder. The chance of developing a disorder depends on the individual's level of vulnerability, level of stress and ability to cope. The level of stress may be determined by a single stressor or a combination of stressors.

ISBN 978-1-009-25416-8 Gallagher et al

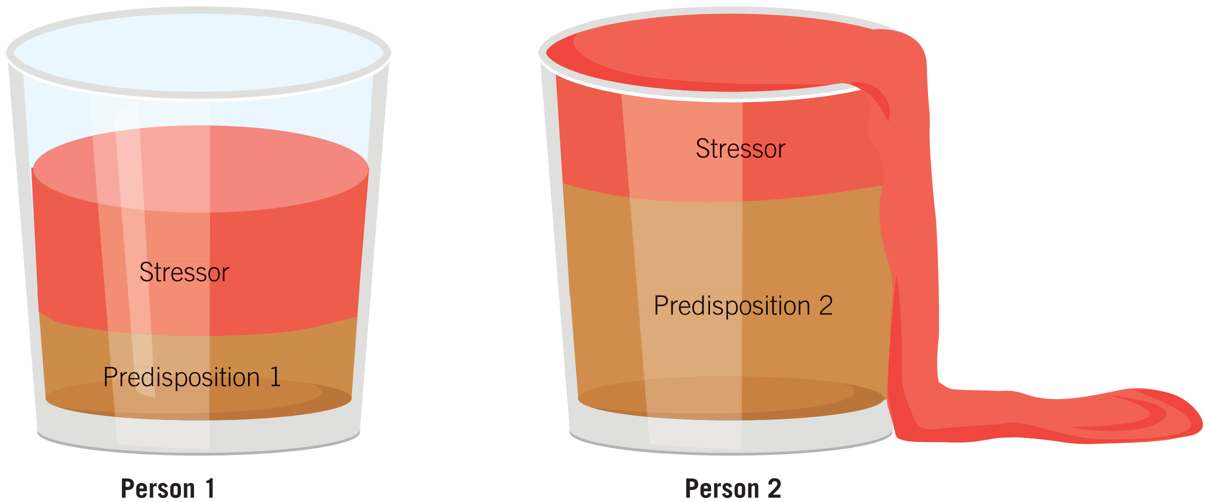


Figure 9C–7 A cup analogy demonstrates that, under the same amount of stressors, person 2 is more vulnerable than person 1, because of their greater predisposition. In this analogy, the same amount of added stressor overflows, representing the inability to cope with the stress, leading to a disorder.

Poor self-efficacy

Self-efficacy relates to a person's confidence that they can complete life tasks and meet their goals. High self-efficacy is the belief that they can influence events that affect their life and have control over the way events are experienced.

Self-efficacy a person's confidence that they can complete life tasks and meet their goals

High self-efficacy beliefs help people to interpret potential threats as manageable, and to feel less stressed in such situations. Conversely, someone with poor self-efficacy may have negative thought patterns about their ability to cope with the everyday demands of life, and this can contribute to the development of a mental disorder.

Psychologist Albert Bandura, who developed the definition and theory of self-efficacy, said:

> People who doubt their capabilities shy away from difficult tasks which they view as personal threats. They have low aspirations and weak commitment to the goals they choose to pursue. When faced with difficult tasks, they dwell on their personal deficiencies, on the obstacles they will encounter, and all kinds of adverse outcomes rather than concentrate on how to perform successfully. They slacken their efforts and give up quickly in the face of difficulties. They are slow to recover their sense of efficacy following failure or setbacks. Because they view insufficient performance as deficient aptitude it does not require much failure for them to lose faith in their capabilities. They fall easy victim to stress and depression.

A person's lack of confidence in their abilities can prevent them from functioning effectively, and this increases their susceptibility to developing a mental disorder.

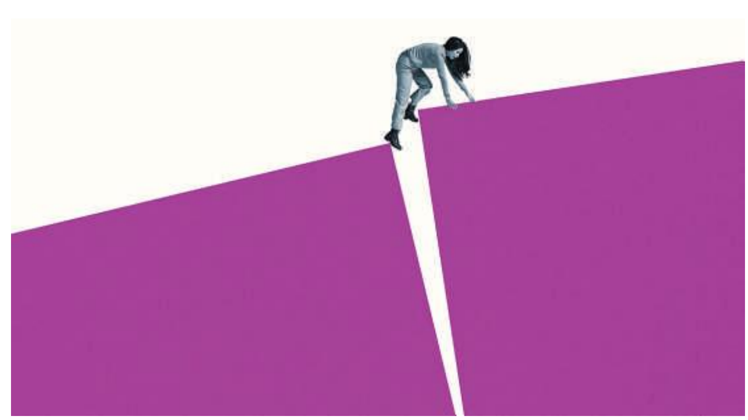


Figure 9C–8 Poor self-efficacy relates to doubting your capabilities.

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 2

1 Contrast psychological and biological risk factors and explain whether there are any links between them.
2 Explain why poor self-efficacy is considered to be a psychological risk factor.

Social risk factor a factor that relates to a person's social contacts and how culture and the social environment can influence the development of mental disorders

Disorganised insecure attachment occurs when a child does not receive consistent care or emotional support from a primary caregiver early in life; leads to inconsistent behaviour being displayed towards this caregiver by the child

Social risk factors

Social risk factors are a range of factors that relate to a person's social contacts and how culture and the social environment influence the development of mental disorders.

Disorganised insecure attachment

Attachment refers to the very first relationships a baby forms. This person is designated the primary caregiver, although there may be more than one. Typically, a child is given consistent care and love and this is termed secure attachment. It provides a strong basis for that individual to form solid, trusting relationships throughout their life.

Disorganised insecure attachment occurs when an infant or young child does not receive consistent care or emotional support from a primary caregiver early in life. This may be due to changes or disruptions in the primary caregiver and/or unpredictable emotional responses from them. This results in the child displaying inconsistent behaviour towards the caregiver.

Children who have been exposed to this type of caregiving may develop a disorganised insecure attachment style and then will probably find it hard to achieve the usual cognitive milestones. It also interferes with emotional and social development. It can also lead to difficulties in forming trusting relationships with adults later in life, because the person may not feel that they can rely on others, which may also result in poor social skills.

Loss of a significant relationship

Losing a loved one is a very distressing event. Loss of a significant relationship may be due to the death of a family member or close friend, separation, the need to move far away from someone you are close to, or even the loss of a pet.

Loss of a significant relationship is a major stressor and it may even cause the onset of a mental disorder. When someone loses a significant relationship, they have to adapt to life without the presence of this person. Studies have shown that people who lose a spouse or child in a car accident may experience distress for as long as 4–7 years afterwards. Symptoms of prolonged distress include depression, sleep disturbances, fatigue, panic attacks, loneliness and an increased mortality rate.

Figure 9C–9 Attachment relates to the level of care and support an infant or child receives from a primary caregiver.

ISBN 978-1-009-25416-8 Gallagher et al

Stigma as a barrier to accessing treatment

Stigma is typically considered to be the feeling of shame or disgrace associated with a personal characteristic that indicates you belong to a culturally devalued group in society – this can be real or imagined. Stigma is a social risk factor because it relates to the interactions that people have with their community.

Stigma the feeling of shame or disgrace associated with a personal characteristic that indicates you belong to a culturally devalued group in society – this can be real or imagined

Stigma can lead to lowered self-esteem, increased isolation and hopelessness, and it may negatively influence a person's family and professional life. People with a mental disorder may experience discrimination in many aspects of their life, such as employment and participation in community activities (e.g. sport). This can influence how a person feels about interacting with their environment, which can then perpetuate their mental disorder.

Stigma associated with having a mental disorder may be linked to a range of historical factors, including negative portrayal in the mass media, and the common use of disrespectful and dehumanising labels such as 'crazy', 'nuts' and 'mental'. Although society has come a long way in the treatment of people with a mental disorder, many people still experience stigma associated with their condition. This stigma may prevent people from seeking help from a psychologist or family doctor if they feel a sense of shame and discomfort when talking about their condition.

Figure 9C–10 Stigma can act as a barrier to accessing treatment for a mental disorder.

Check-in questions – Set 3

1 Identify three social risk factors.
2 Copy the table and categorise the risk factors by placing a cross in the appropriate box.

Factor	Biological	Social	Psychological
Stress			
Poor response to medication			
Stigma			
Impaired memory and reasoning			
Loss of a significant relationship			
Poor sleep			

ISBN 978-1-009-25416-8

VIDEO 9C–2
SKILLS: QUESTIONS ON STRESS SCENARIOS

9C–1 SKILLS

Questions on stress scenarios

On VCE Psychology exams, you may be provided with two scenarios that detail the stressors in people's lives. You may then be asked to outline which of the two people you believe would be at most risk of having low levels of mental wellbeing. In such a case, it would be important to consider the combined effect that several stressors would play in each person's life, and you would need to consider the cumulative effect of the various stressors, and how this may contribute to one of the people having a lower level of mental wellbeing than the other.

Scenarios:

Elena has recently separated from her husband of 15 years. This has contributed to her not feeling motivated to cook for herself; instead she has been regularly consuming take-away meals such as pizza and fish and chips. She has also found it difficult to sleep because she lies awake at night thinking about what led to her marriage breakdown.

Jack has recently lost his job as an electrician because of his inability to drive. Jack did have his licence but lost it because he had several unpaid speeding fines. Jack is concerned about his ability to pay the bills, but he is comforted that his partner of five years earns a decent wage as a doctor, and this means he can take the time to find a new job where he does not require a car.

Question:

Is Elena or Jack at the greatest risk of experiencing low levels of mental wellbeing? Justify your response.

Attempted answer:

Jack is at the greatest risk of low levels of mental wellbeing as losing your job is a significant life event. This is more significant than Elena separating from her husband.

Suggested answer:

Elena is at a greater risk of low levels of mental wellbeing than Jack. Although Jack lost his job, he has the support of his partner to pay his bills while he finds a new job. However, Elena has experienced a significant life event, a marriage breakdown, and she appears to be ruminating over this, which is causing her poor sleep. She is also consuming an unhealthy diet, due to a lack of motivation. There is likely to be a greater cumulative effect on the mental wellbeing of Elena than of Jack, given the information provided.

Key points to remember:

- Start your answer by stating whether Elena or Jack is at the greatest risk of experiencing low levels of mental wellbeing.
- Use examples from the scenario to support your response.
- Keep in mind the cumulative effect of events in people's lives on their overall mental wellbeing.
- You may like to think about people in your life, and to note down what stressors you think they may be experiencing, then make a judgement, with a justification, on why you think one is likely to have greater amounts of cumulative risk than the other.

ISBN 978-1-009-25416-8 Gallagher et al

9C–1 KEY SCIENCE SKILLS

VIDEO 9C–3
KEY SCIENCE SKILLS: MULTIPLE RISK FACTORS

Combined effect of multiple risk factors – data analysis case study
John wanted to investigate whether exposure to multiple risk factors increases a person's likelihood of developing a mental health condition. He hypothesised that exposure to a greater number of risk factors would increase the chance that someone would develop a mental health condition.

John collected data from 100 adults from each of four classes of numbers of risk factors: those with no risk factors, those with 1–3 risk factors, those with 4–6 risk factors and those with 7–9 risk factors. He recorded whether they were currently experiencing any clinically diagnosed mental health conditions. He obtained the following results.

Number of risk factors	Number of participants with a diagnosed mental health condition	Number of participants without a diagnosed mental health condition
0	5	95
1–3	15	75
4–6	26	74
7–9	43	57

Question:

Does the data presented support the aim of this investigation?

Answer:

To answer this question, you must review the aim. In the text above it states: 'John wanted to investigate whether exposure to multiple risk factors increases a person's likelihood of developing a mental health condition'. By recording the number of participants with a diagnosed mental health condition for each class (number range) of risk factors, you can observe whether or not this number increases as the number of risk factors increases – this is therefore a good method of determining whether more risk factors correlates with increasing numbers of mental health conditions being experienced. The number of participants with a diagnosed mental health condition does increase with increasing number of risk factors, so, the data does support the aim of the investigation.

Question:

How could this experiment be modified or extended to better assess the effect of multiple risk factors?

Answer:

To answer this question, you need to consider whether the experiment could be changed to better assess the impact of being exposed to multiple risk factors. The dependent variable is the number of participants with diagnosed mental health conditions, the independent variable is the number of risk factors they experience. These should be sufficient to assess the aim. But no information is given about controlled variables, such as mental health diagnoses used, the age, education and family status of participants, or their socioeconomic status. All of these could affect participants' access to mental wellbeing and support. The experiment would be improved by controlling such variables. In addition, it would be improved by ensuring that the selection of the participants is representative of the population and no information is given as to how John did this.

ISBN 978-1-009-25416-8 Gallagher et al

A better assessment might be also achieved if John did not group the number of risk factors into classes (number ranges) but recorded the number of participants with a diagnosed mental health condition against number of risk factors (0, 1, 2, 3, 4, etc.). Graphing the results might show more clearly if there is a 'threshold' number of risk factors that has a significant impact on whether a mental health condition is experienced.

Question:

Outline whether the data presented supports or refutes John's hypothesis.

Answer:

To answer this question, you first need to review the hypothesis – John 'hypothesised that exposure to a greater number of risk factors would increase the chance that someone would develop a mental health condition'. As you can see from the data, as the number of risk factors rises, the number of participants with a diagnosed mental health condition also rises. Therefore, the data supports John's hypothesis.

Question:

John's friend Sally reviewed the results of the experiment and concluded that people who experience 7–9 risk factors are almost three times as likely to develop a mental health condition as those who experience 1–3 risk factors.

Using the data provided to justify your response, outline whether you agree with Sally.

Answer:

To answer this question, you first need to look at the results of the experiment and make a conclusion. You can see that 15/100 of those who experience 1–3 risk factors had a diagnosed mental health condition, whereas 43/100 of those who experience 7–9 risk factors had a diagnosed mental health condition. 43 is almost three times 15; therefore, Sally is correct to conclude that people who experience 7–9 risk factors are almost three times as likely to develop a mental health condition as those who experience 1–3 risk factors.

Protective factors

There are a range of protective factors that prevent the occurrence or re-occurrence of mental disorders. These factors do not guarantee that a mental disorder will not occur, but they do reduce the likelihood of this, because they have a positive effect on the health of an individual. These factors can often also be categorised according to the biopsychosocial approach, as biological, social or psychological protective factors.

Figure 9C–11 Protective factors against mental disorders

ISBN 978-1-009-25416-8 Gallagher et al

Resilience is the ability to respond or bounce back to previous normal functioning when faced with adversity. A person's level of resilience can be thought of as a protective factor against developing a mental disorder; the greater their ability to overcome adversity, the less likely they are to develop a mental disorder. Other protective factors for mental disorders are adequate nutritional intake and hydration and sleep, social support, practising mindfulness meditation, and cognitive behavioural strategies.

Adequate nutritional intake and hydration and sleep (biological)

Adequate nutritional intake and hydration ensures that you are consuming the appropriate nutrients to allow your body to carry out all the processes required to maintain high levels of physical and mental wellbeing. It provides the body with enough energy for you to go about your daily life, and to adapt to and overcome stressors. In this way, adequate nutritional intake and hydration also contributes to the development and maintenance of resilience.

Adequate sleep is vital as a restorative process to prepare the body for the rigours of day-to-day life. People who have adequate sleep are likely to be less irritable and less likely to become ill. So, when stressors are encountered, a person is well placed to overcome them. In this way, adequate sleep also contributes to the development and maintenance of resilience.

As adequate nutritional intake and hydration and sleep relate to the functioning of the body, they are considered biological protective factors.

Figure 9C–12 Adequate nutritional intake and hydration can be a protective factor for mental wellbeing.

Support from family, friends and community (social)

Having a supportive network of family, friends and community can assist an individual to overcome challenges without feeling overwhelmed, which may help to protect from the occurrence or re-occurrence of mental disorders, but also to develop and maintain resilience. Different networks provide different types of support.

Family can provide:

- a sense of belonging to a familiar group over time
- support when times are difficult
- unconditional love through the ups and downs of life.

Friends can provide:

- a group that contributes to individual happiness
- an outlet for sharing experiences that a person may not be comfortable sharing with their family
- a group that can contribute to a sense of like-minded belonging in the world.

Community can provide:

- challenging experiences that allow for personal growth and learning
- a group that can contribute to a sense of purpose and collective achievement when working together on tasks
- opportunities for interaction and relationship development with a wide group of people.

ISBN 978-1-009-25416-8 Gallagher et al

Figure 9C–13 Support from family, friends and community is a strong protective factor.

It is important that the connections we have with others are authentic, meaning that we have a genuine connection and that we can rely on these people in times of need. Sometimes, the connections that we make with others, particularly online via social media, are superficial and would not be considered authentic forms of support. Authentic forms of support provide you with energy to go about your day-to-day life, and don't leave you feeling drained and depleted. Sometimes, providing support to family, friends and your community can be energy draining, but overall, supportive networks should provide you with more energy than they take.

Because a supportive network of family, friends and community relates to the people in your social environment, they are considered social protective factors.

Mindfulness meditation (psychological)

Mindfulness meditation the practice of observing the present moment, suspending judgements, and focusing on something calm and peaceful

Mindfulness meditation is a practice that can help people maintain and improve their mental wellbeing – the American Psychological Association considers it to be 'a moment-to-moment awareness of one's experience without judgement'.

Mindfulness is characterised by focusing on the present, being aware of where you are and what you are doing, and not being overly reactive or overwhelmed by what is going on in the environment you are in. Mindfulness takes practice and can be done regularly throughout the day. Mindfulness brings awareness to what you are directly experiencing via your senses, or to your state of mind via your thoughts and emotions.

Figure 9C–14 Mindfulness meditation can act as a protective factor for mental wellbeing.

Meditation is about redirecting your thoughts, to calm the mind and focus on something specific. Meditation is about venturing into the workings of your mind, and this can include your sensations, emotions and thoughts.

ISBN 978-1-009-25416-8 Gallagher et al

Therefore, mindfulness meditation can be done by setting aside some time in the day to observe the present moment, suspend judgements, and focus on something calm and peaceful. This could be a mindfulness meditation that focuses on breathing, an awareness of the body or being in a calm place such as by the beach.

Research on mindfulness has identified many benefits. Mindfulness:

- reduces rumination
- reduces stress
- boosts working memory
- allows greater focus
- results in more cognitive flexibility
- results in less emotional reactivity.

Because mindfulness meditation relates to how people think and process information, it is considered to be a psychological protective factor.

Cognitive behavioural strategies (psychological)

Cognitive behavioural therapy involves strategies that focus on the ways in which people think, which often then influences their behaviour. Such strategies focus on replacing unhealthy or unhelpful thinking patterns with more helpful ways of thinking. These helpful cognitions can then influence behaviour and mood and have been shown to be effective in treating a range of mental health conditions such as depression. These cognitive behavioural strategies can also help to increase a person's level of resilience by equipping them with strategies to manage challenging situations they may encounter in their day-to-day lives.

For example, if someone is stuck in catastrophising thinking patterns, they could be taught to think more realistically and focus on problem-solving. Other examples of cognitive behavioural strategies are:

- encouraging someone to recognise the difference between productive and unproductive worries
- teaching relaxation and breathing techniques, particularly muscle relaxation, to control anxiety and the physical symptoms of tension.

WORKSHEET 9C–1 BIOPSYCHOSOCIAL APPROACHES TO MENTAL WELLBEING

Because cognitive behavioural strategies relate to how people think and process information, they are considered to be a psychological protective factor.

ACTIVITY 9C–1 COMPLETE YOUR OWN MINDFULNESS

You might like to complete you own mindfulness meditation. The following steps provide an overview of one approach that you could adopt:

1. Set aside some time. You don't need any equipment to engage in mindfulness meditation but you do need to set aside some time and a quiet space.
2. Observe the present moment as it is. The aim of mindfulness is not quieting the mind or attempting to achieve a state of eternal calm. The goal is to pay attention to the present moment, without judgement.
3. Let your judgements roll by. If you notice judgements arise during mindfulness meditation, make a mental note of them, and let them pass.
4. Return to observing the present moment as it is. The mind often gets carried away in thought. That's why it is important during mindfulness meditation to return to the present moment, again and again, if need be.
5. Be kind to your wandering mind. Don't judge yourself for whatever thoughts arise during your mindfulness meditation, just practise recognising when your mind has wandered off, and gently bring it back to the present.

ISBN 978-1-009-25416-8 Gallagher et al

ACTIVITY 9C–2 EXPLORING HELP WEBSITES

There are many helpful websites that you can access to help with mental wellbeing challenges. Familiarise yourself with some of the following websites and the resources and the support they offer:

Beyond Blue: http://cambridge.edu.au/redirect/9730

Headspace: http://cambridge.edu.au/redirect/9731

R U OK?: http://cambridge.edu.au/redirect/9732

Black Dog Institute: http://cambridge.edu.au/redirect/9733

9C–2 SKILLS

VIDEO 9C–4 SKILLS: QUESTIONS ON PROTECTIVE FACTORS

Questions on protective factors in scenarios of daily activities and events
In VCE Psychology, you may be provided with a scenario that details the daily activities and events of a person's life. You may then be asked to outline protective factors from that scenario that may be helping to promote and protect that person's mental wellbeing. In such a case, it is important to consider how the factors you identify would be acting as protective factors, and be able to explain this.

Scenario:

Nadia was recently diagnosed with a serious health condition that could threaten her life. She was highly stressed about this diagnosis. Nadia was leaning on her husband for support during this tough time. She was also fortunate that she could afford private health insurance and was able to access the most up-to-date treatment. Nadia continued to eat a healthy diet and exercised daily to do her best to manage her new health condition.

Question:

Identify examples of protective factors that are likely to be promoting Nadia's mental wellbeing. Justify your response.

Attempted answer:

Nadia had a supportive husband and was eating a healthy diet, which would have helped her overcome her cancer.

Suggested answer:

Nadia had several protective factors in her life. This included a supportive husband who could offer her social and emotional support during her diagnosis and treatment. In addition, she was able to afford her choice of care through private health insurance, which could lower levels of stress and anxiety regarding her diagnosis.

Key points to remember:

- Ensure you state an example of a protective factor from the scenario.
- Follow up your example with a justification of why it is likely to promote Nadia's mental wellbeing.

ISBN 978-1-009-25416-8 Gallagher et al

9C–2 KEY SCIENCE SKILLS

VIDEO 9C–5 KEY SCIENCE SKILLS: PROTECTIVE FACTORS

Protective factors data analysis case study

In Skills 9C–1, John investigated multiple risk factors and the chance of developing a mental health condition. In a new experiment, he collected data from 100 adults in each of four classes (number ranges) of protective factors, and recorded whether they were currently experiencing any clinically diagnosed mental health conditions. John obtained the following results.

Number of protective factors	Number of participants with a diagnosed mental health condition	Number without a diagnosed mental health condition
0	55	45
1–3	37	63
4–6	20	80
7–9	11	89

Question:

John analysed the results and concluded that people who experience 5 protective factors in their life have a 20% chance of developing a diagnosed mental health condition.

Outline any limitations of this conclusion and what action might avoid them.

Answer:

The data indicates that 20/100 of people who experienced 4–6 protective factors had a diagnosed mental health condition. 20/100 is 20% and so the data suggests that people with 4-6 protective factors have a 20% chance of experiencing a diagnosed mental health condition. Although having 5 protective factors fits into the range, the data is not precise as the measurement is affected by the data for 4 and 6 protective factors. which is lumped in with it.

If John recorded the number of participants with a diagnosed mental health condition against number of protective factors (0, 1, 2, 3, 4, etc.) rather than grouping the number of protective factors into classes (number ranges), a graph of the data should show with greater precision the number of participants with 5 protective factors who had a diagnosed health condition. This would allow John to conclude with greater accuracy the chance of people with 5 protective factors developing a diagnosed mental health condition.

Question:

Describe the potential implications of the data collected, when considering how to help reduce the likelihood that people will develop mental health conditions.

Answer:

By looking at any trends or conclusions that can be drawn from the data, we can see that, as the number of protective factors rises, the number of people with a diagnosed mental health condition falls. This suggests that we can reduce the likelihood that people will develop mental health conditions by introducing more protective factors into their lives. For example, this could be through joining a social sporting club, as both exercise and close relationships are protective factors.

ISBN 978-1-009-25416-8 Gallagher et al

Section 9C questions

1 Justify why the biopsychosocial model is a useful model when considering the level of mental wellbeing of an individual.
2 Poor response to medication is a biological risk factor. With reference to biology, explain why some people may respond differently to medication than others.
3 Why may it be important to modify or extend an investigation once data collection is complete?
4 Jenni hypothesised that a decrease in hours of sleep would lead to increased levels of stress and anxiety. What data would refute this hypothesis?
5 Identify four protective factors against mental disorders.
6 Categorise each of the following as relating to friends, family or community.
   a a sense of belonging to a familiar group over time
   b opportunities for interaction and relationship development with a wide group of people
   c unconditional love through the ups and downs of life
   d an outlet for sharing experiences that a person may not be comfortable sharing with their family
   e a group that can contribute to a sense of purpose and collective achievement when working together on tasks
7 Why might friendships not always be authentic in today's society?
8 Why might conclusions in some experiments be limited by the data that has been collected?

ISBN 978-1-009-25416-8 Gallagher et al

9D Cultural determinants of mental wellbeing

Study Design:
Cultural determinants, including cultural continuity and self-determination, as integral for the maintenance of wellbeing in Aboriginal and Torres Strait Islander peoples

Glossary:
Culture
Cultural continuity
Cultural determinant of wellbeing
Self-determination

ENGAGE

Arts and crafts in health and wellbeing

Although some Greek and Roman physicians advocated the therapeutic value of music, the importance of arts, crafts and other aspects of culture was not well recognised in western medicine until the 19th century. That was when occupational therapy became a recognised branch of healthcare, and its professional standards and qualifications began to be developed. The 'occupation' referred to is not necessarily a person's employment or livelihood, but any meaningful activity, which is most likely to be determined by one's culture.

In cultures that see arts and crafts as part of everyday life, their role in wellbeing is accepted as natural. To explore Indigenous arts and crafts you could start by searching for the National Museum of Australia and its Indigenous collections. Not only can you explore many cultural objects, the museum's YouTube channel includes artists and craftspeople talking about their work and culture. For example, Girramay Elder and master basket weaver Abe Muriata talks about reviving the ancient weaving techniques of his ancestors: http://cambridge.edu.au/redirect/9734.

To shed light on the role of his craft on mental wellbeing, one only has to imagine the devastating effect of not being able to pursue such a cultural activity.

EXPLAIN

Why is culture important?

You may have heard the term '**culture**' mentioned in reference to different groups in society. Culture typically refers to the characteristics and knowledge of a particular group, and may encompass language, social habits, music, religion, food and more. It often also includes shared patterns of behaviour and interactions, and understandings that are learned through socialisation. Culture may be thought of as a way of life for people that is shared and learned.

Culture
a way of life that is shared and learned

Many people consider their culture to be very important because it provides a sense of belonging, and has influenced how they became the people they are. Vitally, people often want their culture to persevere and be passed onto other members of their community. Therefore, it is often very important that it is transmitted into the future in the same form it was experienced.

The digital resources include links to further reading and resources on Indigenous cultural determinants of wellbeing to use with this section.

ISBN 978-1-009-25416-8 Gallagher et al

Figure 9D–1 Culture is passed from one generation to another.

Cultural determinants of health

Many cultures around the world view health in a holistic way. Health is more than just physical wellbeing; it also incorporates individual and community, social, emotional, spiritual and cultural wellbeing. Western culture, on the other hand, has been through a period in which ill-health was thought of in purely physiological terms. It is only in comparatively recent times that there has been a return to more holistic views, with social, emotional and mental factors being brought back into the picture, often due to the influence of non-Western culture. Aboriginal and Torres Strait Islander peoples' view of health has always been holistic. Therefore, to promote and maintain Aboriginal and Torres Strait Islander wellbeing, including mental wellbeing, we should consider not only physical health but also **cultural determinants of wellbeing**, among others. These are protective factors that support good health and wellbeing, including mental wellbeing.

The cultural determinants of wellbeing originate from and promote a strength-based perspective, acknowledging that stronger connections to culture and Country build stronger individual and collective identities, a sense of self-esteem and resilience. There are many examples of cultural determinants of wellbeing, such as connection to Country, self-determination and language. In this section, we will focus on cultural continuity and self-determination, and how these are integral for the maintenance of wellbeing in Aboriginal and Torres Strait Islander peoples.

Cultural determinants of wellbeing cultural factors that influence health and wellbeing

Cultural continuity the ability to preserve the historical traditions of a culture and carry them forward with that culture into the future

It is important to acknowledge that there are many Aboriginal and Torres Strait Islander cultures and peoples and that these cultures exist and thrive in a wide range of communities throughout Australia. However, while diversity exists across and within Aboriginal communities, some cultural characteristics are part of most, if not all, Aboriginal cultures and unite Aboriginal and Torres Strait Islander peoples through shared history and shared experiences.

Cultural continuity

Cultural continuity can be thought of as the ability to preserve the historical traditions of a culture and carry them forward with that culture into the future. Cultural continuity is also understood by Indigenous peoples as an expression of self-determination, and community self-sufficiency.

For Aboriginal and Torres Strait Islander peoples, cultural continuity and the practising of culture can involve a living relationship with ancestors, the spiritual dimension of existence, and connection to Country and language.

The Victorian Public Sector Commission's *Aboriginal Culture and History* notes that colonisation can be thought of as the process of settling among and establishing control over an area, and in some instances, the people in that area. The arrival of Lieutenant James Cook (1770) and Captain Arthur Phillip (1786) on the eastern coast of Australia began the process of the colonisation of Australia by non-Indigenous people.

OVERVIEW: ABORIGINAL AND TORRES STRAIT ISLANDER KNOWLEDGE, CULTURES AND HISTORY LINK

Before colonisation, Aboriginal peoples often lived in small family groups linked into larger language groups with distinct territorial boundaries. Aboriginal cultures were strong and well developed, with complex kinship systems and rules for social interaction. They had language, ceremonies, customs and traditions and extensive knowledge of their environment.

ISBN 978-1-009-25416-8 Gallagher et al

The AIATSIS Map of Indigenous Australia on pages xii–xiii shows the territories of the main groups.

European colonisation had a devastating impact on Aboriginal and Torres Strait Islander communities and cultures, with Aboriginal and Torres Strait Islander peoples being subjected to a range of injustices, including mass killings, or being displaced from their traditional lands and relocated to missions and reserves in the name of 'protection.' Cultural practices were denied, and subsequently many were lost. For Aboriginal and Torres Strait Islander peoples, colonisation meant massacre, violence, disease and loss.

Figure 9D–2 Prioritising culture can help to enable Aboriginal and Torres Strait Islander people's self-determination.

Therefore, the ability of Aboriginal and Torres Strait Islanders to practise their culture has not always been present, which is likely to have had an impact on the ability to maintain cultural continuity.

Research has demonstrated that strengthening cultural identity acts as a buffer against psychological stress, the transmission of historical trauma between generations (intergenerational trauma), self-harm and suicide.

Self-determination

Another cultural determinant that is integral to the maintenance of wellbeing in Aboriginal and Torres Strait Islander peoples is **self-determination**. Self-determination for Aboriginal and Torres Strait Islander peoples is the right to make decisions on matters that affect their lives and communities. The right to self-determination is enshrined in the United Nations Declaration on the Rights of Indigenous Peoples, to which Australia is a signatory. Article 3 of this UN document states: 'Indigenous peoples have the right to self-determination. By virtue of that right they freely determine their political status and freely pursue their economic, social and cultural development.'

Self-determination the ability to participate in decisions on matters that affect one's life

When Aboriginal and Torres Strait Islander peoples were subjected to colonisation and dispossession, this cultural determinant was lost, and this has contributed to significant disadvantage and low levels of wellbeing often experienced by Aboriginal and Torres Strait Islander peoples. A range of practices or activities may be used by governments and organisations to demonstrate that they respect and are enabling Aboriginal and Torres Strait Islander peoples' self-determination. These practices include:

- prioritising culture
- addressing trauma and supporting healing
- addressing racism and promoting cultural safety
- transferring power and resources to communities.

It is important to note that Aboriginal and Torres Strait Islander self-determination does not mean that Indigenous people or communities are a separate state or are separate from the wider Australian community. Aboriginal and Torres Strait Islander peoples assert their right to freely determine their own political, economic, social and cultural development This contributes to the promotion and maintenance of wellbeing for Aboriginal and Torres Strait Islander peoples.

WORKSHEET 9D–1 CULTURAL DETERMINANTS OF WELL BEING

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 1

1 What are cultural determinants of wellbeing?
2 List three examples of cultural determinants of wellbeing.
3 What does cultural continuity refer to?
4 What does Article 3 of the United Nations Declaration of the Rights of Indigenous People state in relation to self-determination?

ACTIVITY 9D–1 WHOSE COUNTRY AM I ON?

No matter where you are in Australia, you are on the lands of First Australians. Identifying the Traditional Custodians of the area in which you live may help you to gain a better understanding of some of their cultural practices, strengthening your understanding of cultural determinants of Aboriginal and Torres Strait Islander peoples' wellbeing.

5D ABORIGINAL AND TORRES STRAIT ISLANDER WAYS OF KNOWING LINK

This activity overlaps with Activity 5D–1 and could be seen as an extension of it.

A number of resources can help you determine the Traditional Custodians of the land where you reside.

- Start with the website for your local government authority (shire or municipal council). Many council websites include an acknowledgement of the local Traditional Custodians, on the home page, or elsewhere.
- State and territory government websites often include information about Traditional Custodians in their jurisdictions. In addition, several states and territories have Aboriginal and Torres Strait Islander consultative bodies, which might be able to offer advice.
- Carry out searches on the name of the Traditional Custodians, looking for information on them and their cultural practices.

Write a report on the cultural practices and aspects you have found out about, including their language (if you didn't do Activity 5D–1) and any sacred sites identified in your area.

Section 9D questions

1 What is culture?
2 How did European colonisation impact on Indigenous culture?
3 How can strengthening cultural identity contribute to Aboriginal and Torres Strait Islander peoples' wellbeing?
4 Provide four examples of what governments and organisations can do to demonstrate that they are respecting and enabling Aboriginal and Torres Strait Islander peoples' self-determination.
5 Explain how a lack of self-determination could be detrimental to Aboriginal and Torres Strait Islander peoples' wellbeing.

ISBN 978-1-009-25416-8 Gallagher et al

Chapter 9 review

Summary

Create your own set of summary notes for this chapter on paper or in a digital document. A model summary is provided in the Teacher Resources, which can be used to compare with yours.

Checklist

In the Interactive Textbook, the success criteria are linked from the review questions and will be automatically ticked when answers are correct. Alternatively, print or photocopy this page and tick the boxes when you have answered the corresponding questions correctly.

	Success criteria – I am now able to:	Linked question
9A.1	Understand that there are a range of characteristics that contribute to mental wellbeing	1☐, 6☐
9A.2	Identify key characteristics of mental wellbeing	12☐
9A.3	Describe key characteristics of someone with high levels of mental wellbeing	12☐
9A.4	Distinguish between key characteristics of mental wellbeing and apply key characteristics of mental wellbeing	1☐, 8☐
9A.5	Understand social and emotional wellbeing (SEWB) as a multidimensional and holistic framework for wellbeing that encapsulates all elements of being (body, mind and emotions, family and kinship, community, culture, Country, spirituality and ancestors) for Aboriginal and Torres Strait Islander peoples	6☐, 8☐
9B.1	Understand that mental wellbeing is on a continuum	11☐
9B.2	Understand that mental wellbeing is influenced by internal and external factors – both risk and protective	3☐
9B.3	Identify internal and external factors that influence mental wellbeing	2☐
9B.4	Distinguish between internal and external factors that influence mental wellbeing	2☐
9B.5	Describe internal and external factors that influence mental wellbeing	3☐
9B.6	Apply internal and external factors that influence mental wellbeing, including to stress, anxiety and phobia	13☐
9B.7	Describe stress, anxiety and phobia	5☐
9B.8	Distinguish between stress, anxiety and phobia	5☐
9C.1	Understand there are a range of biological, psychological and social factors that maintain and protect mental wellbeing and that they interrelate	7☐
9C.2	Identify the biological, psychological and social factors that maintain and protect mental wellbeing	4☐, 15☐, 7☐

ISBN 978-1-009-25416-8 Gallagher et al

Success criteria – I am now able to:		Linked question
9C.3	Describe the biological, psychological and social factors that maintain and protect mental wellbeing	14☐
9C.4	Explain the biological, psychological and social factors that maintain and protect mental wellbeing	13☐
9C.5	Apply the biological, psychological and social factors that maintain and protect mental wellbeing	9☐, 13☐, 15☐
9D.1	Understand and identify a range of cultural determinants that are integral for the maintenance of wellbeing in Aboriginal and Torres Strait Islander peoples	10☐
9D.2	Describe and explain a range of cultural determinants that are integral for the maintenance of wellbeing in Aboriginal and Torres Strait Islander peoples	17☐
9D.3	Apply a range of cultural determinants that are integral for the maintenance of wellbeing in Aboriginal and Torres Strait Islander peoples	17☐

Key Science Skills

Skills	Questions and Skills boxes
• Evaluate data to determine the degree to which the evidence supports the aim of the investigation, and make recommendations, as appropriate, for modifying or extending the investigation • Evaluate data to determine the degree to which the evidence supports or refutes the initial prediction or hypothesis • Use reasoning to construct scientific arguments, and to draw and justify conclusions consistent with the evidence and relevant to the question under investigation • Identify, describe and explain the limitations of conclusions, including identification of further evidence required • Discuss the implications of research findings and proposals, including appropriateness and application of data to different cultural groups and cultural biases in data and conclusions	9C–1 Key Science Skills 9C–2 Key Science Skills

Multiple-choice questions

1 Which of the following is not an example of emotional wellbeing?

A the ability to express a range of emotions relevant to the context
B the ability to get along with a range of people from a variety of ethnic and cultural backgrounds
C the ability to control varied emotions and respond to these in a positive manner
D the ability to identify emotions in others and respond appropriately

2 Identify the internal factor.

A discrimination
B social support
C income
D genetic predisposition

ISBN 978-1-009-25416-8 Gallagher et al

3 Resilience is best described as
- **A** the ability to complete daily tasks.
- **B** how effectively one is able to express emotions.
- **C** one's ability to respond or bounce back to previous normal functioning when faced with adversity.
- **D** knowing who to turn to when faced with challenges.

4 The biopsychosocial model does not include which of the following categories?
- **A** biological
- **B** psychic
- **C** psychological
- **D** social

5 Which of the following best matches the characteristics of stress, anxiety and phobia?

	Stress	Anxiety	Phobia
A	Typically, experienced in daily life	Typically, experienced in daily life	Not experienced by most people in daily life
B	May contribute to developing a mental disorder	A diagnosed mental disorder	A diagnosed mental disorder
C	Can impact on day-to-day functioning if not well managed	Can significantly impact on day-to-day functioning if not well managed	Can impact on day-to-day functioning if not well managed
D	Can be adaptive and helpful in some situations	Can be adaptive and helpful in some situations	Can be adaptive and helpful in some situations

6 Which of the following is not a domain in the Aboriginal and Torres Strait Islander social and emotional wellbeing framework?
- **A** connection to body
- **B** connection to mind and emotions
- **C** connection to culture
- **D** connection to siblings

7 Which of the following is not considered a protective factor for mental wellbeing?
- **A** possessing resilience
- **B** adequate diet
- **C** smoking to relieve stress
- **D** adequate sleep

8 The three determinants that form part of the Aboriginal and Torres Strait Islander social and emotional wellbeing framework are
- **A** social, political and historical.
- **B** biological, social and psychological.
- **C** social, economic and political.
- **D** historical, political and psychological.

9 Cognitive behavioural strategies for protecting mental wellbeing do not include
- **A** adequate sleep.
- **B** taking psychedelic drugs.
- **C** going for a run.
- **D** all of the above.

ISBN 978-1-009-25416-8 Gallagher et al

10 Which of the following is a cultural determinant of mental wellbeing for Aboriginal and Torres Strait Islander peoples?
- **A** resilience
- **B** cultural continuity
- **C** adequate diet
- **D** mindfulness meditation

Short-answer questions

11 Aisha told Danny that mental wellbeing is dynamic, not static. In relation to the mental wellbeing continuum, explain why Aisha is right. (3 marks)

12 Both social and emotional wellbeing contribute to overall mental wellbeing. Contrast social and emotional wellbeing, using an example of each. (4 marks)

13 Significantly more homeless people than the general population have a mental disorder. Use the biopsychosocial model to identify and outline an example of a factor from each category that may contribute to more homeless people having a mental disorder. (3 marks)

14 Explain how levels of self-efficacy can influence resilience. (2 marks)

15 Read the following scenario.

Sally has been struggling after breaking up with her boyfriend of 7 years. She has been turning to illicit drugs to help her cope. Although she has a supportive family and friends whom she has been leaning on for support, she has still struggled. She is exercising daily to try to distract herself from the pain, but even this is not helping her to get to sleep at night, and she lies awake thinking, 'What did I do wrong?' Sally is going to make an appointment with a psychologist, but she can't do this for three weeks because she can't afford to attend this and pay for her food and bills.

Outline why Sally has a high risk for a mental disorder, but contrast this by listing two protective factors in Sally's life. (4 marks)

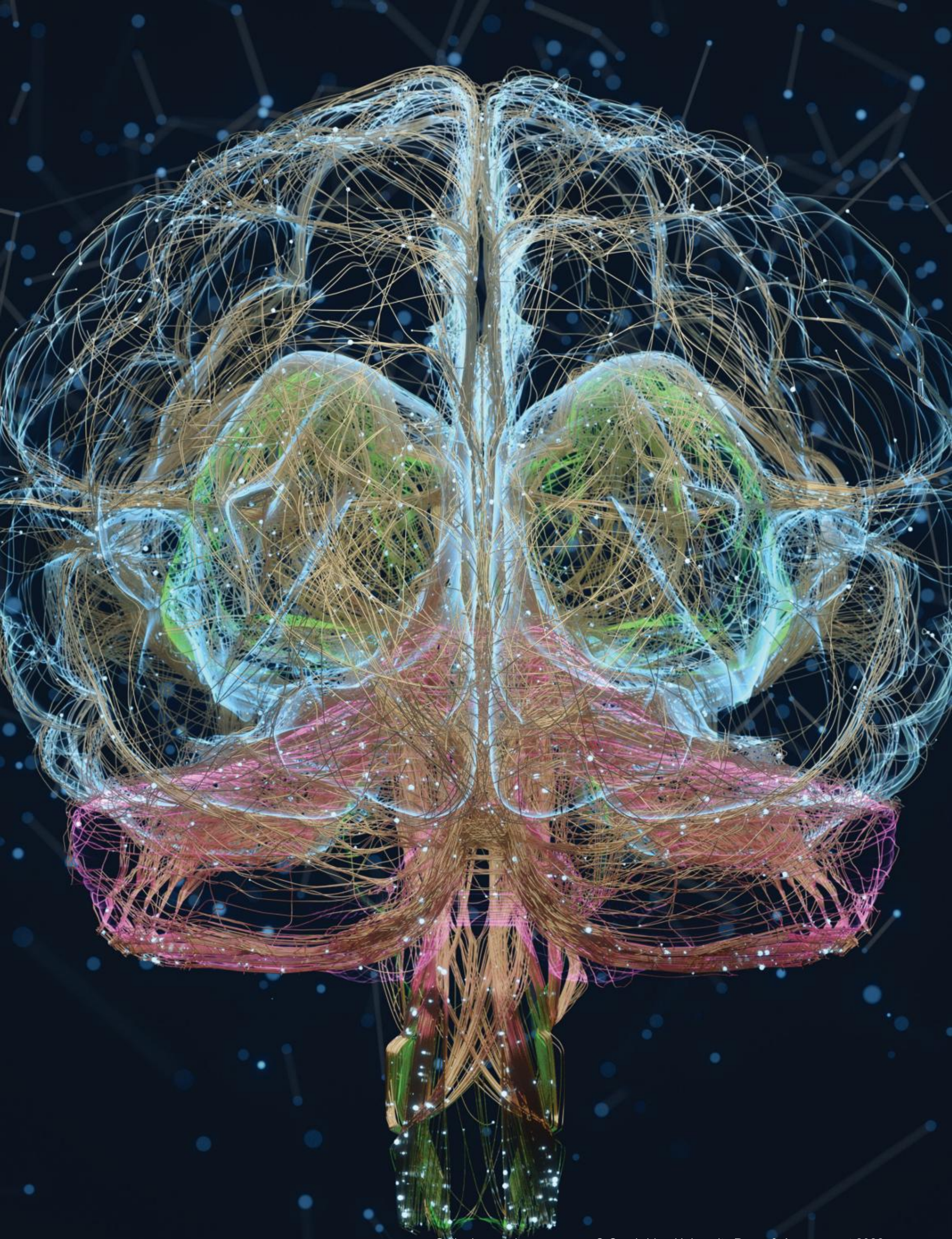
16 Tao wants to determine whether anti-anxiety medication can help reduce levels of anxiety. He collects data from patients who have been taking anti-anxiety medication over a 4-week period, since the onset of their anxiety, and rates their anxiety at the end of each week. A rating of 5 indicates high levels of anxiety, and 1 indicates low levels of anxiety. Tao averages the ratings. The results are presented in the following table.

Week	Average anxiety rating
1	4.7
2	4.4
3	3.6
4	2.9

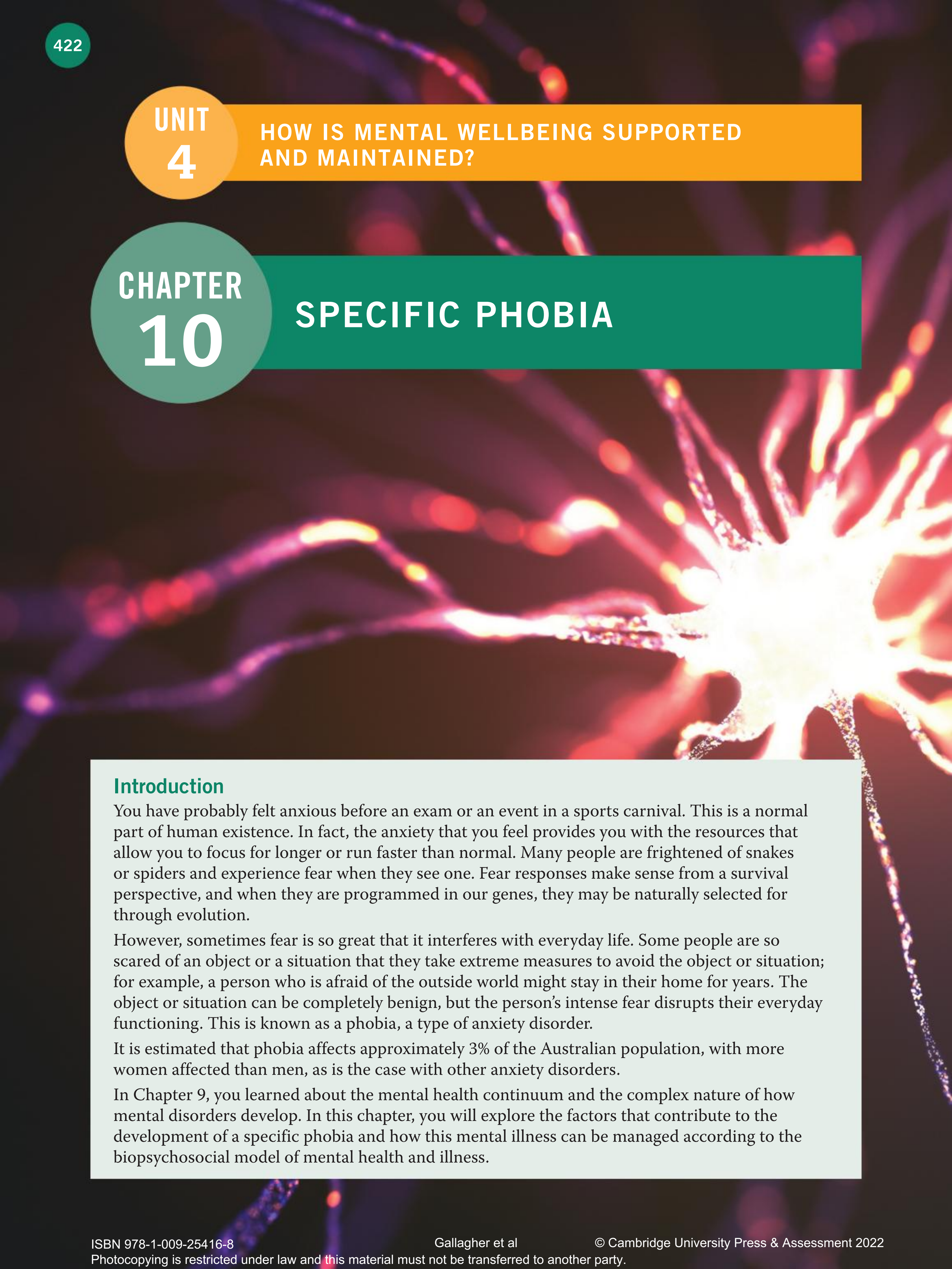
Using the data, draw a conclusion about the use of anti-anxiety medication and levels of anxiety. Discuss the implications of these findings. (3 marks)

17 Justify why enabling self-determination should be prioritised by governments and organisations who work with Aboriginal and Torres Strait Islander peoples. (2 marks)

ISBN 978-1-009-25416-8 Gallagher et al



ISBN 978-1-009-25416-8 Gallagher et al



UNIT 4 HOW IS MENTAL WELLBEING SUPPORTED AND MAINTAINED?

CHAPTER 10 SPECIFIC PHOBIA

Introduction

You have probably felt anxious before an exam or an event in a sports carnival. This is a normal part of human existence. In fact, the anxiety that you feel provides you with the resources that allow you to focus for longer or run faster than normal. Many people are frightened of snakes or spiders and experience fear when they see one. Fear responses make sense from a survival perspective, and when they are programmed in our genes, they may be naturally selected for through evolution.

However, sometimes fear is so great that it interferes with everyday life. Some people are so scared of an object or a situation that they take extreme measures to avoid the object or situation; for example, a person who is afraid of the outside world might stay in their home for years. The object or situation can be completely benign, but the person's intense fear disrupts their everyday functioning. This is known as a phobia, a type of anxiety disorder.

It is estimated that phobia affects approximately 3% of the Australian population, with more women affected than men, as is the case with other anxiety disorders.

In Chapter 9, you learned about the mental health continuum and the complex nature of how mental disorders develop. In this chapter, you will explore the factors that contribute to the development of a specific phobia and how this mental illness can be managed according to the biopsychosocial model of mental health and illness.

ISBN 978-1-009-25416-8 Gallagher et al

Curriculum

Area of Study 2 Outcome 2
Specific phobia

Study Design	Learning intentions – at the end of this chapter I will be able to:
• The relative influences of contributing factors to the development of specific phobia with reference to gamma-aminobutyric acid (GABA) dysfunction and long-term potentiation (biological); behavioural models involving precipitation by classical conditioning and perpetuation by operant conditioning and cognitive biases, including memory bias and catastrophic thinking (psychological); specific environmental triggers and stigma around seeking treatment (social)	**10A Contributing factors to the development of specific phobia** **10A.1** Explain what is meant by specifc phobia, including how it is different from anxiety and fear **10A.2** Explain what is meant by the biopsychosocial framework, with reference to biological, psychological and social contributing factors **10A.3** Explain what is meant by gamma-aminobutyric acid (GABA) and how it regulates anxiety in the central nervous system **10A.4** Explain what is meant by gamma-aminobutyric acid (GABA) dysfunction and how it affects the regulation of anxiety in relation to a specific phobia **10A.5** Explain what is meant by long-term potentiation (LTP) and how LTP continues the feeling of anxiety in relation to a specific phobia **10A.6** Describe the process of the three-stage model of classical conditioning in relation to the development of a specific phobia **10A.7** Describe the process of the three-stage model of operant conditioning in the continuation of a specific phobia, with reference to negative reinforcement **10A.8** Explain what is meant by cognitive bias, including memory bias and catastrophic thinking **10A.9** Describe how memory bias and catastrophic thinking continue a phobic response with reference to appropriate examples **10A.10** Explain what is meant by a specific environmental trigger and its role in the development of a specific phobia with reference to classical conditioning elements **10A.11** Explain what is meant by stigma and how stigma acts as a barrier to treatment **10A.12** Apply my understanding of the biological, psychological and social contributing factors to a specifc phobia to real-world scenarios

ISBN 978-1-009-25416-8 Gallagher et al

Study Design	Learning intentions – at the end of this chapter I will be able to:	
• Evidence-based interventions and their use for specific phobia with reference to: the use of short-acting anti-anxiety benzodiazepine agents (GABA agonists) in the management of phobic anxiety and breathing retraining (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)	**10B**	**Evidence-based interventions and their use for specific phobia**
	10B.1	Explain what is meant by the biopsychosocial framework, with reference to biological, psychological and social Evidence based interventions
	10B.2	Explain what is meant by a GABA agonist, identify relevant examples of short-acting anti-anxiety benzodiazepine agents as examples of a GABA agonist and explain how short-acting anti-anxiety benzodiazepine agents reduce feelings of anxiety in someone exposed to a phobic stimulus
	10B.3	Explain what is meant by breathing retraining and how it helps to reduce phobic anxiety, with reference to physiological systems
	10B.4	Explain what is meant by cognitive behavioural therapy (CBT) and its underlying aims in relation to the treatment of a specific phobia
	10B.5	Outline how both cognitive and behavioural therapies work to identify maladaptive thoughts and behaviours in relation to a phobia and change them into more adaptive ones
	10B.6	Explain what is meant by systematic desensitisation and its underlying aims in relation to the treatment of a specific phobia
	10B.7	Describe the process that systematic desensitisation uses to reduce anxiety (with reference to the three-stage model of classical conditioning)
	10B.8	Explain what is meant by psychoeducation and its underlying aims in relation to the treatment of a specific phobia
	10B.9	Outline how both challenging unrealistic or anxious thoughts and not encouraging avoidance behaviours work to identify maladaptive thoughts and behaviours in relation to a specific phobia and change them into more adaptive ones
	10B.10	Apply my understanding of biological, psychological and social evidence-based interventions to real-world scenarios

Key Science Skills

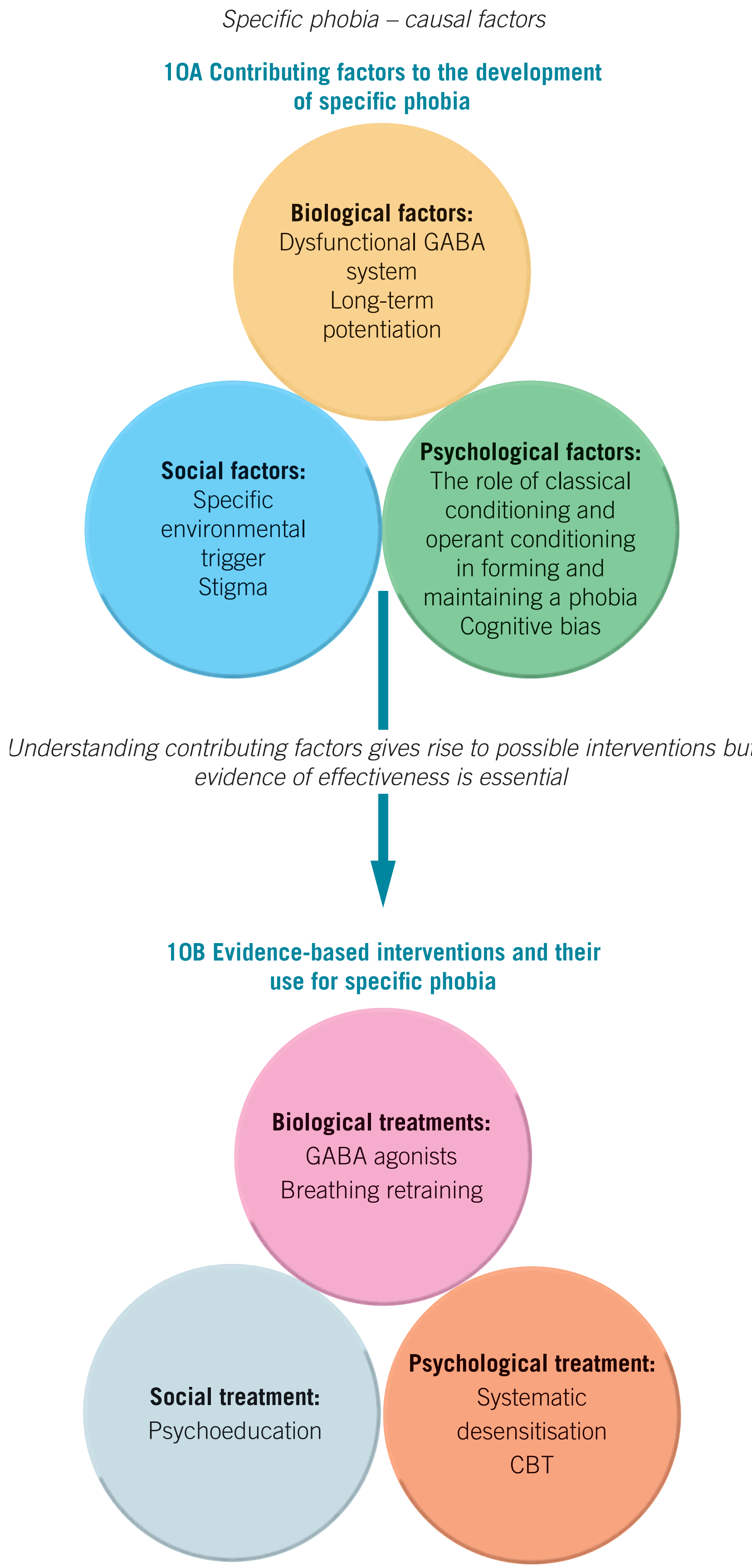
- Use appropriate psychological terminology, representations and conventions, including standard abbreviations, graphing conventions and units of measurement
- Discuss relevant psychological information, ideas, concepts, theories and models and the connections between them
- Analyse and explain how models and theories are used to organise and understand observed phenomena and concepts related to psychology, identifying limitations of selected models/theories
- Critically evaluate and interpret a range of scientific and media texts (including journal articles, mass media communications and opinions in the public domain), processes, claims and conclusions related to psychology by considering the quality of available evidence
- Analyse and evaluate psychological issues using relevant ethical concepts, including the influence of social, economic, legal and political factors relevant to the selected issue
- Use clear, coherent and concise expression to communicate to specific audiences and for specific purposes in appropriate scientific genres, including scientific reports and posters
- Acknowledge sources of information and assistance, and use standard scientific referencing conventions

Glossary

Agonist
Avoidance behaviour
Behavioural model
Benzodiazepine
Biological factor
Biological intervention
Breathing retraining
Catastrophic thinking
Classical conditioning
Cognitive behavioural therapy (CBT)
Cognitive bias
Cognitive model
Dysfunctional GABA system
Evidence-based intervention
Fear hierarchy
Gamma-aminobutyric acid (GABA)
Glutamate
Hyperventilation
Long-term potentiation (LTP)
Memory bias
Negative reinforcement
Operant conditioning
Perpetuation
Precipitate
Psychoeducation
Psychological factor
Psychological intervention
Psychotherapy
Relaxation technique
Social factor
Social intervention
Specific environmental trigger
Specific phobia
Stigma
Systematic desensitisation

ISBN 978-1-009-25416-8

Concept map



See the Interactive Textbook for an interactive version of this concept map interlinked with all concept maps for the course.

ISBN 978-1-009-25416-8 Gallagher et al

10A Contributing factors to the development of specific phobia

Study Design:
The relative influences of contributing factors to the development of specific phobia with reference to gamma-aminobutyric acid (GABA) dysfunction and long-term potentiation (biological); behavioural models involving precipitation by classical conditioning and perpetuation by operant conditioning and cognitive biases including memory bias and catastrophic thinking (psychological); specific environmental triggers and stigma around seeking treatment (social)

Glossary:
Avoidance behaviour
Behavioural model
Biological factor
Catastrophic thinking
Classical conditioning
Cognitive bias
Cognitive model
Dysfunctional GABA system
Gamma-aminobutyric acid (GABA)
Glutamate
Long-term potentiation (LTP)
Memory bias
Negative reinforcement
Operant conditioning
Perpetuation
Precipitate
Psychological factor
Social factor
Specific environmental trigger
Specific phobia
Stigma

ENGAGE

The discovery of the biopsychosocial model

Over the last century, our understanding of how mental illness develops and how to treat it has gone through many trends and been explored from many perspectives.

In ancient times, dating back as much as 12,000 years, people who were considered to be behaving abnormally were treated by having holes drilled into their skull. This process was known as trepanning. It was thought that trepanning let out evil spirits.

In the 1800s, psychiatric hospitals started using the technique of bloodletting to treat mentally ill people. Bloodletting was the practice of withdrawing blood from a person's veins and was believed to cure a range of conditions by ridding the body of impure fluids.

Through the 1900s, doctors in psychiatric hospitals began to treat mental illness with insulin shock therapy. Patients were repeatedly injected with large doses of insulin to produce daily comas over several weeks. It was thought that waking from a coma resulted in mental clarity.

In 1977, US psychiatrist George L. Engel published his influential article, 'The need for a new medical model: a challenge for biomedicine'. Engel suggested that clinicians should move away from treating physical and mental illnesses in a purely physiological manner. This traditional way of treating illness (both physiological and psychological) was considered distant, impersonal and even dangerous. Engel believed that this gave an incomplete and inaccurate picture of the causes of an individual's illness and the plan for their recovery.

ISBN 978-1-009-25416-8 Gallagher et al

Engel proposed that psychological and social factors influence biological functioning, and vice versa, and play a role in both health and illness. To truly understand and treat a person's mental and/or physical illness, it was important to consider their condition in terms of biological, psychological and social influences. This more holistic view of health came to be known as the biopsychosocial framework. Now, when mental illnesses are considered, the biopsychosocial model is a useful tool to understand the causes and management of each illness.

EXPLAIN

What is a phobia?

Anxiety is the most common mental health condition in Australia. Anxiety affects one in four people (one in three women and one in five men) at some stage in their life. More than two million Australians experience anxiety each year. Anxiety belongs to a group of mental health disorders characterised by worry, fear and anxiety strong enough to interfere with daily activities. There are many different anxiety disorders in the current *Diagnostic and Statistical Manual of Mental Disorders*, with specific phobia being one of the most common. Table 10A–1 (on page 430) explores some of the more common types of anxiety disorders.

Case study 1: Phobia

Claire was a 19-year-old first-year student who had suffered from a lifetime fear of elevators. For as long as she could recall, she was simply petrified of riding in an elevator. Claire could not point to a specific traumatic event that produced her fear – it had just always been there.

Claire reported that she was a shy, timid, well-behaved child, and felt great unwillingness to speak up about her fear, despite having very warm and loving parents. In adolescence, Claire recalls having had a panic attack when forced to ride in an elevator in a subway station while on a class excursion. Her peers ridiculed her about it for the remainder of the trip. Claire began using an elaborate series of avoidance behaviours, finding a variety of excuses not to ride in elevators. For example, when a family friend was going to be showing some artwork at a local museum, Claire went online before the opening to look through a floorplan of the museum to determine how she might navigate the event without riding in an elevator. When Claire entered college, she took a job in the college library, a beautiful building where she loved spending time. However, it quickly became clear that the job would involve moving books with a cart from floor to floor in one of the elevators. Embarrassed and ashamed, Claire confided in her boss at the library about her phobia. Her boss understood and Claire decided to receive treatment for her phobia.

In her first therapy session, she described the history of her problem. Claire was aware of the severe limitations imposed by her elevator phobia. For example, she reported social discomfort with friends during the first few weeks of college, feeling pressure to find excuses for her avoidance of elevators, such as, 'I'm being healthy by taking the stairs'. Even more dramatically, when Claire was asked to imagine that upon graduating from college, she was offered her dream job, with every perfect quality except that it was on the 60th floor of a building,

ISBN 978-1-009-25416-8 Gallagher et al

she responded that she would probably turn it down if her fear remained as strong as it currently was, and this was why she was so committed to overcoming her phobia now.

Adapted from Adler, Jonathan M. and Cook-Nobles, Robin (2011) 'The successful treatment of specific phobia in a college counselling center', Journal of College Student Psychotherapy, 25: 1, 56–66.

In the case study, it is evident that Claire displays the characteristics of someone with a **specific phobia** – a persistent, intense, irrational fear of a specific object or event, often leading to avoidance behaviour. Claire, like many people with a specific phobia, is aware that her level of fear is excessive or unreasonable, but she feels compelled to avoid the phobic stimulus (elevators), going so far as to organise her life to avoid the phobic stimulus. Unlike ordinary fear, which can protect us from dangerous situations, if she encounters or expects a phobic stimulus, Claire experiences fear that is out of proportion to the actual danger.

Specific phobia a persistent, intense, irrational fear of a specific object or event

For a diagnosis of specific phobia, symptoms must be present for six months or longer and disrupt the person's life, especially work and social relationships, or cause them serious distress.

Phobias can generally be placed in four categories that relate to:
- the natural environment (e.g. water, storms)
- animals (e.g. snakes, spiders, dogs)
- potential bodily pain or injury (e.g. needles, dental and medical procedures, sight of blood)
- situations (e.g. heights, confined or open spaces, aeroplanes, tunnels).

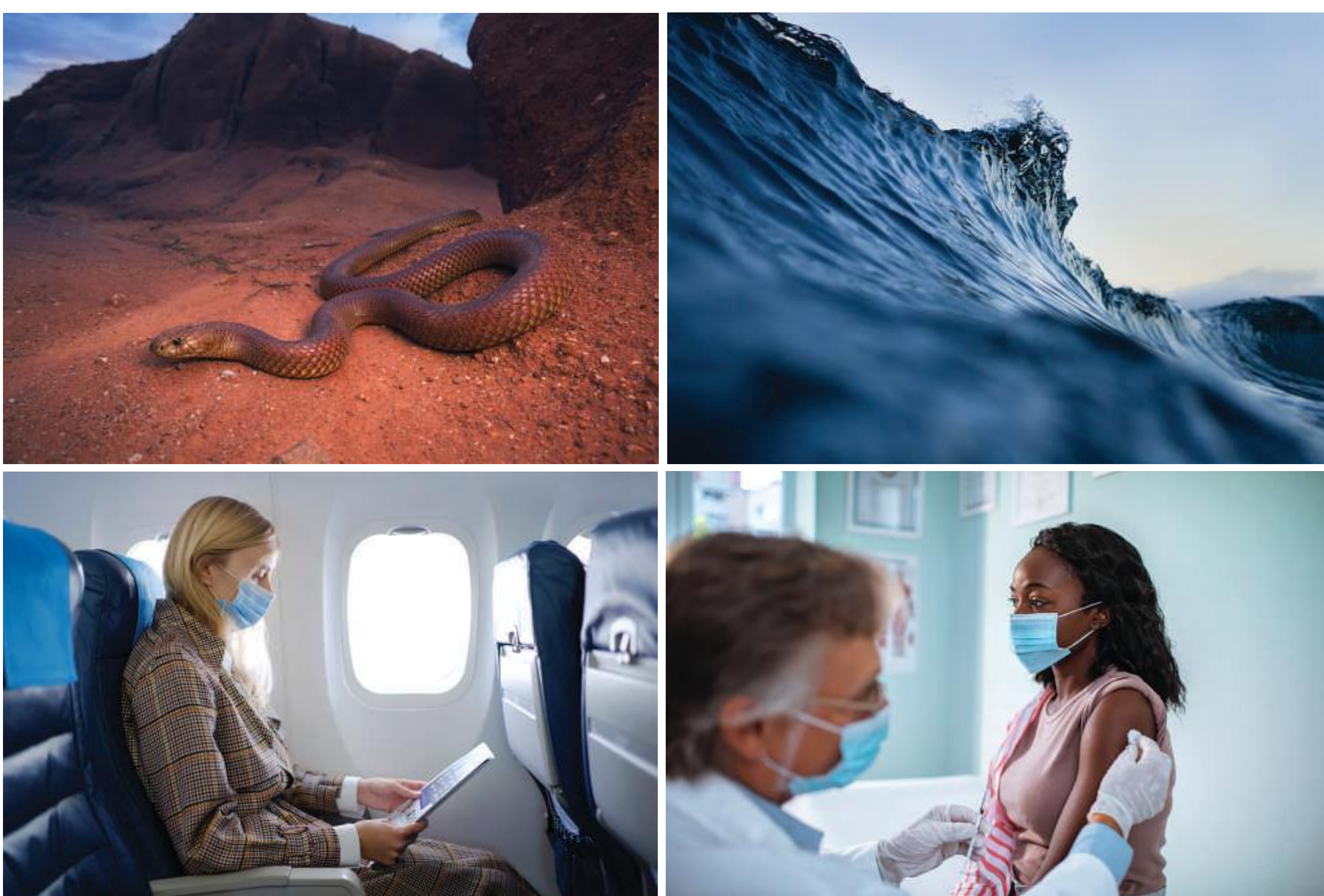


Figure 10A–1 The four categories of specific phobia relate to animals, the natural environment, situations and bodily pain.

ISBN 978-1-009-25416-8 Gallagher et al

Table 10A–1 Types of anxiety disorders described by the Australian Psychological Society

Type of anxiety disorder	Description
Generalised anxiety disorder (GAD)	Persistent and excessive worry, often about daily situations like work, family or health. This worry is difficult to control and interferes with the person's day-to-day life and relationships
Specific phobia	Extreme anxiety and fear of particular objects or situations. Common phobias include fear of flying, fear of spiders and other animals, and fear of injections
Panic disorder	The experience of repeated and unexpected panic attacks – sudden surges of overwhelming fear and anxiety accompanied by physical symptoms such as chest pain, heart palpitations, dizziness and breathlessness. In panic disorder, these panic attacks come 'out of the blue' with no apparent trigger.
Agoraphobia	Involves intense anxiety in situations and places where the person feels it would be difficult for them to get out quickly or get help if needed. This includes situations such as using public transport, being in a lift or a cinema, standing in a queue, being in a crowd, or being outside of the home alone.
Obsessive compulsive disorder (OCD)	Recurring, persistent and distressing thoughts, images or impulses known as obsessions (e.g. a fear of catching germs), or feeling compelled to carry out certain repetitive behaviours, rituals or mental acts, known as compulsions (e.g. handwashing). Some people with OCD have both obsessions and compulsions. These thoughts and behaviours can take over a person's life and, while people with OCD usually know that their obsessions and compulsions are an overreaction, they feel they are unable to stop them.
Social anxiety disorder	Severe anxiety about being criticised or viewed negatively by others. This leads the person to avoid social events and other social situations for fear of doing something that leads to embarrassment or humiliation.

Source: Australian Psychological Society

ACTIVITY 10A–1 IDENTIFYING THE TOP TEN PHOBIAS

Copy the table below and try to correctly rank each phobia from the most to the least common (from 1 to 10).

Phobia	Description	Rank
Carcinophobia	Fear of developing cancer	
Emetophobia	Fear of vomiting	
Acrophobia	Fear of heights	
Zoophobia	An umbrella term that involves extreme fear of certain animals	
Brontophobia	Fear of thunder and thunderstorms	
Aerophobia	Fear of flying	
Blood, injury and injection phobia	Generally associated with fear of medical procedures	
Phasmophobia	Fear of ghosts	
Triskaidekaphobia	Extreme fear related to the number 13	
Claustrophobia	Fear of being in constricted, confined spaces	

ISBN 978-1-009-25416-8 Gallagher et al

Once you have ranked the phobias, access the answers and reflect on any differences between the two lists. In small groups or as a whole class, consider the following questions.

- Were you surprised at the rankings of any of the items on the list? Why?
- Why do you think there are so many different types of specific phobia?
- How might any of these phobias develop? Do you think some types of phobias might be more difficult to develop than others?

Check-in questions – Set 1

1 What are two key characteristics of a phobia?
2 Explain how a phobia is different from fear.
3 Identify the four types of phobias and provide two examples of each type.
4 Explain how a specific phobia is different from other anxiety disorders.

Development of specific phobia and the biopsychosocial model

LINK CHAPTER 9

As you read in Chapter 9, the biopsychosocial model describes how biological, psychological and social factors combine to influence physical and mental health. The onset of all physical and mental illnesses occurs as a result of a complex combination of these three factors, and in turn each factor is considered when managing illness. Even though two people may have the same diagnosis, the same factors will not necessarily interact in the same way in the development of their illnesses. Rather, each person's case is considered separately, and each contributing factor is identified so that doctors understand the extent of the illness and can devise a unique treatment plan for each person.

To understand a person's phobia, you need to look at the biological, psychological and social factors that contribute to it. You also need to consider how the factors interact in a person's unique circumstances.

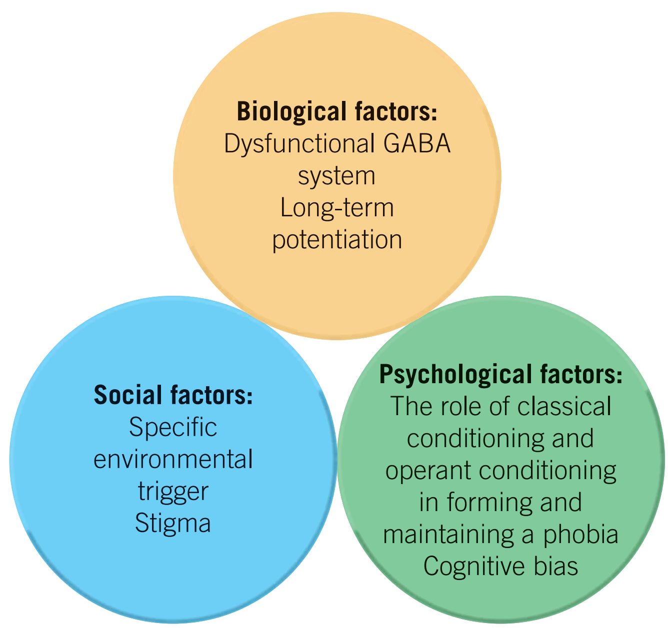


Figure 10A–2 The biological, psychological and social factors that contribute to a specific phobia.

Biological factors

If a member of your family has a phobia, then you are more likely to have one as well, and are more likely to have the same one. One study showed that first-degree relatives, such as parents, siblings or children of someone with a specific phobia, are approximately three times more likely to develop a phobia. This suggests that biological factors have a strong effect on the development of phobias. But it is not clear whether these factors are genetic or due to something in the home environment or upbringing. Twin studies have shown evidence of a genetic component; for example, identical twins are more likely to share a specific phobia than other siblings raised in the same household.

ISBN 978-1-009-25416-8 Gallagher et al

Biological factor a factor that relates to the physiological functioning of the body

Gamma-aminobutyric acid (GABA) the main inhibitory neurotransmitter in the nervous system, associated with anxiety, specific phobias and Parkinson's disease

Glutamate the main excitatory neurotransmitter in the nervous system, involved with learning and memory

VIDEO 10A–1 GABA DYSFUNCTION

Biological factors are internal physiologically based or determined factors. Genetics is just one example of a biological factor that contributes to the development, progression or perpetuation of a specific phobia. In this section, we explore biological factors, such as gamma-aminobutyric acid (GABA) dysfunction, the role of the stress response and the impact of long-term potentiation, and how they contribute to the development of a phobia.

Figure 10A–3 Twin studies have shown evidence of a genetic component in the development of specific phobia.

Gamma-aminobutyric acid dysfunction

Gamma-aminobutyric acid (GABA) and **glutamate** are primary neurotransmitters that work together to regulate the levels of arousal in the central nervous system (CNS). GABA is considered an inhibitory neurotransmitter because it blocks, or inhibits, certain neural signals and decreases activity in the nervous system. When GABA activates its receptors, it makes post-synaptic neurons less likely to fire an action potential, producing a calming effect. This reduces feelings of anxiety, stress and fear.

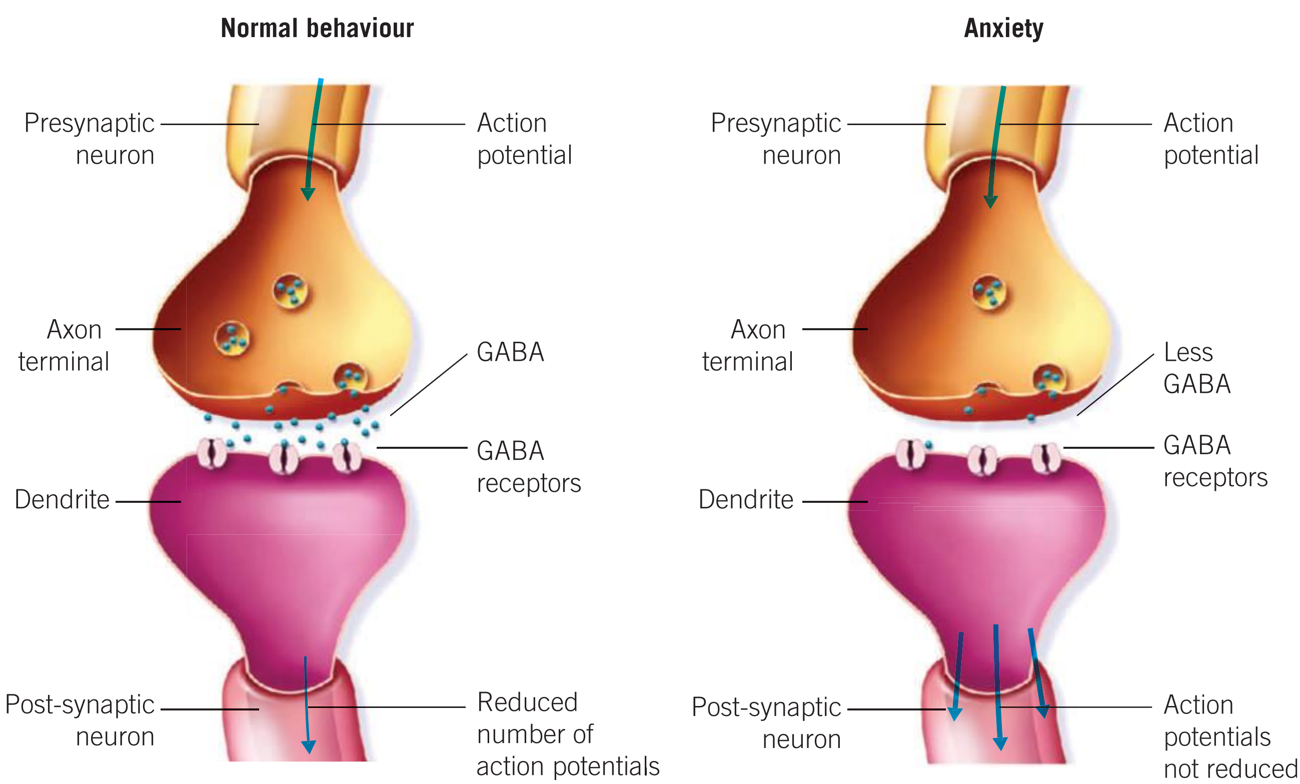


Figure 10A–4 Left: Normal behaviour. When the inhibitory neurotransmitter gamma-aminobutyric acid is released by the presynaptic neuron and binds to GABA receptors on the post-synaptic neuron, it reduces action potential firing by the post-synaptic neuron and so reduces nervous system activity. Right: If less GABA is released, or it is inhibited in some way, action potential firing by the post-synaptic neuron is not reduced and so nervous system activity is higher than normal. Individuals with anxiety may have low levels of GABA.

ISBN 978-1-009-25416-8 Gallagher et al

Research suggests that people diagnosed with a specific phobia are predisposed to anxiety because they have a **dysfunctional GABA system**. Excessive anxiety is due to an elevated stress response caused by the release of glutamate during a flight-or-fight-or-freeze response. If there is a failure to produce, release or receive the correct GABA signal, then there is an insufficient inhibitory signal to adequately regulate heightened arousal levels that are caused by excitatory neurons being too active. Therefore, people with a phobia have an insufficient GABA signal to inhibit this neural activation, resulting in exaggerated feelings of fear or anxiety.

Dysfunctional GABA system a failure to produce, release or receive the correct amount of gamma-aminobutyric acid

People with a low GABA signal are more vulnerable to anxiety. Furthermore, their flight-or-fight-or-freeze response may be more easily activated when they encounter or believe they will encounter a phobic stimulus, and they become more anxious to stimuli. When someone perceives that they will be exposed to or might be exposed to the fear object (in the absence of any real danger), their flight-or-fight-or-freeze response may be more easily activated than someone with a functional GABA system. This stress response is often very severe and can persist for long periods. This can maintain the feelings of anxiety in relation to the fear object, even though the perception of danger is imagined and not real.

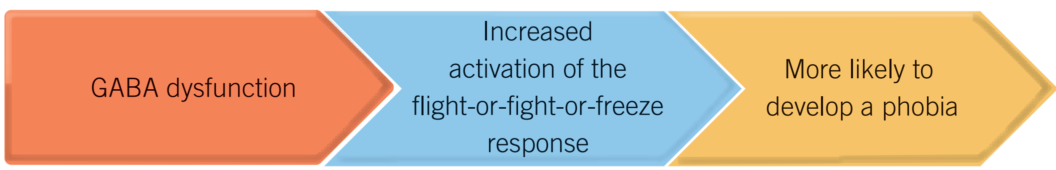


Figure 10A–5 The impact of GABA dysfunction on the development of a phobia.

Long-term potentiation

Case study 2: Dog phobia

Zach is an 18-year-old apprentice electrician who is seeking help for an intense fear of dogs. When he was young, he was playing soccer in the backyard when the ball went into the neighbour's garden. Zach climbed over the fence to retrieve the ball, but when he was climbing back, he was attacked by the neighbour's dogs. Zach sustained severe injuries to his face, neck and hands, for some of which he required painful surgery. Before the event, Zach loved dogs and was the main caregiver of the family dog, a golden retriever called Larry. Since the incident, Zach has not been able to look at or pat Larry. If Larry comes close to him, Zach freezes until Larry moves away. This situation has become so bad that Zach's family has given Larry away.

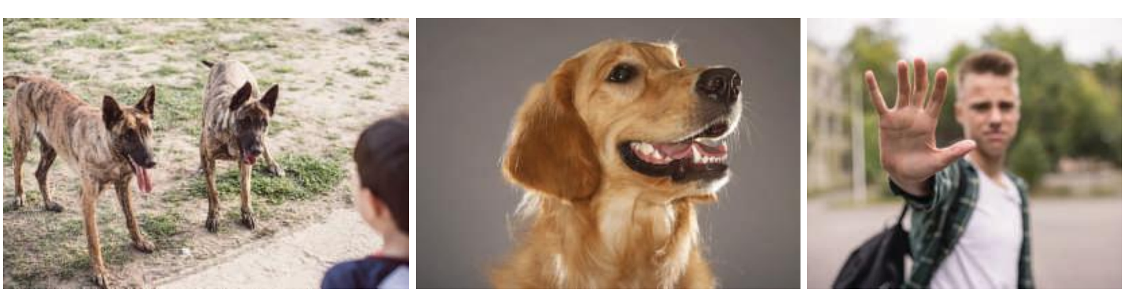


Figure 10A–6 Zach was attacked by the neighbour's dogs and now whenever he sees a dog, he is reminded of being attacked. This repeatedly activates the same neural pathway between the memory of the dog attack and fear of dogs, making Zach's fear of dogs stronger.

ISBN 978-1-009-25416-8 Gallagher et al

In normal circumstances, fear aids in our survival. For example, if we are bitten by a dog, we will learn that dogs can be dangerous, and the next time we encounter a dog, we will be careful around it. Thus, many of our fears are learned responses. However, although Zach's fear was learned, his fear led to a maladaptive behavioural response. How does this occur?

CHAPTER 3 LINK

In Chapter 3, you learned about how learning and memory occur at a neurobiological level. **Long-term potentiation (LTP)** is the long-lasting strengthening of synaptic connections of neurons resulting in enhanced signalling between neurons. LTP can strengthen the association between a phobic stimulus and a fear/anxiety response through repeated activation of the same neural pathways. When these connections are activated through different encounters with the phobic stimulus or thinking about a past or future encounter, the connections are further strengthened. Subsequently, the associated fear response to the phobic stimulus strengthens, and it is much less likely that what is learned will be forgotten. In Zach's case, every time he thinks about being attacked by the neighbour's dog, this repeatedly activates the same neural pathway between the memory of the dog attack and his fear of dogs, making the neural pathway, and Zach's fear of dogs, stronger.

Long-term potentiation (LTP) the relatively permanent strengthening of synaptic connections as a result of repeated activation of a neural pathway

VIDEO 10A–2 SKILLS: GABA AND GABA DYSFUNCTION

10A–1 SKILLS

Applying your understanding to the role of GABA and GABA dysfunction

When discussing the effect of GABA and a dysfunctional GABA system on the CNS, it is important to specify the impact on the post-synaptic neuron. For example, it is important to explain that GABA makes the post-synaptic neuron less likely to fire. However, when discussing the impact of dysfunctional GABA system in the CNS, it is important to specify that as a result of a low GABA signal, the post-synaptic neuron is *more* likely to fire.

Question:

Ashlee has had a phobia of clowns since she was a child. Recently, Ashlee was invited to a children's birthday party. Ashlee was so afraid that a clown might be present that she found an excuse not to attend. Ashlee saw a psychologist, who believes she may be experiencing GABA dysfunction. Explain the effect that GABA dysfunction could have on Ashlee's anxiety levels. (3 marks)

Attempted answer:

Ashlee would have low levels of GABA. This would result in her neurons firing less and increase her anxiety arousal levels when she is potentially exposed to a clown.

Marking comments:

This attempted response would achieve a score of 2/3 marks. The response correctly suggests that a GABA dysfunction involves low levels of GABA, which can lead to increased anxiety when exposed to clowns. However, the response mistakenly suggests that the post-synaptic neuron is less likely to fire as a result of a GABA dysfunction, rather than more likely to fire.

Suggested answer for full marks:

Ashlee would have low levels of GABA. This would result in her post-synaptic neurons being more likely to fire when she is potentially exposed to a clown. Therefore, her anxiety arousal levels increase.

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 2

1 List three physiological responses that may occur when a person is exposed to their phobic stimulus (these were covered in Chapter 3).
2 What is GABA?
3 Explain what GABA dysfunction means.
4 How can GABA dysfunction increase the risk of someone developing a specific phobia?
5 Define 'long-term potentiation'.
6 Explain how LTP can contribute to the development and continuance of a specific phobia.

Psychological factor
a factor that relates to the functioning of the brain and the mind, including cognitive and affective processes such as thought patterns and memory

Behavioural model
phobias are learned through experience and may be developed, sustained or modified by environmental consequences such as rewards or punishments

Psychological factors

Psychological factors refer to internal influences associated with mental processes. As with biological factors, these thoughts and perceptions play a key role in developing and maintaining a specific phobia. In this section, you will learn about the formation and the continuation of a specific phobia according to behavioural and cognitive models.

Behavioural models of phobia development

Behaviourism is a theory of learning based on the idea that all behaviours are acquired through an interaction with the environment. Therefore, **behavioural models** suggest that phobias are learned through experience and may be developed, sustained or modified by environmental consequences such as rewards or punishments. Explanations of phobias propose that classical conditioning plays a role in the precipitation (initiation or development) of a specific phobia and operant conditioning plays a role in the perpetuation (or maintenance) of a specific phobia.

Precipitation by classical conditioning

LINK 5A CLASSICAL CONDITIONING

As discussed in Chapter 5, Ivan Pavlov discovered that when a stimulus that did not previously elicit a response is repeatedly paired with a stimulus that produces a naturally occurring response, the two stimuli will be linked, and the previously neutral stimulus will consistently produce an involuntary response. This became known as **classical conditioning**. In 1920, John B. Watson applied the process of classical conditioning to condition a fear response into a baby known as Little Albert.

Classical conditioning
a simple form of learning that occurs through the repeated association between a neutral stimulus and an unconditioned stimulus to produce a conditioned response

Figure 10A–7 A still from a film of John B. Watson's Little Albert experiment to classically condition a fear response in a person. Here Albert cries at the sight of rabbit, having been conditioned to associate a furry animal with a sudden, loud frightening noise.

ISBN 978-1-009-25416-8 Gallagher et al

ACTIVITY 10A–2 EXPLORING THE CASE OF LITTLE ALBERT: CONDITIONING A FEAR RESPONSE

The famous case of Little Albert is a demonstration of how an emotional response can be conditioned. After having read through Chapter 5, conduct some research and discover how John B. Watson used classical conditioning principles to teach Little Albert to fear white rats. Use the questions below to guide your research.

- How can I apply this to the three-stage model of classical conditioning?
- How did Little Albert exhibit stimulus generalisation?
- How could extinction be used to help reduce Little Albert's fear?
- What happened to Little Albert?
- Do you think this experiment was ethical? Why or why not?

Three-stage model of classical conditioning applied to phobias

Precipitate trigger the onset or exacerbation of a mental disorder

Watson's experiment demonstrated how classical conditioning can precipitate the emergence of a phobia. An example of a phobia being **precipitated** through classical conditioning is a teenager who is repeatedly swooped by a magpie while riding to school. As a result of the shock and fear of being swooped, the teenager now fears magpies. The magpie (a neutral stimulus with no particular meaning) is repeatedly paired with a sufficiently traumatic event such as being swooped (unconditioned stimulus), which elicits an intensely negative emotional response such as shock and fear (unconditioned response). After enough pairings, the magpie has become associated with the shock and fear of being swooped, and the sight of any magpie (conditioned stimuli) alone is enough to make the teenager feel shock and fear (conditioned response). This is summarised in Figure 10A–8.

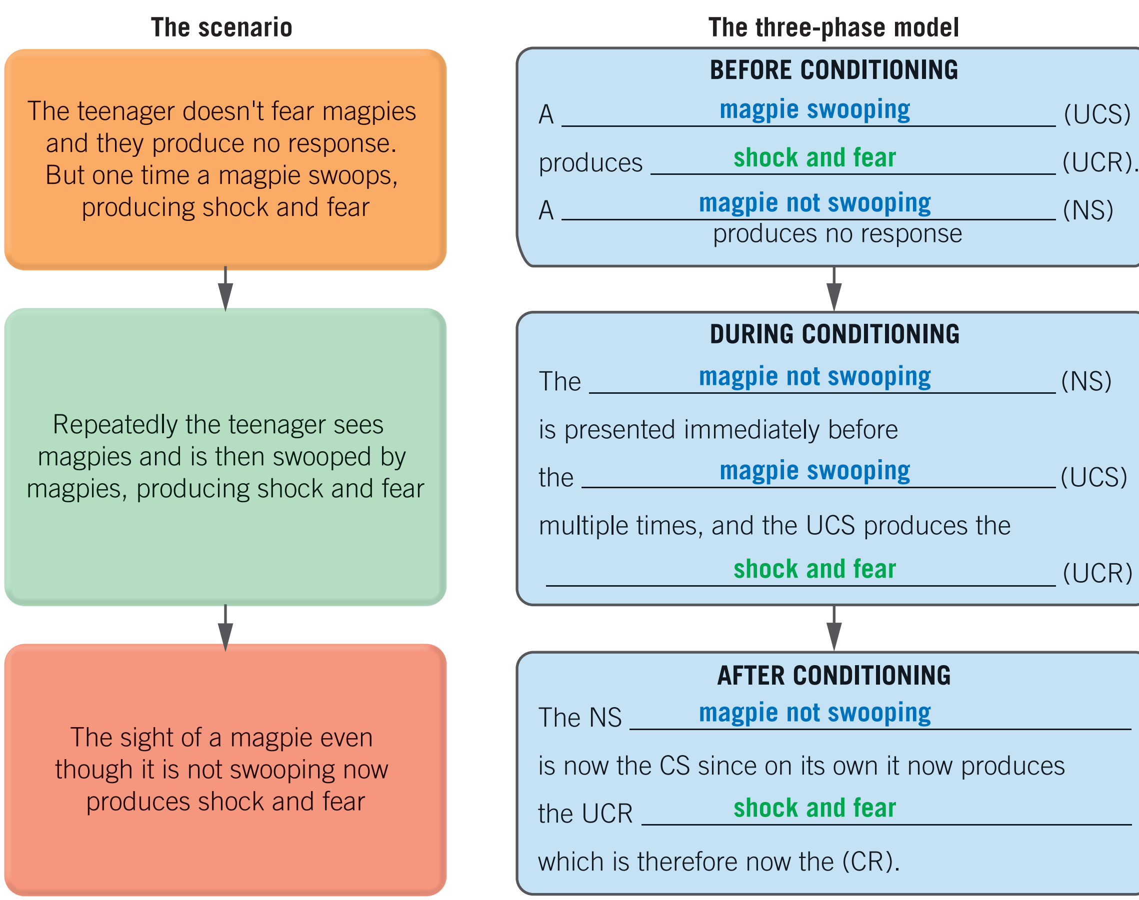


Figure 10A–8 The three-stage model of classical conditioning can precipitate a phobia, in this case of magpies. On the left is the scenario, on the right, the classical conditioning model from Figures 5A–4 and 5A–5 is applied to the scenario to explain how the phobia is created.

ISBN 978-1-009-25416-8 Gallagher et al

As was the case for Little Albert, the teenager's fear response may become generalised to other similar stimuli. For example, the teenager may now experience fear at the sight of all birds, not just magpies.

Perpetuation of specific phobia by operant conditioning

LINK 5B OPERANT CONDITIONING

Have you ever had a test coming up that you felt underprepared for and so skipped school that day? The feeling of relief at avoiding a stressful experience is an example of **operant conditioning**. You might have found that after you felt relief at missing the test, you were more likely to avoid any future tests that you were not prepared for!

Once a phobia has developed, it can be **perpetuated** by operant conditioning, more specifically by **negative reinforcement**. When a person is confronted by, or thinks they might be confronted by, a phobic stimulus, using **avoidance behaviour** reduces or removes the unpleasant feelings of fear or anxiety associated with the stimulus. This makes the person more likely to avoid the phobic stimulus in future, effectively continuing the cycle of fear. An example of avoidance behaviour is shown in Figure 10A–9.

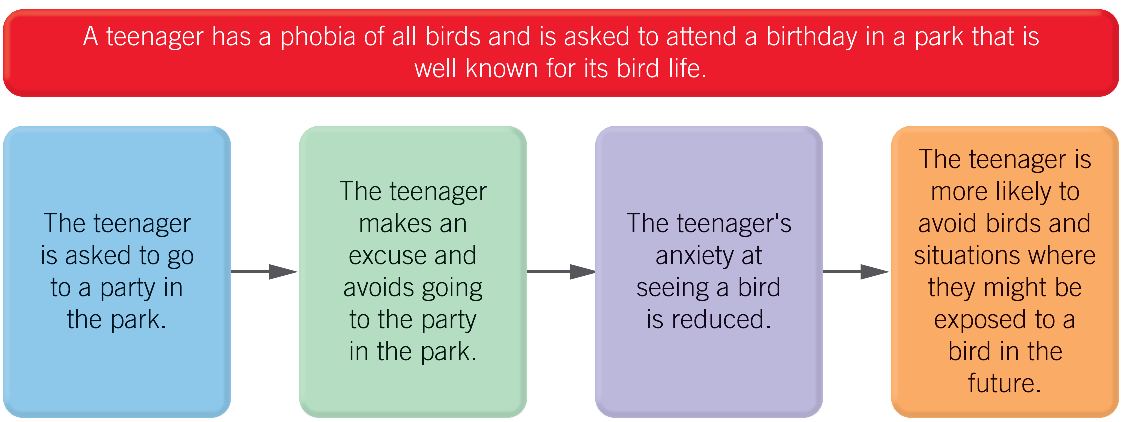


Figure 10A–9 The perpetuation of a bird phobia through operant conditioning.

Cognitive bias, memory bias and catastrophic thinking

In contrast to the behavioural model, the **cognitive model** describes how people's perceptions of situations influence their emotional and behavioural reactions. When we are distressed, our perceptions are often distorted. Therefore, the cognitive model is used to examine distorted thinking in the development and maintenance of a specific phobia. It focuses on how a person processes information about the phobic stimulus and related events, including their perceptions, memories, attitudes and biases. The underlying assumption of the cognitive model is that people with a specific phobia often have one or more **cognitive biases**, a tendency to think in a way that involves errors of judgement and faulty decision-making. In this section, you will examine two common cognitive biases – memory bias and catastrophic thinking.

Figure 10A–10 If you have a memory bias, you might only recall the times when you were chased by a kangaroo and not all the times that you had a positive interaction with a kangaroo.

Memory bias

A **memory bias** is a form of distorted thinking that either enhances or impairs the recall of a memory or that alters its content. In people with a specific phobia, a memory bias completely distorts and exaggerates fears relating to phobias

Operant conditioning a type of learning process in which the likelihood of a voluntary behaviour occurring is determined by its consequences

Perpetuation prolonging of the occurrence of a mental disorder and preventing recovery

Negative reinforcement when a behaviour is followed by the removal of an undesirable stimulus, increasing the likelihood of the behaviour occurring again

Avoidance behaviour actions a person takes to escape from difficult thoughts and feelings

Cognitive model a model that describes how people's perceptions of situations influence their emotional and behavioural reactions

Cognitive bias the tendency to think in a way that involves errors of judgement and faulty decision-making

Memory bias distorted thinking that either enhances or impairs the recall of a memory or alters its content

ISBN 978-1-009-25416-8 Gallagher et al

by focusing more on the fearful or negative experiences. For example, someone with a moth phobia will tend to reconstruct their memory of an experience with a moth in a way that describes it as bigger, more dangerous or more frightening than it actually was. Furthermore, they might also demonstrate that they have a memory bias by minimising or forgetting more positive or contradictory information that might challenge the fear. For example, a person with a phobia of kangaroos will tend to remember the one instance that they were chased by a kangaroo but forget all the other times when they interacted with kangaroos in a peaceful manner.

ACTIVITY 10A–3 EXPLORING OTHER COGNITIVE BIASES THAT AFFECT A SPECIFIC PHOBIA

People with phobias tend to be hypervigilant; that is, they are always alert and constantly looking for something relevant to their phobia that may be potentially threatening. This is like having a radar specifically set to pick up information in the environment relating to the specific phobia. Hypervigilance, like other cognitive biases, is not helpful and maintains symptoms of the specific phobia.

Research two other forms of cognitive bias that perpetuate specific phobias: attentional bias and interpretation bias. Then complete a table like the one shown here.

Cognitive bias	Description	Example
Attentional bias		
Interpretation bias		

Catastrophic thinking
a cognitive bias that involves overestimating and exaggerating the worst possible outcomes to situations even though they are unlikely to occur

Catastrophic thinking

Have you ever been in a situation when you were nervous about a future event, such as a speech or an exam, and you built it up in your mind until you were thinking, 'If I do this speech, I will certainly mess up and everyone will laugh at me'? This is quite common and unhelpful to our daily functioning. These types of thoughts are examples of **catastrophic thinking** – a cognitive bias that involves overestimating and exaggerating the worst possible outcomes to situations even though they are unlikely to occur. For example, a person with a dog phobia may think that any dog will attack them and cause a permanent or painful injury, or a person with a fear of driving may think that every time they get into a car they are likely to be injured or die.

When thinking about an encounter with a phobic stimulus, people with a specific phobia tend to predict the worst outcomes, which is unrealistic and irrational. When this happens, the person generally feels heightened levels of anxiety and distress and underestimates their ability to cope with the situation or their symptoms of anxiety. This in turn perpetuates the fear of the object or situation.

Figure 10A–11 People who have catastrophic thoughts might believe that if they get into a car, they will certainly be in a car crash.

ISBN 978-1-009-25416-8 Gallagher et al

10A–2 SKILLS

Classical conditioning and phobias

In Chapter 5, you learned how to construct a response of how learning occurs through classical conditioning. When discussing the precipitation of a specific phobia through classical conditioning, you must continue to use the following structure:

Before conditioning

- Neutral stimulus elicits no response
- Unconditioned stimulus elicits unconditioned response

During conditioning

- Neutral stimulus is *repeatedly presented before* unconditioned stimulus, which elicits unconditioned response in response to unconditioned stimulus

After conditioning

- Unconditioned stimulus *alone* elicits conditioned response in response to unconditioned stimulus

When constructing your response, it is important that you use appropriate language at each stage. For example, in the 'During conditioning' stage, you must be explicit in saying that the neutral stimulus is *repeatedly presented before* the unconditioned stimulus, rather than being *paired with* the unconditioned stimulus.

Operant conditioning and phobias

In Chapter 5, you also learned how to construct a response for how learning occurs through operant conditioning. When discussing the perpetuation of a specific phobia through operant conditioning, you must continue to use a similar structure.

Question:

Cooper has had a terrible phobia of cupcakes since he was a child. When he was 8 years old, Cooper choked on a cupcake at a party and thought he was going to die. Cooper now has his own children and refuses to take them to parties because he fears encountering a cupcake. With reference to the three-stage model of operant conditioning, describe how Cooper's avoidance behaviours could perpetuate his phobia of cupcakes. (4 marks)

Attempted answer:

Cooper could be asked to go to a party where he might be exposed to a cupcake, so he refuses the invitation. This has the effect of reducing Cooper's fear so he is more likely to avoid a party again.

Marking comments:

This response would achieve a score of 2/4. The response has correctly identified the antecedent and the behaviour in the scenario, receiving a mark for each of these applications. However, the response has not identified any of the three stages of operant conditioning, so it loses 1 mark. A further mark has been lost because the application of the consequence to the scenario is not clear. Cooper is more likely to avoid parties or cupcakes in the future because his anxiety in relation to cupcake has been reduced. This is an example of negative reinforcement.

VIDEO 10A–3
SKILLS: CLASSICAL CONDITIONING AND PHOBIAS

LINK CHAPTER 5

VIDEO 10A–4
SKILLS: OPERANT CONDITIONING AND PHOBIAS

ISBN 978-1-009-25416-8 Gallagher et al

It is important to ensure that you use appropriate signposting to organise your response. Using subtitles and dot points are great ways to do this. Here is an example of a response that would achieve full marks and makes use of the signposting technique.

Suggested answer for full marks:

- Antecedent: Cooper's children are invited to a birthday party and Cooper is afraid that he might see a cupcake.
- Behaviour: Cooper avoids going to the party (phobic stimulus).
- Consequence: Cooper's anxiety about seeing a cupcake is reduced or avoided (negative reinforcement) and therefore he is more likely to avoid taking his children to parties (phobic stimulus) in future.

Check-in questions – Set 3

1. Compare and contrast the behavioural and cognitive models.
2. Using your own example, explain how a specific phobia can be precipitated through classical conditioning.
3. Explain, using a flow chart, how operant conditioning can perpetuate a phobia.
4. Based on what you have learned about operant conditioning in Chapter 3, explain how a specific phobia could be precipitated through operant conditioning.
5. Define 'cognitive bias'.
6. Name and explain two types of cognitive biases associated with a specific phobia.
7. Explain how cognitive biases affect the progression of a specific phobia.

Social factors

In 1869, the phrase 'nature versus nurture' was formulated by Francis Galton to describe an intense debate that was occurring in the psychological community. Those who agreed with the nature side argued that the DNA we are born with determines who we are and what personality traits we have. Those who argued for the nurture side thought that we come into the world as a blank slate and it is our experiences and interactions that allow us to develop as we do.

Social factor a factor that relates to the social components of a person's environment

Specific environmental trigger an object, situation or circumstance that probably caused a direct, negative traumatic experience associated with extreme fear or discomfort, which then acts as a cue for future phobic fear responses

Parallels can be drawn between nature versus nurture and the biopsychosocial framework that helps illustrate how a specific phobia is caused. **Social factors** are external factors that involve skills in interacting with others; and the range and quality of interpersonal relationships are examples of nurture in action. In this section, we discuss how specific environmental triggers and stigma can contribute to the type and incidence of specific phobia.

Specific environmental triggers

Many people diagnosed with a specific phobia report that they had a negative and traumatic experience with the object of their phobia in the past. These people generally attribute this specific encounter as the cause of their phobia. For example, a child with a phobia of injections might recall that they developed the phobia when they were immunised at the doctors and experienced sudden and extreme pain. This is known as a **specific environmental trigger** – when a specific phobia is developed after a direct negative and traumatic experience with an object or situation that produces extreme fear or discomfort.

ISBN 978-1-009-25416-8 Gallagher et al

Figure 10A–12 A child might develop a phobia after a direct traumatic experience with the phobic object, such as a needle.

In some cases, even observing a frightening event can result in phobia. For example, if a person witnesses a terrible traffic accident where someone is covered in blood, they may later have a blood phobia. In general, the more traumatic the event (whether directly experienced or observed), the more likely it is that a phobia will develop, even if the event or situation occurs only once. For example, someone who almost drowned might develop a phobia of water. Or if a young child is attacked by a dog, then they might be afraid of every dog as they grow up; being bitten by a dog, even once, can produce an extreme fear response, which becomes a conditioned fear response through classical conditioning processes. This conditioned response is then produced whenever the specific stimulus (or a generalised version) is encountered.

A single traumatic experience through direct experience does not explain the origin of all phobias. Moreover, not everyone who is exposed to similar traumatic events develops a phobia. Why is this the case? Development or onset of specific phobias is not necessarily explained by one factor alone and everyone's unique past experiences must be considered. If a person is exposed to a positive experience soon after the traumatic one, they are less likely to form an association between the fear object and a fear response. For example, if a child who is given a sudden painful injection is then given a lollipop or a sticker, they may not develop a phobia of injections. Further, if a person who has nearly drowned immediately gets back into the water and has a positive experience, they are less likely to develop a phobia of water.

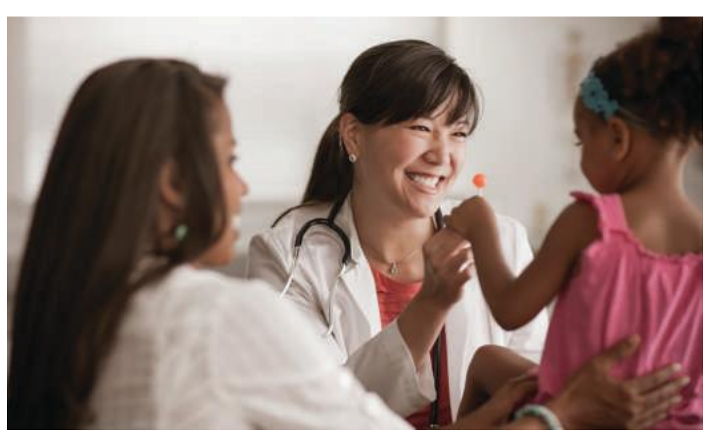


Figure 10A–13 If a traumatic experience such as an injection is followed by a positive one, a phobia is less likely to develop.

ISBN 978-1-009-25416-8 Gallagher et al

Stigma around seeking treatment

Labels such as 'crazy', 'psycho' or 'mental' are examples of stigma. **Stigma** refers to negative stereotypes associated with a trait that sets a person apart, such as ethnicity or a mental health disorder. These negative stereotypes and prejudice associated with stigma may also lead to discrimination. Three-quarters of people with a mental illness report that they have experienced stigma. A 2006 survey in Australia found that:

- nearly a quarter of people thought depression was a sign of personal weakness and would not employ such a person
- about a third would not vote for a politician with depression
- two-fifths thought people with depression were unpredictable
- one-fifth said if they had depression, they would not tell anyone
- nearly two-thirds thought people with schizophrenia were unpredictable
- one-quarter thought people with schizophrenia were dangerous
- stigmatising attitudes were highest towards people with schizophrenia.

Stigma the feeling of shame or disgrace associated with a personal characteristic that indicates you belong to a culturally devalued group in society – this can be real or imagined

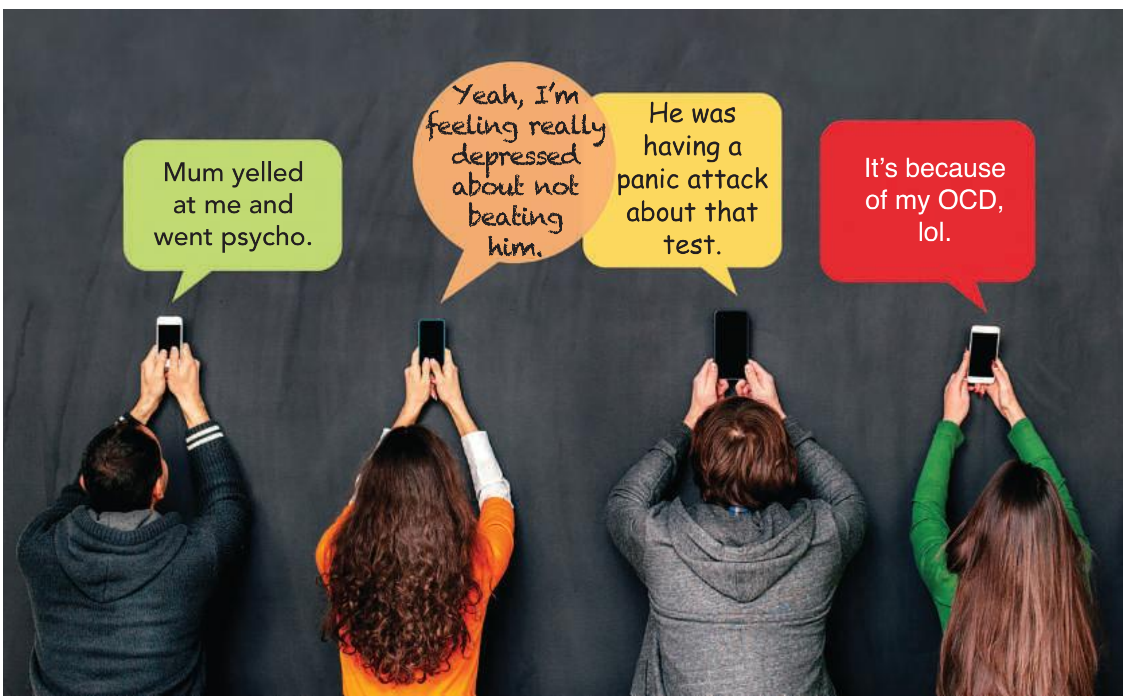


Figure 10A–14 Warning: some of these examples may offend. Language that stigmatises those with mental illness are unfortunately common in our society. These are not acceptable, and including them as examples here does not condone their use.

More specifically, people with a specific phobia are vulnerable to stigmatisation because phobias are irrational fears and it is difficult for others to empathise with people who have them. Someone with a phobia can be subject to ridicule, belittling comments or disbelief because some phobic stimuli such as balloons or buttons are typically perceived as being harmless. Stigma brings with it feelings of shame, poor self-esteem and hopelessness, especially when it results from a mental health disorder. Distress and symptoms may be worsened by a lack of understanding by family, friends and others, and may be a barrier to seeking treatment. In this way, stigma perpetuates a specific phobia.

WORKSHEET 10A–1 CAUSES OF PHOBIA: CASE STUDY

WORKSHEET 10A–2 SUMMARISING THE CAUSATION FACTORS FOR SPECIFIC PHOBIA

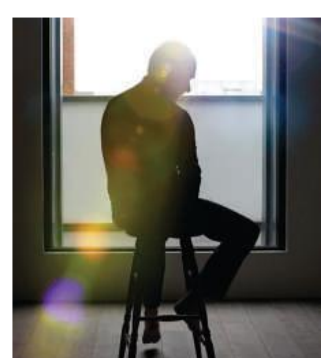


Figure 10A–15 People with a mental illness often feel shame, which makes them less likely to seek treatment.

ISBN 978-1-009-25416-8 Gallagher et al

ACTIVITY 10A–4 EXPLORING STIGMA IN THE MEDIA

How do we develop our attitudes towards people with a mental illness? A lot of people develop their attitudes through their consumption of media. Think about the different representations of mental health that you have seen in newspapers, movies, TV shows or social media; have these representations been positive or negative?

Gather five examples of media that depict a person with a mental illness (for example, the Netflix show *13 Reasons Why*). Analyse the media and consider the following questions.

- Is the overall interpretation of the person positive, neutral or negative?
- What stereotypes about mental illness do you see? How many examples can you find?
- What does this interpretation of mental illness suggest about people who suffer from a mental illness in our society?
- What conclusions can you draw about the role of media in the stigmatisation of those with a mental illness?

Check-in questions – Set 4

1 Explain what a social contributing factor is with reference to an example.
2 What effect does a specific environmental trigger have on the development of a phobia?
3 Why do some people experience a traumatic experience but not develop a phobia?
4 Explain the term 'stigma' with reference to an example.
5 How does stigma allow a specific phobia to progress?

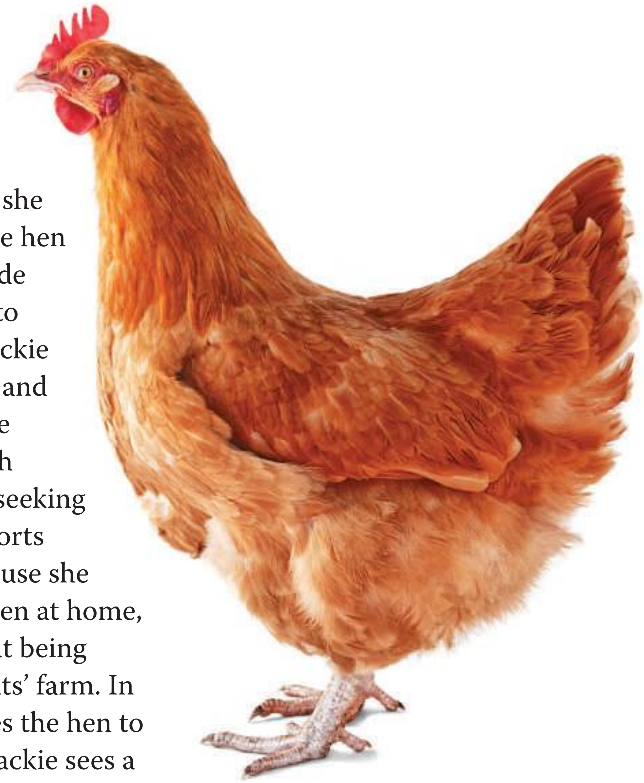
Section 10A questions

1 Summarise each of the contributing factors that influence a specific phobia listed in the table below.

Biological	Psychological	Social
GABA dysfunction	Classical conditioning	Specific environmental trigger
Long-term potentiation	Operant conditioning	Stigma
	Cognitive bias	

2 Explain why a specific phobia falls under the category of an anxiety disorder.
3 Discuss two characteristics of a mental disorder that could be used before deciding whether someone is suffering from a specific phobia.
4 Rina has been frightened of moths since she was hit on the head with a ball immediately after a moth flew past. She now thinks they are a danger to her safety and wellbeing. She also thinks that if she sees a moth, a ball will hit her immediately. One day when going into her room, Rina saw a few large moths flying above her bed and she became distressed. From that night on, Rina refused to enter her room, preferring to sleep on the couch.
Explain why Rina would be considered to have a phobia, with reference to two characteristics of mental disorders.

ISBN 978-1-009-25416-8 Gallagher et al



5 When Jackie was a small girl, she would often go to her grandparents' farm on the weekends. When she was there, she would collect fresh eggs from the hens. One weekend, when Jackie was collecting the eggs, she was chased by an aggressive hen. The hen pecked Jackie on her legs, which made her very frightened and she burst into tears. For the next few days, when Jackie tried to collect eggs, she was chased and pecked by the hen, resulting in Jackie becoming frightened and crying each time. Jackie is now 34 years old and seeking treatment for a bird phobia. She reports that she rarely leaves her house because she is scared that she will see a bird. When at home, she often finds herself thinking about being chased by the hen at her grandparents' farm. In these memories, she always perceives the hen to be scarier than it really was. When Jackie sees a bird, her first thought is that it will attack her.

   a Identify the specific environmental trigger in the scenario.
   b Has Jackie generalised her fear response? Justify your answer.
   c Outline how GABA dysfunction could have contributed to the development of Jackie's phobia.
   d Explain what a perpetuating factor is and outline a biological, psychological and social factor that may have had a role in the perpetuation of Jackie's phobia.
   e Explain how the process of classical conditioning could affect Jackie's bird phobia.

Figure 10A–16 Phobias can arise in a number of ways, and it is important to be supportive and understanding of those who have one.

ISBN 978-1-009-25416-8 Gallagher et al

10B Evidence-based interventions and their use for specific phobia

Study Design:
Evidence-based interventions and their use for specific phobia with reference to: the use of short-acting anti-anxiety benzodiazepine agents (GABA agonists) in the management of phobic anxiety and breathing retraining (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)

Glossary:
Agonist
Benzodiazepine
Biological intervention
Breathing retraining
Cognitive behavioural therapy (CBT)
Evidence-based intervention
Fear hierarchy
Hyperventilation
Psychoeducation
Psychological intervention
Psychotherapy
Relaxation technique
Social intervention
Systematic desensitisation

ENGAGE

The lobotomy

In the early 1930s, Egas Moniz, a Portuguese neurologist, was treating a 63-year-old woman suffering from hallucinations, severe anxiety, insomnia and paranoia. Moniz believed that mental disorders were abnormalities in the brain's frontal lobes. There were few effective treatments for mental illnesses at the time. Moniz arranged for surgical colleagues to inject the prefrontal lobe of the woman's brain with alcohol, killing the neurons within it. Moniz later examined the woman and noted that she still seemed melancholy, but that her anxiety and paranoia had decreased significantly. The operation was considered a success and was called a leucotomy; it was later modified and renamed a lobotomy.

In the early 1940s, mental institutions in the United States and Europe were very overcrowded and psychiatrists were desperate for new treatments. Moniz's lobotomy was adapted by Walter J. Freeman, a neurologist at George Washington University, and quickly became part of mainstream medicine. Freeman's later method involved using an ice pick inserted through the patient's eye socket with the help of a mallet, then moving it back and forth to sever the

Figure 10B–1 A guard at Vacaville State Prison in the USA prepares a prisoner for a lobotomy in 1961.

ISBN 978-1-009-25416-8 Gallagher et al

connection to the prefrontal cortex. For many, this was deemed a miracle cure. It is estimated that 60 000 lobotomies were performed in the United States between 1936 and 1956 on patients with anxiety, depression and schizophrenia. Some patients recovered from previously untreatable conditions, but there were many complications such as apathy, childish or uninhibited behaviour and epilepsy. Freeman's own records suggest that lobotomies killed or worsened the condition of 14% of his patients.

Although there was some evidence that lobotomies improved symptoms of mental disorders including extreme specific phobia, there was also much evidence of very harmful side effects. Consequently, it was controversial from the start, and from the late 1950s onwards came to be viewed as an unethical treatment in most cases, especially as it was performed on some patients and prisoners without their informed consent.

EXPLAIN

Evidence-based interventions and their use for specific phobia

10A CONTRIBUTING FACTORS TO THE DEVELOPMENT OF SPECIFIC PHOBIA LINK

Evidence-based intervention a treatment shown to be effective in valid and reliable research studies

In Section 10A, you learned about the factors that interact to contribute to the development and maintenance of specific phobia with reference to the biopsychosocial framework. As with causal factors, the ways to manage or treat specific phobia must also be considered using the biopsychosocial framework. In doing so, we consider **evidence-based interventions** – treatments that were effective in valid and reliable research studies. Using evidence-based interventions that specifically address each of the causal factors of a phobia creates a holistic approach to treatment that is likely to be effective for different people with various types of phobias.

In this section, we explore the various biological, psychological and social interventions that are effective in treating phobias.

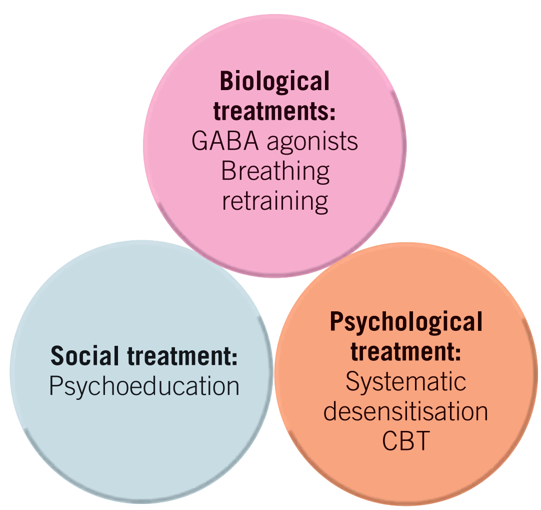


Figure 10B–2 The biological, psychological and social management factors of a specific phobia.

Biological factors

Biological intervention a treatment targeting physiological mechanisms believed to contribute to a condition

As previously discussed, biological factors are causal factors that are physiologically based, such as a genetic predisposition to have decreased GABA signalling. **Biological interventions** target physiological mechanisms believed to contribute to a phobia, and may focus on eliminating or alleviating symptoms of disorders rather than dealing with the underlying causes. Biological management tools for specific phobia include short-acting anti-anxiety benzodiazepine agents (GABA agonists) and breathing retraining.

ISBN 978-1-009-25416-8 Gallagher et al

Short-acting anti-anxiety benzodiazepine agents (GABA agonists)

Several types of medications, including antidepressants, beta-blockers and benzodiazepines, are effective at reducing the symptoms associated with specific phobia.

Benzodiazepines are a class of sedatives or depressants and are used to manage insomnia and anxiety. Benzodiazepines are commonly used as sleeping pills or to reduce anxiety because they slow down activity in the CNS, which reduces physiological arousal and promotes relaxation.

Benzodiazepines are **agonists** – drugs that mimic or enhance the action of a neurotransmitter that binds to its receptor on the post-synaptic neuron. More specifically, when a benzodiazepine binds to a GABA receptor site, it increases the inhibitory effects of GABA. This makes the post-synaptic neuron less likely to fire, which reduces the feelings of anxiety, thus making benzodiazepines an effective treatment for a specific phobia. For example, someone who has a blood/injection phobia might take a benzodiazepine to feel calm before getting an immunisation injection.

Benzodiazepine a type of agonist drug that works on the central nervous system to make the post-synaptic neuron less likely to fire, which regulates anxiety

Agonist a type of drug that mimics the action of a neurotransmitter that binds to the same receptor by stopping the presynaptic neuron from firing

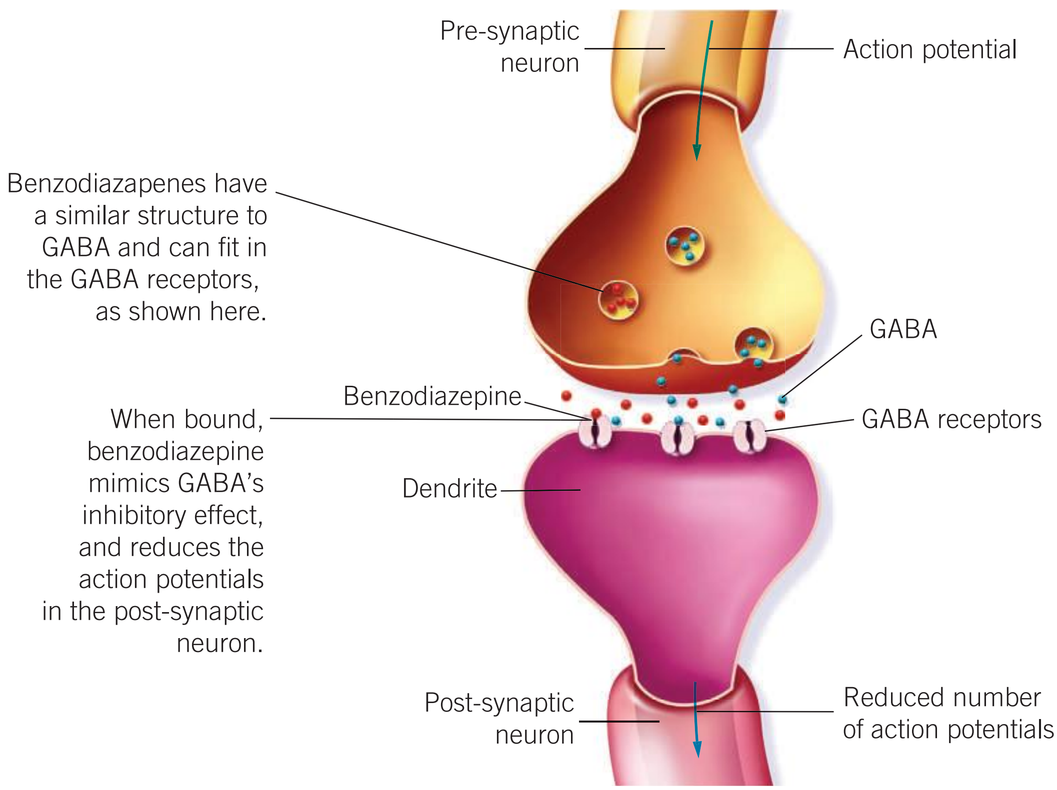


Figure 10B–3 GABA agonists such as benzodiazepines mimic the action of GABA by having an inhibitory effect on the post-synaptic neuron and so reduce nerve activity.

Benzodiazepines are generally safe to take but can have side-effects. They may reduce alertness, coordination and reaction time; this increases the risk of accidents. They can also lower inhibitions, particularly if mixed with alcohol or other drugs, so they can make some people more impulsive. Benzodiazepines are typically prescribed for short-term use because they can be addictive if taken for a long time. If a person suddenly stops taking them, the person's symptoms of anxiety, agitation and insomnia may return, and the person may also show sensory disturbances and even have seizures.

ISBN 978-1-009-25416-8 Gallagher et al

Hyperventilation rapid, shallow breathing

Breathing retraining

When someone with specific phobia is facing their phobic stimulus, they may experience abnormal breathing patterns. Their breathing might consist of rapid, small shallow breaths (**hyperventilation**), resulting in oxygen and carbon dioxide imbalances in the blood. Carbon dioxide levels can become low. Carbon dioxide helps regulate the body's reaction to anxiety, and when levels are too low this can cause reactions such as dizziness, light-headedness, blurred vision and pins and needles, which in turn increases already heightened anxiety.

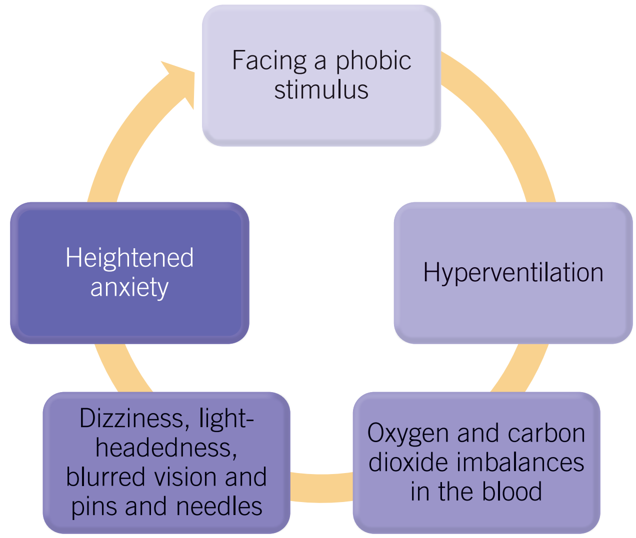


Figure 10B–4 The impact of hyperventilation on the experience of anxiety.

Breathing retraining an anxiety management technique that involves teaching someone with a specific phobia how to control their breathing in the presence of their phobic stimulus

Breathing retraining is an anxiety management technique that involves teaching someone how to control their breathing in the presence of their phobic stimulus. Breathing retraining is advantageous because it can be taught in a session with a therapist and then used in a public setting without drawing much attention to the individual using the technique.

Breathing retraining aims to slow breathing and practise maintaining regular breathing rhythms (Figure 10B–5). For example, a therapist might teach a person who fears cats to consciously control their breathing by breathing slowly in through the nose, and focusing on breathing out slowly from the diaphragm, whenever they see or think about a cat. When the person can control their breathing, this restabilises the balance of oxygen and carbon dioxide in the bloodstream, which in turn helps to reduce heart rate and respiration, lower stress hormones and increase feelings of calm and control. However, breathing retraining needs to be well practised, especially in the absence of the phobic stimulus, to make it a habit that then can be used when experiencing anxiety.

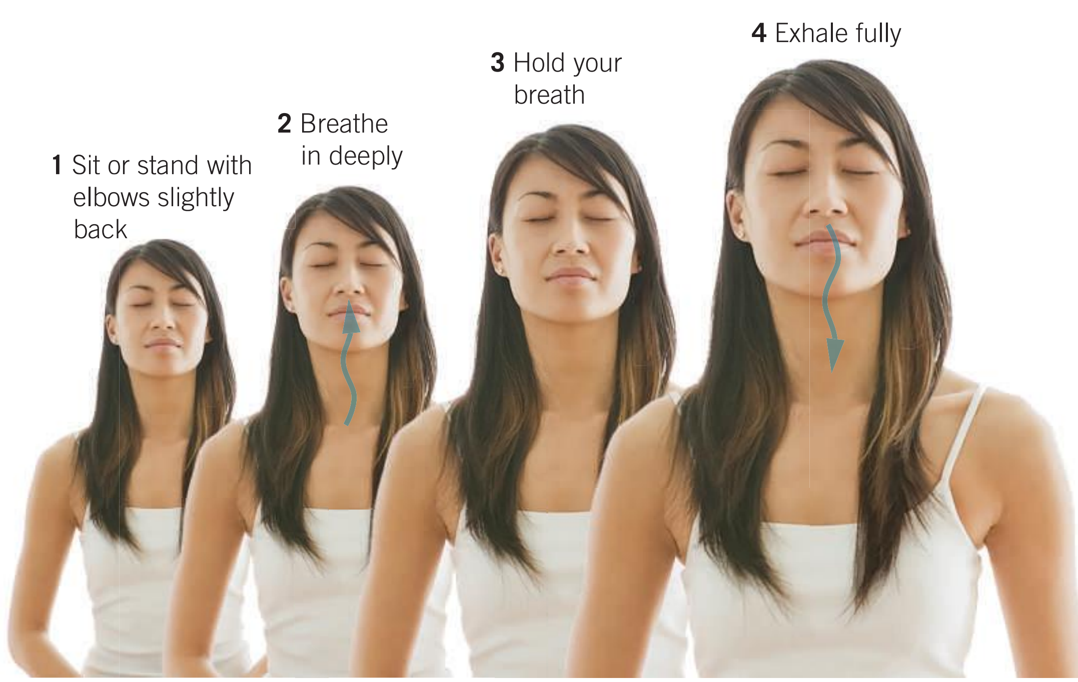


Figure 10B–5 An example of the process used for breathing retraining.

ISBN 978-1-009-25416-8 Gallagher et al

ACTIVITY 10B–1 PRACTISING BREATHING TECHNIQUES

Although a simple concept, breathing control is a useful skill to have and use in stressful or anxiety-provoking situations. An example of a breathing technique is diaphragmatic breathing or belly breathing. Using your diaphragm makes breathing easier and allows you to take in more air, which may help you breathe easier, relax or exercise more effectively.

How to do diaphragmatic breathing

1. Sit in a comfortable chair or lie on your back with a pillow under your head. Make sure your back is supported.
2. Place one hand over your stomach and one hand on your chest.
3. Breathe in slowly through your nose as you count to 2. Your chest should stay still and your abdomen (where your stomach is) should move out against your hand. You may find this a little strange, but if you make your abdomen move outwards you should feel air being sucked into your lungs.
4. Breathe out with your mouth closed while you count to 4. As you breathe out, you should feel your stomach move inwards.
5. Continue breathing, keeping your chest still and feeling your abdomen move out and in as you breathe in and out. Breathing in to a count of 2 and out to a count of 4 helps keep your breathing slow and steady.
6. Practise this breathing technique for 5–10 minutes. Try to do it three or four times a day. Then increase the length of time and how often you do it.

Make a note of the times you did it and for how long, and make a note of how you felt during and afterwards. Discuss your experiences with the class.

Check-in questions – Set 1

1. What are benzodiazepines?
2. Explain how benzodiazepines are used to manage the symptoms of a phobia.
3. Outline two limitations of using benzodiazepines to treat phobic anxiety.
4. Explain why breathing retraining is a useful intervention for specific phobia.
5. Outline how breathing retraining is used to manage specific phobia.

Psychological factors

Many clinical psychologists believe that learned behaviours and environmental triggers are the most important causes of phobias. They argue that a phobia is a learned response to a stimulus. 'Unlearning' the response cures the phobia. **Psychological interventions** using **psychotherapy** aim to achieve this, with evidence suggesting that these methods are as effective as (or more effective than) biological interventions. Consequently, psychotherapy and biological interventions are often used together. Two psychological evidence-based interventions are **cognitive behavioural therapy (CBT)** and systematic desensitisation.

Psychological intervention treatment that uses activities such as psychotherapy to modify thoughts, feelings and behaviours

Psychotherapy any talking therapy designed to help people with a broad range of mental health issues

Cognitive behavioural therapy (CBT) a common intervention consisting of a range of cognitive and behavioural therapies and learning principles to help people identify and change unhelpful thought processes, feelings and behaviours to more helpful ones

ISBN 978-1-009-25416-8 Gallagher et al

10A CONTRIBUTING FACTORS TO THE DEVELOPMENT OF SPECIFIC PHOBIA LINK

Cognitive behavioural therapy

In Section 10A, you learned that most people with a specific phobia experience both cognitive bias and a disproportionate behavioural reaction to the fear-producing stimulus. Unfortunately, suffering from a phobia occurs as a cycle. When a person is exposed to the phobic stimulus, negative thoughts (memory bias, catastrophic thinking) leads to an emotional response (distress, shame, embarrassment) and a biological response (activation of the flight-or-fight-or-freeze response). The person then alters their behaviour (actively avoids the object or situation), which perpetuates the phobia.

CBT is an intervention comprising a range of cognitive and behavioural therapies and learning principles to help people identify, challenge and change unhelpful thought processes, feelings and behaviour to ones that are more helpful. It assumes that the way a person thinks about an object or situation influences the way they feel about it, as well as the way they behave in response to it. Therefore, if a person suffering from a specific phobia can develop a new understanding of the phobic stimulus as not dangerous, then they can also reduce the instances of avoidance behaviour by using coping strategies. For example, if someone with a cat phobia realises that it is unlikely that they will be attacked and disfigured by all cats, then they will be more likely to expose themselves to situations where they might encounter a cat, with minimal fear or anxiety.

CBT is one of the most common interventions for a specific phobia. Evidence suggests that this treatment can be effective immediately after the therapy has ended. Traditional CBT usually requires weekly sessions of 30–60 minutes, over 12–20 weeks. Within these sessions, the therapist will address both the cognitive and behavioural components of the therapy.

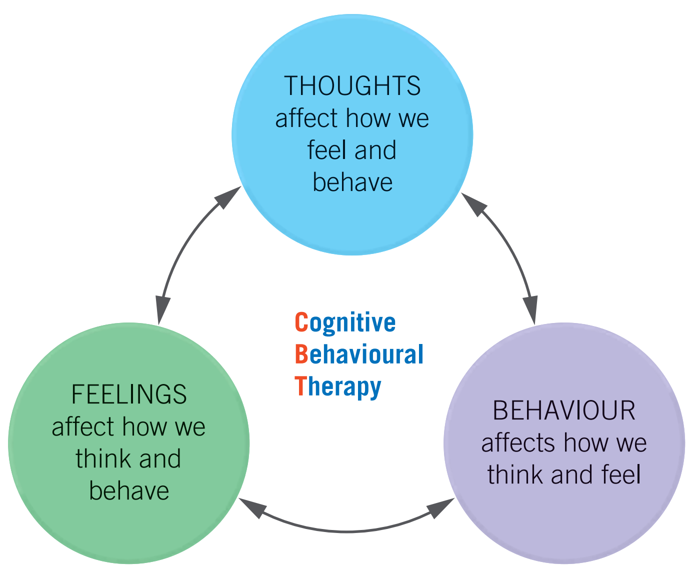


Figure 10B–6 Cognitive behavioural therapy assumes that cognitive biases have a negative impact on the way a person feels and behaves in response to a phobic stimuli.

Cognitive therapy

Cognitive therapy focuses on the role of thoughts, beliefs and attitudes in determining emotions and behaviour. The therapist will encourage their client to identify which thoughts and feelings related to the phobic stimuli might be cognitive biases or fear related. The client is then encouraged to gather evidence that supports, as well as refutes, their fear.

ISBN 978-1-009-25416-8 Gallagher et al

For example, a person with a fear of flying might gather information about the number of plane crashes over the past year. The therapist would then encourages the person to acknowledge that it is unlikely that they will crash and die the first time they fly in an aeroplane. This evidence helps the person to challenge their belief and realise that it is false.

Figure 10B–7 The cognitive component of CBT is designed so that a person evaluates the evidence that supports or refutes their fear. For example, a child might evaluate whether they will be attacked by all birds, then challenge and change the maladaptive thought to one that is more realistic.

Once the person has identified and challenged their cognitive distortions, they are more likely to be able to change their thoughts, feelings and beliefs to more realistic and positive ones. This is turn leads to a reduction in fear-related behaviours such as avoidance of the phobic stimulus. For example, a person might now believe that they will be perfectly safe if they take a flight (instead of thinking that the aeroplane they are in will crash), which in turn leads to reduced anxiety about booking a flight.

Figure 10B–8 In the behavioural component of CBT, relaxation techniques are taught so that they can be used when exposed to the phobic stimulus. For example a child with a fear of birds may be taught to relax when exposed to chickens.

Behavioural therapy

Behavioural therapy deals directly with maladaptive behaviours that can maintain or worsen a person's psychological problems and the thoughts and feelings associated with them. This could include teaching them relaxation techniques such as breathing retraining or progressive muscle relaxation, promoting exercise, or encouraging them to engage in activities that are distracting and rewarding. This allows dysfunctional ways of responding to be replaced with new, more functional behaviours. For example, a person could be helped to gradually expose themselves to the phobic stimulus while using relaxation techniques to reduce anxiety (systematic desensitisation).

ISBN 978-1-009-25416-8 Gallagher et al

VIDEO 10B–1
SKILLS: UNDERSTANDING CBT

10B–1 SKILLS

Applying your understanding of CBT

When discussing CBT in scenario-based questions, it is important to address *both* the cognitive and the behavioural components of the psychological intervention. You must also ensure that you use explicit examples from the scenario to support your point.

Question:

Discuss how a psychologist could use CBT to help manage a client's bird phobia.

Suggested answer:

The client would need to identify their fear-related thoughts about birds; for example, 'All birds are going to attack me'. A psychologist would encourage them to challenge and replace the unhelpful thoughts with more realistic ones such as, 'It is unlikely that all birds are going to attack me'. This is the cognitive component of the intervention.

The psychologist could then help the client modify their maladaptive behaviour of avoiding birds, by teaching the client to use relaxation techniques such as deep breathing to reduce their anxiety when they are going into a situation where birds will be present. This is the behavioural component.

VIDEO 10B–2
SYSTEMATIC DESENSITISATION

10A CONTRIBUTING FACTORS TO THE DEVELOPMENT OF SPECIFIC PHOBIA
LINK

Systematic desensitisation

As you saw in Section 10A, classical conditioning plays a role in the development of some specific phobias. As with other conditioned emotional responses, an association developed through classical conditioning can be exceedingly strong, long-lasting and resistant to simple extinction. This has led psychologists to apply classical conditioning processes in developing therapies for treating phobias.

Systematic desensitisation involves progressively introducing a person to their phobic stimulus while using relaxation techniques until their fear is replaced by a relaxation response. This model operates on the principles of classical conditioning, and aims to recondition the association between the phobic stimulus and the fear response, by associating the phobic stimulus with a relaxation response instead. Systematic desensitisation involves three steps:

1 learning a relaxation technique
2 forming a fear hierarchy
3 gradual exposure to the fear stimulus.

Relaxation techniques

Before the person is exposed to any stimulus, they are taught a **relaxation technique**. This may include breathing retraining, progressive muscle relaxation or the use of visual imagery to reduce the physiological arousal involved in the fear response.

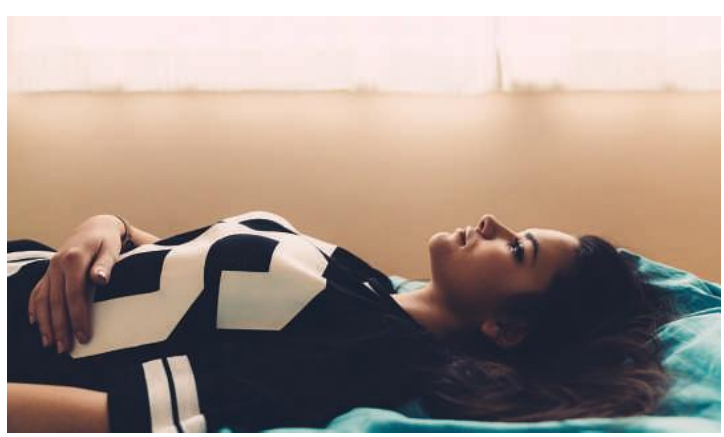


Figure 10B–9 Relaxation techniques are taught before a person is exposed to any stimulus.

Systematic desensitisation a method for treating phobias in which the phobic stimulus is progressively introduced while the person uses relaxation techniques until their fear is replaced by a relaxation response

Relaxation technique any method or procedure that helps to induce a physiological and psychological relaxation response

ISBN 978-1-009-25416-8 Gallagher et al

Fear hierarchies

After learning a relaxation technique, the person is helped to form a **fear hierarchy** by breaking down and then organising the phobic stimulus into a list of anxiety-inducing situations from easiest to most difficult to confront. The therapist then arranges these situations into a hierarchical order from least frightening to most frightening. For example, a person with a phobia of aeroplanes might be provided with a fear hierarchy similar to the one displayed in Figure 10B–10.

Fear hierarchy a list of anxiety-inducing experiences relating to the patient's phobia, in order from easiest to confront, to the most difficult to confront

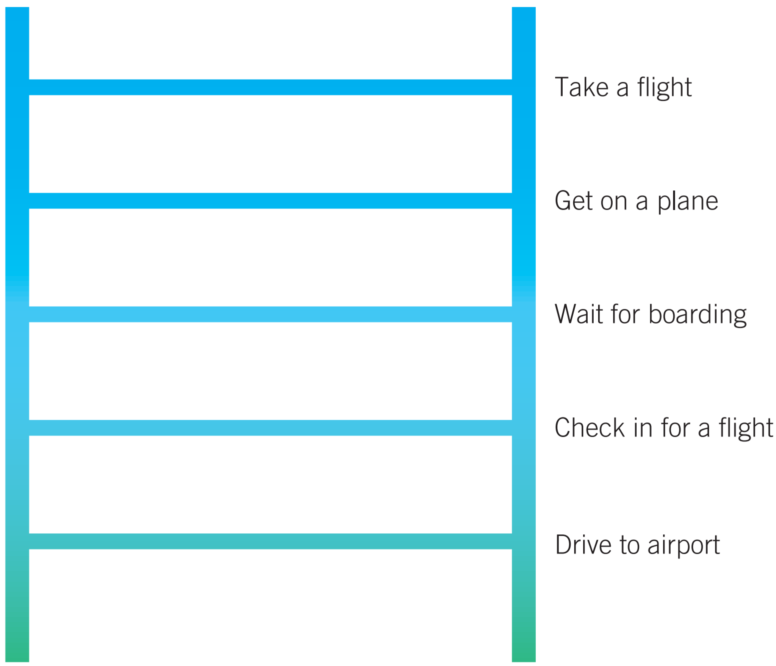


Figure 10B–10 An example of fear hierarchy for someone with a phobia of aeroplanes

Gradual exposure to fear stimulus

After creating their fear hierarchy, the person is progressively exposed to each of the fear-producing situations. They are exposed to the least-frightening fear on the fear hierarchy while using a relaxation technique to control the fear response. This is repeated until the stimulus no longer produces a fear response, but instead produces a relaxation response.

For example, the therapist might first show the client a photo of a plane and help them to remain calm and breathe deeply throughout the exercise. Once the client can look at a photo of a plane and feel calm, rather than fearful, they tackle the next fear in the hierarchy. Exposure to a phobic stimulus may involve imagining the situation using visual imagery or a real-life experience.

Although treatment can be conducted within a therapeutic environment, evidence suggests that the best results occur through real-life exposures. Once the first step of the fear hierarchy has been overcome, the therapist allows the client to move on to the next ones until the phobic stimulus does not elicit a fear response, but rather a relaxation response.

Figure 10B–11 Gradual exposure to the fear is an element of desensitisation.

ISBN 978-1-009-25416-8 Gallagher et al

VIDEO 10B–3 SKILLS: APPLYING SYSTEMATIC DESENSITISATION

10B–2 SKILLS

Applying systematic desensitisation to classical conditioning principles
On the VCE Psychology exam, you may be asked to apply systematic desensitisation to classical conditioning principles in scenario-based examples. In your response, you must use the elements of classical conditioning to explain how a fear response is reconditioned to a relaxation response.

Here is an example of a structure that can be used.

Before conditioning
- CS = phobic stimulus leads to the CR = fear of phobic stimulus
- UCS = relaxation technique produces UCR = feelings of relaxation in response to the relaxation technique

During conditioning
- Fear hierarchy is established from least to most fearful.
- Each step in the hierarchy (CS) is progressively presented while performing the relaxation technique (UCS), which produces feelings of relaxation in response to the relaxation technique (UCR).

After conditioning
- CS = phobic stimulus alone now produces CR = feeling relaxed around phobic stimulus

Check-in questions – Set 2

1 What are the underlying assumptions of cognitive behavioural therapy?
2 Outline how cognitive behavioural therapy can be used to overcome a phobia.
3 What is systematic desensitisation?
4 Explain why systematic desensitisation is effective in managing a specific phobia.
5 Provide an example of a fear hierarchy that might be used in systematic desensitisation.
6 Outline how systematic desensitisation can be used to overcome a phobia.

Social factors

Having social support is very important in the treatment of a phobia. Sufferers often experience their phobia every day, but only see their therapist every one or two weeks. So they need the support of family and friends to help manage their phobia. **Social interventions** may be used alongside biological and psychological interventions to provide support.

Social intervention an intervention designed to increase social support for people with a mental illness

Psychoeducation educating people diagnosed with mental health conditions and their family members about the disorder and possible treatment options

Psychoeducation for families and supporters

Psychoeducation is the process of providing information to people with a mental illness and their family members or friends to increase their understanding of the disorder and possible treatment options. When first diagnosed with a specific phobia, people generally do not know much about their condition. Psychoeducation assumes that sufferers and their social supporters cope better if they have a thorough understanding of the illness, its treatment and the challenges sufferers face.

Psychoeducation can take place in individual or group sessions. Group sessions would include the person with the phobia and members of their social support network, such as family, partners or friends. It is important that friends and family are included in

ISBN 978-1-009-25416-8 Gallagher et al

psychoeducation because learning more about the symptoms and difficulties associated with a specific phobia can decrease the stigma that might be associated with the disorder. For example, if a person with a specific phobia of buttons is educated about the characteristics of a phobia and the opportunity for treatment, they may feel less shame and be more likely to seek treatment.

Common topics in psychoeducation sessions are symptoms, causes, treatment options, support services and networks, useful sources of information, effects on family, work-related issues, and what constitutes improvement. Furthermore, those in the social support network are educated about two key strategies to help manage a phobia: challenging unrealistic or anxious thoughts and not encouraging avoidance behaviours.

Figure 10B–12 Psychoeducation is designed to help people suffering from a mental illness and their support network increase their knowledge and understanding of a specific phobia.

Challenging unrealistic or anxious thoughts

The anxious thoughts that are characteristic of a specific phobia are usually negative and unrealistic. For example, Clayton, a 20-year-old man with a needle phobia, thinks that if he has an injection, it could hit a bone or lead to an infection and then death. Unrealistic thoughts such as these perpetuate the phobia because they make the individual less likely to confront the stimulus. Members of a social support network can encourage them to recognise and challenge these unrealistic or anxious thoughts. Family or friends can do this by using questions to help the person look for evidence that counters their thoughts in a calm, gentle manner. Members of Clayton's support network could ask, 'How likely is it that you will get an infection?' or 'Do you remember all the times you got an injection, and you were OK?' This will help Clayton become more able to recognise when his thoughts are unrealistic and replace them with a more rational evaluation of potential exposure to the phobic stimulus.

WORKSHEET 10B–1 APPLYING INTERVENTIONS FOR SPECIFIC PHOBIA

WORKSHEET 10B–2 SPECIFIC PHOBIA: EXTENDED RESPONSE

Not encouraging avoidance behaviours

Avoidance can make the person feel better in the short term, but perpetuates the phobia. Avoidance behaviour stops a person from facing the phobic stimulus. The person needs to see that it is not as dangerous as they believe. The comfort of avoiding the stimulus negatively reinforces the phobia. Often, members of a social support network encourage avoidance behaviours to reduce the distress of the sufferer. This is detrimental because it unintentionally inhibits recovery.

Figure 10B–13 Members of an individual's social support network can encourage them to face their fears in a gradual manner.

Rather, members of a support network might encourage the person to slowly expose themselves to the fear stimulus and use praise and companionship while the sufferer does this. For example, Clayton's girlfriend might suggest that he sit in a doctor's office for a small amount of time and encourage him to remain if he gets distressed.

ISBN 978-1-009-25416-8 Gallagher et al

Check-in questions – Set 3

1 What is psychoeducation?
2 What are the underlying assumptions of psychoeducation?
3 Explain how family members of someone with a specific phobia can challenge unrealistic or anxious thoughts and not encourage avoidance behaviours to help manage the phobia.

10B–3 SKILLS

Scientific reporting conventions

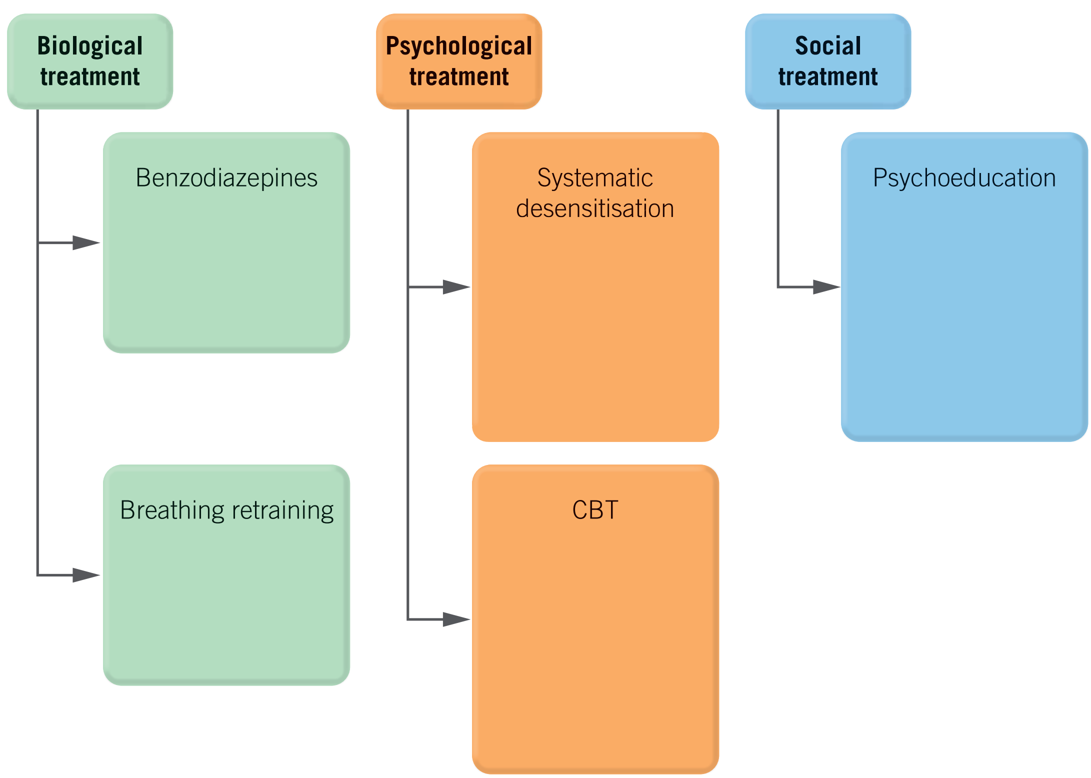
In VCE Psychology, you will be expected to plan, conduct and communicate the findings of a scientific investigation as part of an assessment. The two methods of reporting in the scientific community are a scientific report and a scientific poster. Both formats have specific conventions that outline the information that should be included and how it must be set out. It is important to know these conventions, and how they differ, when you construct a poster or report of your own.

DOCUMENT 10B–1 SCIENTIFIC REPORTING CONVENTIONS

Refer to the Document 10B–1 Scientific reporting conventions in the Interactive Textbook for a detailed, annotated example of a scientific report.

Section 10B questions

1 Summarise the evidence-based interventions that manage specific phobia by copying and filling in the diagram below, or drawing your own.



ISBN 978-1-009-25416-8 Gallagher et al

2 Mithu is terrified of seaweed. This is quite a new phobia for him because it has only developed within the last few months. Whenever he thinks about seaweed, he can feel his heart pounding in his chest and he feels as if he is going to faint.
   a Give an example of an abnormal breathing pattern that Mithu might experience when he thinks about seaweed and explain why this pattern needs to be retrained.
   b Name and explain one other biological treatment that a psychiatrist could use to help Mithu.

3 Compare and contrast cognitive behavioural therapy and psychoeducation.

4 Ziggy has been terrified of cats for as long as he can remember. He recently had to move out of his share house because his housemate had a cat, Mr Wiggles. Whenever Ziggy encountered Mr Wiggles, he would panic and feel that he was going to die from fear. Ziggy would avoid going home so he wouldn't have to see Mr Wiggles, and, when in his bedroom, he often thought about seeing Mr Wiggles in the hallway or kitchen. After moving out, Ziggy always remembered Mr Wiggles as being very dangerous and 'out to get him'. Now Ziggy spends most of his time in his new apartment because he is petrified of seeing a cat outside and thinks that any cat he encounters will claw his eyes. Ziggy's friend Kida convinces him to see a psychologist, who diagnoses him with a specific phobia of cats. The psychologist decides to use cognitive behavioural therapy (CBT) to help manage his phobia.
   a Explain what would be involved in the cognitive component of Ziggy's CBT with the psychologist.
   b For the behavioural component of CBT, the psychologist decided to use systematic desensitisation. Outline how the psychologist could use systematic desensitisation to manage Ziggy's phobia of cats.
   c After 6 weeks, Ziggy has not noticed any significant reduction in the symptoms of his phobia. Kida decides to take Ziggy to a psychoeducation class to learn more about his cat phobia. Why is it important for both Ziggy and Kida to attend a psychoeducation class?
   d Explain how Kida could help to discourage Ziggy's avoidant behaviours.

5 The following extract is from a scientific report on the effect of benzodiazepines compared with CBT on the reduction of phobic symptoms.

   The aim of this experiment was to investigate the influence of benzodiazepines compared with CBT on the reduction of phobic symptoms. The operationalised independent variable is whether participants consume 30 mg of a benzodiazepine three times a day for 6 weeks compared with completing six sessions of CBT over a 6-week period. The operationalised dependent variable is the mean score on a rating scale measuring the number of symptoms relating to a specific phobia in a day. It was hypothesised that 70 individuals who have been diagnosed with a specific dog phobia will experience a reduction of phobic symptoms after 30 mg of a benzodiazepine three times a day for 6 weeks is administered, in comparison with six sessions of CBT over the course of a 6-week period.

   a What section of the scientific report does this extract belong to?
   b Is the order of this section correct? Justify your response.
   c In the section above, the hypothesis is incorrect. Rewrite the hypothesis so that it is correct.

ISBN 978-1-009-25416-8 Gallagher et al

Chapter 10 review

Summary

Create your own set of summary notes for this chapter on paper or in a digital document. A model summary is provided in the Teacher Resources which can be used to compare with yours.

Checklist

In the Interactive Textbook, the success criteria are linked from the review questions and will be automatically ticked when answers are correct. Alternatively, print or photocopy this page and tick the boxes when you have answered the corresponding questions correctly.

	Success criteria – at the end of this chapter I will be able to:	Linked question
10A.1	Explain what is meant by specifc phobia, including how it is different from anxiety and fear	7☐, 19a☐
10A.2	Explain what is meant by the biopsychosocial framework, with reference to biological, psychological and social contributing factors.	1☐
10A.3	Explain what is meant by gamma-aminobutyric acid (GABA) and how it regulates anxiety in the central nervous system	2☐, 16a☐
10A.4	Explain what is meant by gamma-aminobutyric acid (GABA) dysfunction and how it affects the regulation of anxiety in relation to a specific phobia	1☐, 16b☐
10A.5	Explain what is meant by long-term potentiation (LTP) and how LTP continues the feeling of anxiety in relation to a specific phobia	13☐
10A.6	Describe the process of the three-stage model of classical conditioning in relation to the development of a specific phobia.	11☐
10A.7	Describe the process of the three-stage model of operant conditioning in the continuation of a specific phobia, with reference to negative reinforcement.	4☐, 19b☐
10A.8	Explain what is meant by cognitive bias, including memory bias and catastrophic thinking	12☐
10A.9	Describe how memory bias and catastrophic thinking continue a phobic response with reference to appropriate examples	19c☐
10A.10	Explain what is meant by a specific environmental trigger and its role in the development of a specific phobia with reference to classical conditioning elements	3☐
10A.11	Explain what is meant by stigma and how stigma acts as a barrier to treatment	5☐, 17a☐
10A.12	Apply my understanding of biological, psychological and social contributing factors to a specific phobia to real-world scenarios	17☐
10B.1	Explain what is meant by the biopsychosocial framework, with reference to biological, psychological and social evidence-based interventions	10☐

ISBN 978-1-009-25416-8
Gallagher et al

Success criteria – at the end of this chapter I will be able to:		Linked question
10B.2	Explain what is meant by a GABA agonist, identify relevant examples of short-acting anti-anxiety benzodiazepine agents as examples of a GABA agonist and explain how short-acting anti-anxiety benzodiazepine agents reduce feelings of anxiety in someone exposed to a phobic stimulus	8☐, 16c☐
10B.3	Explain what is meant by breathing retraining and how it helps to reduce phobic anxiety, with reference to physiological systems	9☐, 17b☐
10B.4	Explain what is meant by cognitive behavioural therapy (CBT) and its underlying aims in relation to the treatment of a specific phobia	14☐
10B.5	Outline how both cognitive and behavioural therapies work to identify maladaptive thoughts and behaviours in relation to a phobia and change them into more adaptive ones	19c☐
10B.6	Explain what is meant by systematic desensitisation and its underlying aims in relation to the treatment of a specific phobia	15☐
10B.7	Describe the process that systematic desensitisation uses to reduce anxiety (with reference to the three-stage model of classical conditioning)	19d☐
10B.8	Explain what is meant by psychoeducation and its underlying aims in relation to the treatment of a specific phobia	6☐, 18☐
10B.9	Outline how both challenging unrealistic or anxious thoughts and not encouraging avoidance behaviours work to identify maladaptive thoughts and behaviours in relation to a specific phobia and change them into more adaptive ones	17c☐
10B.10	Apply my understanding of biological, psychological and social evidence-based interventions to real-world scenarios	3☐

Key Science Skills

Skills	Questions and Skills boxes
Use appropriate psychological terminology, representations and conventions, including standard abbreviations, graphing conventions and units of measurement	10B Section questions – 5a–c
Discuss relevant psychological information, ideas, concepts, theories and models and the connections between them	10B Section questions – 5a–c
Analyse and explain how models and theories are used to organise and understand observed phenomena and concepts related to psychology, identifying limitations of selected models/theories	Interactive Textbook
Critically evaluate and interpret a range of scientific and media texts (including journal articles, mass media communications and opinions in the public domain), processes, claims and conclusions related to psychology by considering the quality of available evidence	10B Check-in questions – Set 1 – 1 to 3 10B Section questions – 1

ISBN 978-1-009-25416-8 Gallagher et al

Skills	Questions and Skills boxes
Analyse and evaluate psychological issues using relevant ethical concepts, including the influence of social, economic, legal and political factors relevant to the selected issue	Interactive Textbook
Use clear, coherent and concise expression to communicate to specific audiences and for specific purposes in appropriate scientific genres, including scientific reports and posters	Section 10B questions – 5 a–c
Acknowledge sources of information and assistance, and use standard scientific referencing conventions	Interactive Textbook

Multiple-choice questions

1 It is sometimes difficult to understand all the factors that contribute to the development of specific phobia, but it is possible to use a ____________ framework to identify the possible contributing factors.

A psychological
B sociocultural
C biopsychosocial
D biopsychocultural

2 Which of the following statements is correct about the role of GABA?

A GABA excites post-synaptic neurons to reduce their levels of electrical activity.
B GABA inhibits post-synaptic neurons to increase their levels of electrical activity.
C GABA inhibits post-synaptic neurons to reduce their levels of electrical activity.
D GABA excites post-synaptic neurons to increase their levels of electrical activity.

3 Which of the following is not an example of a social factor that could contribute to the development of specific phobia?

A a phobia of birds after being pecked on the head by a swooping magpie
B a phobia of dentists after listening to some of grandpa's horror stories of dentistry in the 1930s
C a phobia of doctors after linking the pain of injections with the doctor's clinic
D a phobia of sharks after watching the movie *Jaws*

Use the following information to answer Questions 4–6.

Jodi suffers from a phobia of heights. Her friends have asked her to join them on the Sydney Harbour Bridge climb, but Jodi begins to worry so much about the climb that she makes an excuse to her friends for not going.

4 Jodi's avoidance of the climb can be most accurately described as

A positive reinforcement, which makes her more likely to avoid heights in future.
B negative reinforcement, which makes her more likely to avoid heights in future.
C positive punishment, which makes her less likely to avoid heights in future.
D negative punishment, which makes her less likely to avoid heights in future.

5 Jodi's friends think her fear is silly and always tease her about it. Her friends' attitude is a

A psychological risk factor.
B stigma.
C behavioural risk factor.
D social intervention.

ISBN 978-1-009-25416-8

6 Jodi's psychologist thinks it would be helpful for her friends to join her in her next therapy session. The psychologist would like to provide them with information about specific phobias, including how they can help reduce Jodie's avoidant behaviours.

Which of the following is correct regarding the evidence-based intervention the psychologist is using and the type of protective factor it represents?

	Intervention	Protective factor
A	cognitive behaviour therapy	psychological
B	psychoeducation	psychological
C	psychoeducation	social
D	systematic desensitisation	social

7 A state that is characterised by excessive and irrational fear of a particular object or situation is

A stress.
B anxiety.
C distress.
D a phobia.

8 When a doctor prescribes benzodiazepines to someone with a phobia, they are

A using a type of behavioural treatment.
B using a GABA agonist.
C decreasing the amount and strength of GABA binding.
D increasing the activity of the amygdala.

9 A person who suffers from anxiety should learn to breathe in a ___________ manner, rather than in __________ breaths.

A quick, controlled
B slow, controlled
C controlled, short
D short, controlled

10 Ideally, when using evidence-based interventions to treat a specific phobia, the most effective intervention to use is a

A biological intervention such as breathing retraining.
B social intervention such as CBT.
C psychological intervention that uses operant conditioning principles.
D biological, psychological and social intervention simultaneously.

ISBN 978-1-009-25416-8 Gallagher et al

The following information relates to Questions 11–13.

When Warren was in the army, he was in a helicopter that had to make an emergency landing, during which he broke a leg. Since then, Warren can't think about flying without becoming distressed.

11 Classical conditioning may also have played a role in the precipitation of Warren's flying phobia. Which of the following is correct in terms of the three-phase model of classical conditioning?

	Before conditioning	During conditioning	After conditioning
A	Flying in a helicopter was the CS and experiencing an emergency landing was the UCS.	Bad turbulence (UCS) and fear in response to the bad turbulence (UCR) were associated.	Flying in a helicopter (CS) alone causes distress in response to flying in a helicopter (UCR).
B	Thinking about flying in a helicopter was the NS and the UCS was distress when thinking about flying in a helicopter.	Thinking about flying in a helicopter (NS) and distress when thinking about flying in a helicopter (UCS) were associated.	Thinking about flying in a helicopter (NS) alone causes distress in response to flying in a helicopter (UCR).
C	Thinking about flying in a helicopter was the NS and the UCR was distress when thinking about flying in a helicopter.	Thinking about flying in a helicopter (NS) and distress when thinking about flying in a helicopter (UCR) were associated.	Flying in a helicopter (NS) alone causes distress in response to flying in a helicopter (CR).
D	Flying in a helicopter was the NS and experiencing an emergency landing and a broken leg was the UCS.	Flying in a helicopter (NS) and bad turbulence (UCS) were associated.	Thinking about flying in a helicopter (CS) alone causes distress when thinking about flying in a helicopter (CR).

12 Warren refuses to fly in either a helicopter or a plane because he is convinced that it will crash. Warren's belief is best explained as

A a phobia.
B catastrophic thinking.
C change bias.
D memory bias.

13 Which of the following correctly describes the perpetuation of Warren's phobia, in relation to LTP?

A Every time Warren thinks about flying in a helicopter, the neural pathways in his brain between helicopters and feeling distressed are activated.
B Every time Warren thinks about a helicopter or a plane, the neural pathways in his brain between helicopters and experiencing an emergency landing and breaking his leg are activated.
C Every time Warren thinks about flying in a helicopter, the neural pathways in his brain between helicopters and feeling distressed experience low levels of stimulation.
D Every time Warren thinks about flying in a helicopter, the neural pathways in his brain between helicopters and experiencing an emergency landing and breaking his leg experience low levels of stimulation.

14 When using cognitive behavioural therapy (CBT) to treat and manage a specific phobia, a mental health professional will focus on

A identifying the specific environmental triggers.
B educating the person about symptoms of a phobia and potential treatments.
C identifying, challenging and changing maladaptive thoughts and behaviours to more appropriate ones.
D educating the person about medications that alleviate anxiety.

ISBN 978-1-009-25416-8 Gallagher et al

15 David is a professional musician with a phobia of performing in public. This means that David is unable to work. David's wife Maite asks him to see a psychologist to help him overcome his fear. The psychologist suggests a particular intervention that involves learning a relaxation technique. The psychologist first suggests that David perform in front of a close friend in familiar surroundings while using the relaxation technique. When he is able to do that without feeling anxious, the psychologist suggests that David practises playing in front of a small group of friends in familiar surroundings while using the relaxation technique. The next step involves David performing in front of a small group of friends in unfamiliar surroundings while using the relaxation technique. Eventually, David is able to perform in public. The intervention strategy the psychologist used is

A extinction.
B cognitive bias.
C systematic desensitisation.
D cognitive behavioural therapy (CBT).

Short-answer questions

16 **a** What is GABA? (1 mark)

b What is the relationship between GABA and the stress response in the development of a phobia? (3 marks)

c Explain how benzodiazepines help to reduce the experience of anxiety. (3 marks)

17 Ailsa is a 30-year-old woman who has had a phobia of water since she was a teenager. When she was in year 7, she went on a whitewater rafting camp with her school. Unfortunately, Ailsa was unaware that falling into the water is quite common. Ailsa got frightened each time she fell in the water and eventually was so frightened that she had to be sent home from the camp. Ever since this incident, Ailsa is too scared to go to the beach or any large lakes. Ailsa's family made fun of her phobia and told her to 'stop being silly' and that it was time to 'grow up and get over it'. This made Ailsa feel ashamed and anxious, and she started isolating herself. However, Ailsa sought help from a psychologist a few weeks ago.

a Explain how stigma played a role in the perpetuation of Ailsa's phobia. (3 marks)

b The psychologist believes Ailsa is experiencing problems with her stress response and tells her to enrol in a breathing retraining course. Explain how breathing retraining would help manage Ailsa's phobia of water. (3 marks)

c Ailsa's psychologist also suggests that her family attend psychoeducation to learn more about her water phobia. Outline two ways Ailsa's family could use psychoeducation to help Ailsa manage her phobia. (2 marks)

18 Why is it important to challenge the unrealistic or anxious thoughts of people with specific phobias? (2 marks)

19 Jake has a specific phobia of injections. In a session with his therapist, he reports an early incident in which he saw his mother have an injection and then faint. Jake, who was 5 years old at the time, had never seen anyone faint before and, for a few moments, he thought his mother was dead. Unfortunately, Jake now is extremely fearful of all needles and anything to do with injections or blood. When he thinks about his experiences with needles, he explains that he avoids them because an injection is likely to make him become deathly ill. Last year, Jake was invited to go on an overseas trip to Cambodia. On the day that Jake was supposed to get his vaccinations, he was so worried about getting an injection that he decided not to go on the trip after all.

ISBN 978-1-009-25416-8 Gallagher et al

a Explain why Jake was diagnosed as having a phobia rather than anxiety. (1 mark)

b In reference to the three-phase model, explain the role of operant conditioning in the perpetuation of Jake's phobia. (3 marks)

c Describe one type of cognitive bias Jake is experiencing about injections and explain how CBT could be used to overcome his phobia. (4 marks)

d As part of CBT, Jake's therapist decides to use systematic desensitisation to help Jake overcome his phobia. Explain how systematic desensitisation could be used to manage Jake's phobia. (4 marks)

20 For his VCE Psychology practical investigation, Byron decided to investigate the impact of social stigma on anxiety levels after exposure to a phobic stimulus.

The following are extracts from his scientific report.

Method

Participants

150 individuals who have been diagnosed with a specific animal phobia and regularly see a psychologist between the ages of 10 and 65 were used. 98 were male and 52 were female.

Procedures

An independent groups design was used.

Informed consent procedures were followed, and confidentiality, voluntary participation and withdrawal rights explained. Deception was not used.

1 All participants were interviewed and asked questions relating to the number and types of experience of stigma they have encountered over the last 12 months.

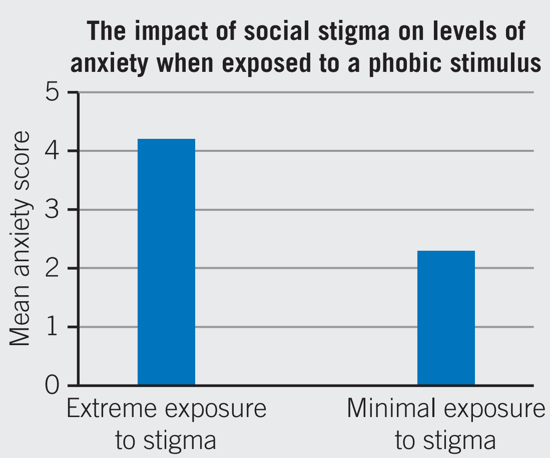
2 Based on the number and types of stigma each participant experienced, they were allocated into one of two groups: extreme exposure to stigma and minimal exposure to stigma.

3 All participants completed a rating scale that measured the extremity of anxiety experienced when exposed to a phobic stimulus.

4 The results were collected and collated.

Participants were debriefed at the conclusion of the study

Results



Note: Anxiety scores were recorded on a rating scale that measured the extremity of anxiety experienced when exposed to a phobic stimulus.

a Is the participants section correct? Justify your response. (2 marks)

b Consider the procedure and outline one limitation of Byron's investigation. (3 marks)

c Summarise the graph in the results section, using the appropriate conventions for a scientific report. (2 marks)

ISBN 978-1-009-25416-8 Gallagher et al

Unit 4 Revision exercise

Multiple-choice questions

1 Which of the following statements is incorrect in relation to the biological mechanisms that regulate sleep–wake patterns?

A Circadian rhythms coordinate the timing of body system activities that follow a period of less than 24 hours.

B The suprachiasmatic nucleus works to regulate various activities in the body according to a daily schedule of sleep and wakefulness.

C REM and NREM patterns of sleep follow an ultradian rhythm.

D The suprachiasmatic nucleus detects the amount of light entering the eyes and sends an appropriate message to the pineal gland to release melatonin.

2 What would be an expected electro-oculography (EOG) result for a person in REM sleep?

A An EOG would measure low levels of eye activity during REM sleep.

B An EOG would detect, amplify and record high levels of electrical activity of the muscles controlling the eyes during REM sleep.

C An EOG would detect, amplify and measure high levels of electrical activity in the muscles during REM sleep.

D An EOG would record high levels of brain activity during REM sleep.

3 Which of the following is correct for sleep?

A Sleep is an example of normal waking consciousness.

B Across the whole life span, REM and NREM sleep are experienced in equal proportions each night.

C N1 and N2 sleep are considered deep sleep.

D Sleep is a naturally occurring altered state of consciousness.

4 What is one difference between the sleep of a newborn and the sleep of a toddler?

A A newborn will sleep for up to 17 hours, whereas an infant will sleep for up to 14 hours.

B A newborn will experience 50% of their sleep in REM sleep, whereas a toddler will experience 60% of their sleep in REM sleep.

C A newborn will experience about 14 hours of sleep and 10% in REM, whereas a toddler will experience about 9 hours of sleep with 20% in REM.

D A newborn will have an established circadian rhythm, whereas a toddler will have an erratic sleep pattern due to an unestablished circadian rhythm.

The following information relates to Questions 5–9.

Sandra has been to a sleep clinic to address her suspected sleep disorder. She likes to relax on the couch after she comes home from work; however, she has recently been falling asleep on the couch at around 6:30 p.m. and not waking up until the middle of the night. When she wakes up on the couch and goes to bed, she finds she is unable to get back to sleep and ends up watching television until the morning. At work the next day, Sandra finds she is constantly making errors in simple calculations and gets annoyed at herself more than she used to. The sleep clinic asks Sandra to keep a sleep diary for two weeks, before coming into the clinic to record her sleep over one night.

ISBN 978-1-009-25416-8 Gallagher et al

5 Which of the following sleep disorders does Sandra appear to be experiencing?

A Delayed Sleep Phase Syndrome
B Advanced Sleep Phase Disorder
C shift work sleep disorder
D both delayed sleep phase syndrome and advanced sleep phase disorder

6 Which of the following would be an example of quantitative data that Sandra may record in a sleep diary?

A a description of the quality of her sleep
B a sentence describing how rested she felt in the morning
C a record of the food she consumed throughout the day
D the time that she woke up during the night

7 Which of the following is not a sleep-hygiene practice that the sleep clinic might recommend to Sandra?

A Sandra should avoid using screens when she wakes up in the middle of the night.
B Sandra should minimise the amount of light coming into her bedroom from outside.
C Sandra should avoid 'watching the clock' when she is trying to get back to sleep.
D Sandra should increase the temperature of her bedroom when she is trying to get back to sleep.

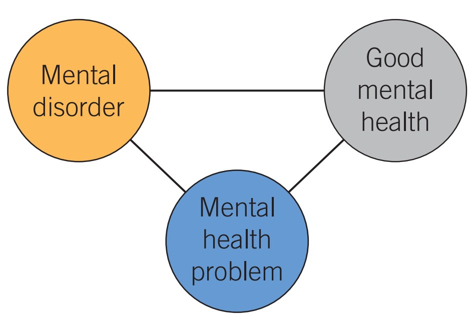
8 When Sandra makes errors at work, which type of functioning has been affected by her sleep deprivation?

A affective
B behavioural
C cognitive
D daily

9 Which diagram best represents the relationship between characteristics of good mental health, mental health problems and mental disorders?

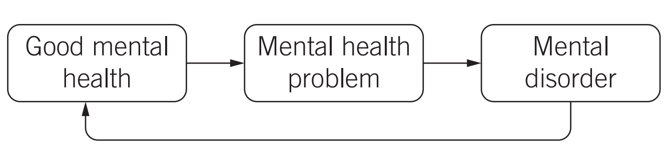
A

B



C

D



ISBN 978-1-009-25416-8 Gallagher et al

10 Self-efficacy refers to
- **A** exercises that individuals can do themselves to improve mental wellbeing, such as mindfulness meditation.
- **B** a tendency to criticise oneself and doubt one's capability.
- **C** confidence that tasks can be completed and goals can be met.
- **D** a tendency to focus on negative thoughts.

11 Social risk factors for the development of mental disorders do not include
- **A** rumination, stress or impaired reasoning.
- **B** loss of a significant relationship.
- **C** stigma as a barrier to accessing treatment.
- **D** disorganised insecure attachment.

12 Aboriginal and Torres Strait Islander peoples relate mental and physical wellbeing to
- **A** spiritual factors and cultural determinants.
- **B** connection to Country.
- **C** community and social engagement.
- **D** all of the above.

13 Breathing retraining helps manage phobia because
- **A** people with phobia tend to consistently have faster breathing patterns than those without phobia.
- **B** it helps to reduce physiological arousal associated with phobic responses.
- **C** it activates a sympathetic nervous system response.
- **D** it causes a new association to form between the phobic stimulus and breathing.

14 GABA agonists help manage anxiety by
- **A** exciting presynaptic neurons and making them more likely to fire.
- **B** inhibiting presynaptic neurons and making them more likely to fire.
- **C** inhibiting post-synaptic neurons and making them less likely to fire.
- **D** exciting post-synaptic neurons and making them less likely to fire.

The following information relates to Questions 15 and 16.

Nick has developed a phobia of bees because of an adverse reaction to a bee sting several years ago. Since then, his phobia has extended to many flying insects, including wasps and mosquitos, and he now avoids going outside in the spring.

15 Which of the following demonstrates that Nick is experiencing a memory bias about the event?
- **A** Nick is unable to recall the events accurately because of a fallible memory system.
- **B** Each time Nick thinks about what happened, the bees seem more threatening than they actually were.
- **C** Nick's encoding of the bee sting has been distorted by retelling the story.
- **D** Nick tends to be hyperaware of stimuli that could involve bees.

16 The first time Nick was stung by a bee is known as ____________ and is a __________ factor.
- **A** operant conditioning; psychological factor
- **B** a specific environmental factor; social
- **C** stigma; social
- **D** long-term potentiation; biological

ISBN 978-1-009-25416-8 Gallagher et al

Short-answer questions

17 Paul is a cleaner who has recently started working regular night shifts at the international airport. He has been having difficulty getting used to the new work schedule. In particular, he finds it hard to fall asleep during the day, resulting in him being tired when he is working nights.

a Explain when Paul could use bright light therapy to help him reduce the likelihood of experiencing a circadian rhythm sleep disorder. (3 marks)

b Provide an example of a behavioural effect of Paul's sleep deprivation at work. (1 mark)

c Describe when Paul should eat during his 24-hour day, and justify your response. (3 marks)

18 Nyah is 17 years old and in year 12, and she works part time at a fast-food restaurant. Over the past 2 months, Nyah has been working extra shifts during the week to cover for some of her work friends. Twice a week, she is on 'closing shift', which finishes at 11:45 p.m. By the time she gets home and gets ready for bed, she does not fall asleep until after 1 a.m. As Nyah lives a fair distance away from her school, she needs to wake up early in order to get to her first lesson on time. This schedule has resulted in Nyah feeling very tired when she gets to school, and she often dozes through first period. On the days when Nyah is not working the closing shift, she can fall asleep at 9 p.m., which results in her feeling rested the next day.

a Identify one example of how Nyah's affective functioning and cognitive functioning may be impaired during her school day. (2 marks)

b Justify whether Nyah would be experiencing a circadian rhythm sleep disorder. (3 marks)

19 Sophie is nine years old and her sister Kate is 18 years old. They are watching a movie on a Friday night with their parents. The movie is only halfway through, and Sophie is starting to feel sleepy, finding herself dozing off briefly, before waking up to Kate laughing. Eventually Sophie cannot stay awake any longer and goes to bed around 9 p.m. Kate and her parents finish watching the movie and Kate decides to put on another one, while her parents go off to bed.

a Explain why sleep is an altered state of consciousness. (2 marks)

b Provide a reason for the differences in bedtime between Sophie and Kate. (4 marks)

c Compare the experience of REM sleep for Sophie and Kate. (2 marks)

20 A researcher investigated how the melatonin levels of patients correlate with age. They collected results from four different sleep centres, noting down how many participants were sampled from each centre and the correlation between melatonin levels and age. The results are shown in the table.

Sleep centre	Number of participants (*n*)	Pearson's *r* correlation
1	23	–0.45
2	45	–0.51
3	5	+0.23
4	39	–0.42

ISBN 978-1-009-25416-8 Gallagher et al

a With reference to data shown in the table for the relationship between melatonin levels and age, provide an interpretation for the correlation for Sleep centre 1. (2 marks)

b Explain how the correlation identified in part **a** could explain the patterns of sleep of older adults. (2 marks)

c Explain how the sample size for Sleep centre 3 may affect the external validity of the findings for that centre. (2 marks)

21 Choose three domains of social and emotional wellbeing and list them as **a**, **b** and **c**. For each one, provide a description of the domain, an example of a risk factor in that domain, and an example of a protective factor in that domain. (12 marks)

	Domain	Description (2 marks each)	Risk factor (1 mark each)	Protective factor (1 mark each)
a				
b				
c				

22 Thuy has had a severe and irrational fear of birds since she was a girl. It started when Thuy saw her friend Hope get attacked by an aggressive emu at a nature park. Since then, Thuy's fear has increased. Now, just seeing a feather or thinking about birds prevents her from leaving her house and seeing her friends.

a Identify whether Thuy is suffering from anxiety or a phobia. Justify your response. (3 marks)

b In terms of operant conditioning, explain how Thuy's fear of birds is perpetuated. (4 marks)

c Thuy decides to seek help from a psychologist to learn to manage her fear so that she feels more relaxed about leaving the house. Outline how a psychologist could use cognitive behavioural therapy (CBT) to help Thuy. (4 marks)

23 Reanna fell down a steep set of stairs when she was six, resulting in her splitting her head open and bleeding excessively. She recalls that when she went to the hospital, she needed ten stiches, which were very painful. She now has a fear of heights but hasn't sought help. Reanna feels that if she tells a doctor that she fears heights, the doctor would make her go on a rollercoaster or something really high to get over her fear. Now, just seeing a steep hill makes her heart race. She starts to shake uncontrollably and can't stop herself from running away. Reanna has started high school, and some of her lessons are in a second-floor classroom, which involves climbing stairs, so she decides to seek help with her fear of heights. Her treatment involves various exercises, such as going up in a lift every day and getting off one floor higher each week.

a Use the three-phase behavioural model of classical conditioning to explain how Reanna may have developed the phobia. (6 marks)

b Explain how long-term potentiation may have had a role in perpetuating Reanna's phobia. (3 marks)

c Reanna is given various exercises to complete, such as going up in a lift every day and getting off one floor higher each week. What type of therapy is being used? (1 mark)

d Identify the key elements of a fear hierarchy and explain how it would be used to treat Reanna's phobia. (3 marks)

ISBN 978-1-009-25416-8 Gallagher et al

Glossary

Aboriginal and Torres Strait Islander peoples
the Australian Indigenous population, which includes Aboriginal peoples, Torres Strait Islander peoples and people who have both Aboriginal and Torres Strait Islander heritage; the term 'Aboriginal and Torres Strait Islander' encompasses all three

Abstract
a section of a scientific report that is a concise summary of the whole investigation

Accuracy
how close a measurement is to the true value of the quantity being measured

Acquired
present after brain injury or a significant psychological event

Acquisition
the process during which an organism learns to associate two events (the neutral stimulus and the unconditioned stimulus)

Acronym
an abbreviation formed from the first letter of each word and pronounced as a single word

Acrostic
a phrase (or poem) in which the first letter of each word functions as a cue to help with recall

Acute stress
stress that usually occurs because of a sudden threat and only lasts for a short time

Advanced Sleep Phase Disorder (ASPD)
a circadian rhythm sleep disorder characterised by an advance in the timing of sleep onset and awakening compared to the timing that is desired

Affective functioning
a person's experience of their emotions

After conditioning
the final stage of classical conditioning

Agonist
a type of drug that mimics the action of a neurotransmitter that binds to the same receptor by stopping the presynaptic neuron from firing

Alarm reaction stage
the first stage of the general adaptation syndrome, in which we first become aware of the stressor; it consists of two phases – shock and countershock

Allocation
dividing a sample into groups in an investigation

Altered state of consciousness
any state that differs in awareness when compared to normal waking consciousness

Alzheimer's disease
a neurodegenerative disease characterised by the progressive deterioration of brain neurons, causing memory loss, decline in cognitive and social skills and personality changes

Amnesia
a permanent or temporary, complete or partial loss of memory

Amygdala
a structure located deep in the temporal midbrain; involved in emotional reactions and formation of emotional memories particularly relating to fear

Amyloid plaque
an abnormal build-up of beta-amyloid proteins between the synapses of neurons that interfere with communication

Anecdote
a short personal account of an event

Antecedent
an environmental stimulus that triggers an action

Anterograde amnesia
the inability to form new explicit long-term memories after an amnesia-causing event

Anxiety
an emotion akin to worrying and uneasiness that something is wrong or something bad is going to happen, usually accompanied by physiological signs

Aphantasia
the inability to visualise imagery

Appraisal
the process of categorising an event on the basis of its perceived significance and how it may affect our wellbeing

ISBN 978-1-009-25416-8 Gallagher et al

Approach strategy
an effort to confront a stressor and deal directly with it and its effects

Attention
the first stage in observational learning, when the learner actively watches the model's behaviour and the consequences

Autobiographical memory
a memory system consisting of episodes recollected from an individual's life, based on a combination of episodic and semantic memory

Autonomic nervous system
a subdivision of the peripheral nervous system that controls the body's internal environment in an autonomous or self-regulated manner

Avoidance behaviour
actions a person takes to escape from difficult thoughts and feelings

Avoidance strategy
an effort to avoid a stressor and not deal directly with it and its effects

Bar chart
a way to display data with discrete categories

Basal ganglia
a group of structures deep within the cerebral hemispheres; involved in motor movement, procedural memory and learning

Before conditioning
the first stage of classical conditioning; at this stage no learning has occurred

Behaviour
any observable action by an organism

Behavioural functioning
a person's observable actions

Behaviourist approach
an approach to learning that states that behaviours are learned through interactions with the environment

Behavioural model
phobias are learned through experience and may be developed, sustained or modified by environmental consequences such as rewards or punishments

Beneficence
an ethical concept involving the commitment to maximising benefits and minimising risks and harms

Benign/positive
describes a situation or event that is perceived as having a positive outcome for an individual, i.e. it either maintains (benign) or enhances their wellbeing (positive)

Benzodiazepine
a type of agonist drug that works on the central nervous system to make the post-synaptic neuron less likely to fire, which regulates anxiety

Between subjects design
an investigation design in which participants are randomly allocated to either the control or the experimental condition

Biological factor
a factor that relates to the physiological functioning of the body

Biological intervention
a treatment targeting physiological mechanisms believed to contribute to a condition

Biological risk factor
a factor that relates to the physiological functioning of the body, and may contribute to mental disorders

Blood alcohol concentration (BAC)
the percentage of alcohol in the bloodstream

Blue light
a part of the visible light spectrum that is emitted from smartphone screens, computer monitors, televisions, LED and fluorescent light bulbs, as well as sunlight

Brain
a complex structure that receives and processes sensory stimuli from the body and coordinates responses, including voluntary movements, emotions and conscious thought

Brain atrophy
the loss of neurons within the brain

Brain scan
an examination of the brain that shows brain activity and tissues that cannot be detected otherwise

Breathing retraining
an anxiety management technique that involves teaching someone with a specific phobia how to control their breathing in the presence of their phobic stimulus

Bright light therapy
a therapy to treat a sleep disorder in which the person is exposed to a bright light to reset the sleep–wake cycle

ISBN 978-1-009-25416-8 Gallagher et al

Capacity
the amount of information held within a memory store

Case study
a type of investigation of a particular activity, behaviour, event or problem that contains a real or hypothetical situation and includes real-world complexities

Catastrophic thinking
a cognitive bias that involves overestimating and exaggerating the worst possible outcomes to situations even though they are unlikely to occur

Central nervous system (CNS)
the brain and the spinal cord; processes and coordinates responses to sensory stimuli

Cerebellum
a cauliflower-shaped structure at the base of the brain; coordinates timing and fluency of movements; encodes and temporarily stores implicit memories of simple conditioned reflexes

Cerebral cortex
a thin, outer layer of the brain; involved in complex mental abilities, sensory processing, voluntary movements and storage of explicit memories

Challenge
the perceived potential for personal gain or growth from an event

Chronic stress
stress that lasts for a long time

Circadian rhythm
biological processes that coordinate the timing of body activities over a 24-hour period

Circadian rhythm sleep disorders
a category of sleep disorders in which sleep is disrupted because the circadian rhythm and a person's sleep–wake schedule are misaligned

Classical conditioning
a simple form of learning that occurs through repeated associations between a neutral stimulus and an unconditioned stimulus to produce a conditioned response

Classification and identification
a type of investigation that involves arranging phenomena, objects or events into manageable sets, and recognising phenomena as belonging to a particular set or part of a new or unique set

Cognitive behavioural therapy (CBT)
a common intervention consisting of a range of cognitive and behavioural therapies and learning principles to help people identify and change unhelpful thought processes, feelings and behaviours to more helpful ones

Cognitive bias
the tendency to think in a way that involves errors of judgement and faulty decision-making

Cognitive functioning
a person's mental processing

Cognitive model
a model that describes how people's perceptions of situations influence their emotional and behavioural reactions

Community
a group of people who live in the same location or who share an interest or characteristic in common, and who interact or have the potential to interact

Conclusion
a statement about the findings of a study, which addresses the aim and hypothesis

Conditioned response (CR)
a learned behaviour that is similar to the unconditioned response and is now triggered by the conditioned stimulus as a result of conditioning

Conditioned stimulus (CS)
a stimulus that was previously neutral but now, as a result of repeated associations with the unconditioned stimulus, produces a conditioned response

Conditioning
the learning process by which the behaviour of an organism becomes dependent on an event occurring in its environment

Confidentiality
an ethical guideline that ensures participants remain anonymous, and their personal information is kept private, protected and secure throughout the study

Confounding variable
an unwanted variable that has affected the results of an investigation

Congenital
present from birth

Connection to Country
Indigenous ways of knowing are known to be rooted with deep respect for the ecology and the importance of the connected relationship with the land

ISBN 978-1-009-25416-8 Gallagher et al

Consciousness
the awareness of your own internal mental processes, including your thoughts, feelings, sensations and perceptions, and your awareness of the external world around you

Conscious response
any response of the nervous system that requires awareness

Consequence
something that makes a behaviour more or less likely to occur again

Consolidation
the process by which a temporary memory is transformed into a more stable, long-lasting form

Context-specific effectiveness
when a coping strategy matches or is appropriate to the stressful situation

Contradictory data
data that appears incorrect

Control group
the group that forms a baseline level to compare the experimental group with

Controlled experiment
an experimental investigation of the relationship between one or more independent variables and a dependent variable, in which all other variables are controlled

Controlled variable
a variable that is held constant to ensure that the only influence on the dependent variable is the independent variable

Coping
all the things we do to manage and reduce the stress we experience

Coping flexibility
the ability to modify our coping strategies to adapt and meet the demands of different stressful situations

Coping strategy
a method that we use to manage or reduce the stress produced by a stressor

Correlational study
a type of investigation that involves planned observation and recording of events and behaviours that have not been manipulated or controlled to understand the relationships or associations existing between variables, to identify which factors may be of greater importance, and to make predictions

Cortisol
a hormone produced by the adrenal glands that regulates a wide range of bodily processes, including metabolism, and is released in response to stress

Countershock
the second phase of the alarm reaction stage of the general adaptation syndrome, in which the body's ability to deal with the stressor rises above normal

Cultural continuity
the ability to preserve the historical traditions of a culture and carry them forward with that culture into the future

Cultural determinants of wellbeing
cultural factors that influence health and wellbeing

Culture
a way of life that is shared and learned

Daylight
all direct and indirect sunlight during the daytime

Debriefing
an ethical guideline involving provision of information to participants at the end of the study, including the true aims, results and conclusions, and answering any questions, clarifying misunderstandings or deception, and providing support to ensure no lasting harm

Decay
the fading away of information in short-term memory when not maintained by rehearsal

Deception in research
an ethical guideline involving withholding the true nature of the study from participants, when their knowledge of the true purpose may affect their behaviour and subsequent validity of the investigation

Declarative memory
an explicit long-term memory of specific facts and events, most of which can be stated or 'declared'

Delayed Sleep Phase Syndrome (DSPS)
a circadian rhythm sleep disorder characterised by a delay in the timing of sleep onset and awakening compared with the timing that is desired

Dementia
a collection of symptoms that are caused by disorders affecting the brain

ISBN 978-1-009-25416-8 Gallagher et al

Dendritic spine
a dendrite fibre that grows by sprouting on the post-synaptic neuron

Dependent variable
the variable that is being measured by the researcher

Discussion section
a section of a scientific report or poster that analyses the findings and concludes the research

Disorganised insecure attachment
occurs when a child does not receive consistent care or emotional support from a primary caregiver early in life; leads to inconsistent behaviour being displayed towards this caregiver by the child

Displacement
adding new single items to short-term memory by pushing out old items

Dopamine
a multifunctional neurotransmitter with both excitatory and inhibitory effects, that is involved in many central nervous system functions such as movement, pleasure, attention, mood, cognition and motivation

Dreaming
a guide to life and living; Dreaming is not just stories, it is art, songs, dance; it is written into the land itself

Duration
the length of time information is held within a memory store

During conditioning
the second stage of classical conditioning, in which learning occurs through association

Dysfunctional GABA system
a failure to produce, release or receive the correct amount of gamma-aminobutyric acid

Electroencephalography (EEG)
a technique that detects, amplifies and records the electrical activity of the brain

Electromyography (EMG)
a technique that detects, amplifies and records the electrical activity of the skeletal muscles

Electro-oculography (EOG)
a technique that detects, amplifies and records the electrical activity of the muscles controlling the eyes

Emotional wellbeing
relates to the ability to feel a range of emotions and express them in a positive way

Encoding
converting sensory information into a useable from that can be processed by the brain

Enteric nervous system (ENS)
a subdivision of the autonomic nervous system; it consists of nerve cells lining the gastrointestinal tract and controls the digestive system

Episodic future thinking
projecting yourself forwards in time to pre-experience an event that might happen in your personal future

Episodic memory
the declarative memory of personally experienced events

Ethical concepts
general ethical considerations used to analyse the ethical and moral aspects of conduct surrounding psychological issues and psychological investigations

Ethical guidelines
guidelines that ensure the protection and welfare of all participants in research

Evidence
a verified fact

Evidence-based intervention
a treatment shown to be effective in valid and reliable research studies

Excitatory effect
the increased likelihood that the post-synaptic neuron will fire an action potential or neural impulse

Exhaustion stage
the third stage of the general adaptation syndrome, in which the continued depletion of energy stores and high levels of hormones such as cortisol decrease resistance to the stressor and impair the immune system

Experimental group
the group that is exposed to the independent variable and receives the experimental treatment

Explicit memory
information that can be consciously retrieved and stated, such as 'known facts'

External factor
a factor that influences mental wellbeing and originates from outside a person, such as the physical and social environment

ISBN 978-1-009-25416-8 Gallagher et al

External stressor
a cause of stress that originates from outside an individual, such as an event or environmental extreme

External validity
whether the results of research can be applied to similar individuals in a different setting

Extraneous variable
a variable other than the independent variable that may have an unwanted effect on the dependent variable and results of an investigation

Fear hierarchy
a list of anxiety-inducing experiences relating to the patient's phobia, in order of from easiest to confront, to the most difficult to confront

Fieldwork
a type of investigation that involves collecting information through observing and interacting with a selected environment

Filigree appendage
a fibre that grows by sprouting from the axon terminal of the presynaptic neuron

First Nations
Indigenous people of Australia; or First Peoples

Flight-or-fight-or-freeze response
an automatic biological response to a perceived stressor that increases our chances of survival in our environment

Gamma-aminobutyric acid (GABA)
the main inhibitory neurotransmitter in the nervous system, associated with anxiety, specific phobias and Parkinson's disease

General adaptation syndrome (GAS)
a biological model of stress that proposes we have a non-specific biological response to stress that occurs in three stages

Genetic vulnerability
an increased likelihood that a person will develop a particular mental disorder because of their DNA

Glutamate
the main excitatory neurotransmitter in the nervous system, involved with learning and memory

Gut
the gastrointestinal tract or long tube that starts at the mouth and ends at the anus

Gut–brain axis (GBA)
the connection between the central nervous system and the enteric nervous system, that enables bidirectional communication between the brain and the gastrointestinal tract

Gut microbiota
the microbe population in the gut (digestive system)

Harm/loss
the damage to the individual that has already occurred as a result of a stressor

High level of functioning
the ability to carry out a wide range of daily activities, attend to self-care, maintain interpersonal relationships and demonstrate resilience in the face of everyday challenges

Hippocampus
a structure in the temporal midbrain; involved in formation of long-term explicit memories and their transfer to the cerebral cortex for storage

Hyperventilation
rapid, shallow breathing

Hypnogram
a line graph that represents the stages of sleep plotted against time

Hypothesis
a statement predicting the probable outcomes of an investigation

Implications
the impact a study might have on the population, relevant theory and future research

Implicit memory
memory not requiring conscious retrieval, such as 'how to' skills

Incomplete data
data that has elements missing

Independent variable
the variable that is being manipulated (controlled, selected or changed) by the researcher

ISBN 978-1-009-25416-8

Indigenous
First Australians and First Peoples of any country

Induced altered state of consciousness
an altered state of consciousness that has been brought about on purpose

Informed consent procedures
an ethical guideline conducted before a study begins – participants agree to participate after they have received all the details of the study, including the purpose, procedures and potential risks

Inhibitory effect
the decreased likelihood that the post-synaptic neuron will fire an action potential or neural impulse

Integrity
an ethical concept involving the commitment to searching for knowledge and understanding and the honest reporting of all sources of information and results

Internal factor
a factor that influences mental wellbeing and originates from within a person, such as genetics and hormones

Internal stressor
a cause of stress that originates within an individual; can be both psychological and biological/physiological

Internal validity
whether a study investigates what it sets out or claims to investigate

Interneuron
a nerve cell in the spinal cord that connects motor and sensory neurons by relaying information between the two

Introduction section
a section of a scientific report or poster that provides an overview of what the investigation is trying to achieve and why it is important

Investigation aim
the purpose of a study

Investigation design
a framework that determines how participants experience the experimental and control conditions

Investigation methodology
the particular type of research study

Investigation question
the question that is to be solved by a study

Irrelevant
describes a situation or event that has no implications for an individual's wellbeing because nothing will be gained or lost, or they are not invested in the situation

Justice
an ethical concept involving fair consideration of competing claims, no unfair burden on a particular group, and fair access to benefits of an action

Kinaesthetic
to do with body movement or sensation

Learner
the individual who observes, remembers and initiates the actions of the model

Learning
the process of acquiring knowledge or skills resulting from experience; there are many approaches

Learning map
images or visuals used to map out processes for learners

Lesion
a damaged or abnormal area of the brain that might appear like a scar or wound

Life span
the period of time a person is alive

Life stressor
an everyday or conceivable event, such as a relationship breakdown, work challenge or failing a test

Limitations of conclusions
the faults or flaws in the design of an investigation that may limit the conclusions of that investigation

Line graph
a way to display numerical and continuous data

Literature review
a type of investigation that involves collating and analysing secondary data findings and viewpoints

ISBN 978-1-009-25416-8 Gallagher et al

Long-term depression (LTD)
the relatively permanent weakening synaptic connections as a result of repeated low-level activation

Long-term memory (LTM)
memory that is relatively permanent and holds huge amounts of information for a long time, possibly lifelong

Long-term potentiation (LTP)
the relatively permanent strengthening of synaptic connections as a result of repeated activation of a neural pathway

Mean
a statistic that is the average value of a set of data

Measurement error
the difference between the measured value and the true value

Measures of central tendency
a category of statistics that describes the central value of a set of data

Measures of variability
a category of statistics that describe the distribution of data

Median
the middle value in an ordered set of data

Melatonin
a hormone that induces drowsiness and decreases cell activity

Memory
an information processing system that actively receives, organises, stores and recovers information

Memory bias
distorted thinking that either enhances or impairs the recall of a memory or alters its content

Mental disorder
a condition that affects mood, thinking and behaviour and is typically long lasting

Mental health and wellbeing
a beneficial emotional state in which a person realises their abilities, copes with the normal stresses of life, works productively and contributes to their community

Mental health problem
a relatively short-term disruption that impacts on a person's everyday functioning

Mental time travel
the capacity to mentally reconstruct past personal events and imagine possible future scenarios

Mentally healthy
the state of not having difficulty with everyday activities and displaying resilience

Method of loci
a mnemonic system that commits a familiar location or sequence of locations to memory, then visually links them with information that needs to be recalled

Methodology section
a section of a scientific report or poster that describes the participants, materials and procedures used in the study

Microbe
a microscopic living thing found in water, soil and the air

Mindfulness meditation
the practice of observing the present moment, suspending judgements, and focusing on something calm and peaceful

Mixed design
an investigation design that combines elements of a between subjects design and a within subjects design

Mnemonic
any technique used for improving or enhancing memory

Mode
the value that occurs most frequently within a set of data

Model
the live, pre-recorded or symbolic person being observed

Modelling
a type of investigation in which a physical or conceptual model is constructed and/or manipulated to simulate a system

Motivation
a stage of observational learning, when the learner has the desire to perform the model's behaviour

Motor neuron
a nerve cell that transmits motor impulses from the spinal cord to the skeletal and smooth muscles

ISBN 978-1-009-25416-8 Gallagher et al

Narrative
a story which in a cultural context may be delivered in a variety of ways including performance, song and dance

Naturally occurring altered state of consciousness
an altered state of consciousness that occurs without any external influence

Negative punishment
when a behaviour is followed by the removal of a desirable stimulus, decreasing the likelihood of the behaviour occurring again

Negative reinforcement
when a behaviour is followed by the removal of an undesirable stimulus, increasing the likelihood of the behaviour occurring again

Neocortex
the top layer of the cerebral cortex that is involved in high-order mental processes such as language, attention and memory

Neural transmission
an electrical impulse that occurs when a neuron is activated or fires

Neurofibrillary tangle
an abnormal build-up of protein inside a neuron that is associated with cell death

Neuromodulator
a subclass of neurotransmitters that alter the strength of neural transmission, by increasing or decreasing the responsiveness of neurons to neurotransmitter signals

Neuron
an individual nerve cell that is specialised to receive, process and/or transmit information within the nervous system

Neurotransmitter
a chemical produced by neurons that carries messages to other neurons or cells within the nervous system, including muscles, organs and glands

Neutral stimulus (NS)
a stimulus (prior to conditioning) that doesn't produce a response

Non-maleficence
an ethical concept involving the avoidance of causing harm

Non-rapid eye movement (NREM) sleep
a type of sleep characterised by a progressive decline in physiological activity

Normal waking consciousness
a state associated with being aware of our internal and external environments

Observational learning
a type of social learning that occurs when a learner observes a model's actions and their consequences to guide their future actions

Occupational health and safety (OHS)
issues of health, safety and welfare that must be protected in a workplace

Operant conditioning
a learning process in which the likelihood of a voluntary behaviour occurring is determined by its consequences

Opinion
a judgement that is not necessarily based on proof

Oral culture
a culture in which information and stories are communicated by word of mouth

Outlier
a value that lies a long way from other results

Parasympathetic nervous system
a subdivision of the autonomic nervous system that controls the body's internal environment in an autonomous or self-regulated manner

Partial sleep deprivation
the experience of achieving inadequate sleep in terms of quantity or quality

Percentage
a part of a whole, a proportion out of 100

Percentage change
a calculation of the degree of change in a value over time

Peripheral nervous system
all the nerves outside of the central nervous system that carry messages between the central nervous system and muscles, organs and glands throughout the body

Perpetuation
prolonging of the occurrence of a mental disorder and preventing recovery

Personal error
a mistake, miscalculation or observer error made when conducting research

ISBN 978-1-009-25416-8 Gallagher et al

Phobia
a persistent, intense, irrational fear of a specific object or event

Place-based learning
learning drawn from the landscape with profound connections to ancestral and personal relationships with place

Polysomnography
a multi-parameter sleep study and a diagnostic tool used in sleep medicine

Population
the wider group of people that a study is investigating

Positive punishment
when a behaviour is followed by adding an undesirable stimulus, decreasing the likelihood of the behaviour occurring again

Positive reinforcement
when a behaviour is followed by adding a desirable stimulus, increasing the likelihood of the behaviour occurring again

Precipitate
trigger the onset or exacerbation of a mental disorder

Precision
how close a set of measurement values are to each other

Primary appraisal
when an individual determines whether a situation or event is significant to them and stressful or not

Primary data
data collected through first-hand research for an intended purpose

Product, process and system development
a type of investigation in which a product, a process or a system is designed to meet a human need

Protective factor
a factor that plays a role in decreasing the chance of developing a mental disorder

Pruning
the removal of excess neurons and synaptic connections to increase the efficiency of neuronal transmissions

Psychoeducation
educating people diagnosed with mental health conditions and their family members about the disorder and possible treatment options

Psychological construct
a concept that cannot be objectively observed or measured directly through the collection of data, but is widely understood to exist

Psychological factor
a factor that relates to the functioning of the brain and the mind, including cognitive and affective processes such as thought patterns and memory

Psychological intervention
treatment that uses activities such as psychotherapy to modify thoughts, feelings and behaviours

Psychological risk factor
a factor that relates to the functioning of the brain and the mind, which may contribute to mental disorders

Psychotherapy
any talking therapy designed to help people with a broad range of mental health issues

Punishment
a stimulus from the environment that decreases the likelihood of a behaviour occurring again

Qualitative data
data that describes characteristics and qualities

Quantitative data
data that includes measurable values and quantities and can be compared on a numerical scale

Random allocation
dividing a sample into groups in such a way that each participant has an equal chance of being placed into the experimental group or the control group

Random error
an error that creates unpredictable variations in the measurement process and results in a spread of readings

Random sampling
selecting participants from the population in a way that means each member of the population has an equal chance of being selected to participate in the study

Rapid eye movement (REM) sleep
a type of sleep characterised by quick darting of the eyes behind closed eyelids and an increase in physiological activity

ISBN 978-1-009-25416-8 Gallagher et al

Receptor site
a membrane protein on the dendrites of neurons that receive and detect specific neurotransmitters

Reconstruction
the combining of stored information with other available information to form what is believed to be a more coherent, complete or accurate memory

References and acknowledgements section
a list of all the sources used in a scientific report or poster

Rehearsal
the conscious manipulation of information to keep it in short-term memory for longer or to transfer it to long-term memory

Reinforcement
a stimulus from the environment that increases the likelihood of a response occurring in the future

Relaxation technique
any method or procedure that helps to induce a physiological and psychological relaxation response

Repeatability
the closeness of the agreement between successive measurements of the same quantity, carried out under the same conditions

Reproducibility
the closeness of the agreement between measurements of the same quantity, carried out under different conditions

Reproduction
the third stage of observational learning, in which the learner's physical and mental capabilities enable them to perform the model's behaviour

Rerouting
the formation of new connections between neurons to establish alternative neural pathways

Resilience
the ability to recover from adversity

Resistance stage
the second stage of the general adaptation syndrome, in which the stressor persists, and the body's resources are maximised to cope and adapt over time

Respect
an ethical concept involving the consideration of the value of living things, giving due regard, and consideration of the capacity of living things to make their own decisions

Response
a behavioural reaction to a stimulus

Results section
a section of a scientific report or poster that outlines the evidence and findings of the study

Retention
the second stage in observational learning, when the learner stores a mental representation of the model's behaviour

Retrieval
accessing information that has previously been stored

Retrograde amnesia
the inability to retrieve previously stored memories after an amnesia-causing event

Reward pathway
a group of structures in the brain that are activated by rewarding or reinforcing stimuli

Risk assessment
a process involving the consideration, identification and reduction of physical and psychological risk

Role
the function of a memory store

Rumination
thinking about and focusing on negative thoughts and experiences

Safety data sheet (SDS)
a document that provides all the important information about a substance, such as its ingredients, precautionary statements and first aid measures

Sample
the smaller group of people selected from the population who will be participants in the investigation

Sampling technique
different procedures for selecting participants from the population

Scientific poster
a way to present the main sections of a scientific report in a brief and visual way

ISBN 978-1-009-25416-8 Gallagher et al

Scientific report
a report outlining why and how some research was conducted, with an analysis of the findings

Secondary appraisal
when an individual considers the available resources and their own coping strategies, to decide the best way of dealing with a stressor

Secondary data
data obtained second hand through research conducted by another person for another purpose

Self-determination
the ability to participate in decisions on matters that affect one's life

Self-efficacy
a person's confidence that they can complete life tasks and meet their goals

Semantic
relating to meaning

Semantic memory
the declarative memory of facts or knowledge about the world

Sensory memory
a memory store that receives and stores an unlimited amount of incoming sensory information for a brief time

Sensory neuron
a nerve cell that carries sensory signals throughout the nervous system

Sensory receptor
a sensory nerve ending that produces an afferent or sensory impulse when stimulated

Serotonin
an inhibitory neurotransmitter that also acts as a neuromodulator, influencing a variety of brain activities

Serotonin pathway
serotonin's neuromodulatory system, which originates in the brainstem and extends to almost all areas of the cerebrum including the cerebral cortex

Shift work
work that regularly takes place outside of normal business hours, particularly at night and the very early morning; can cause a circadian rhythm sleep disorder

Shock
the first phase of the alarm reaction stage of the general adaptation syndrome, in which the body's ability to deal with the stressor falls below normal

Short-term memory (STM)
a memory store that has limited capacity of short duration, unless the information is renewed

Simulation
a type of investigation that uses a model to replicate and study the behaviour of a system

Sleep
a naturally occurring and reversible altered state of consciousness, characterised by a reduction in awareness and responsiveness to external surroundings

Sleep diary
a subjective self-report tool used by a person to track their own sleep and wake patterns

Sleep hygiene
the sleep-related behaviours and environmental conditions that are beneficial for sleep

Social factor
a factor that relates to the social components of a person's environment

Social intervention
an intervention designed to increase social support for people with a mental illness

Social risk factor
a factor that relates to a person's social contacts and how culture and the social environment can influence the development of mental disorders

Social-cognitive approach
when individuals process, remember and learn information in social contexts to explain and predict their behaviours and that of others

Social wellbeing
relates to the connections you make with other people and your ability to get along with people in a community

Somatic nervous system
a subdivision of the peripheral nervous system that carries sensory information to the central nervous system and motor information to the body

ISBN 978-1-009-25416-8 Gallagher et al

Songline
one of many sung narratives of the landscape that weave across Country and enable every significant place in Aboriginal Dreaming to be known

Specific environmental trigger
an object, situation or circumstance that probably caused a direct, negative traumatic experience associated with extreme fear or discomfort, which then acts as a cue for future phobic fear responses

Specific phobia
a persistent, intense, irrational fear of a specific object or event

Spinal cord
a dense bundle of nerves that carries sensory information from the body to the brain and motor information from the brain to the body

Spinal reflex
an involuntary and unconscious response to a stimulus involving the spinal cord, which occurs without input from the brain

Sprouting
the growth of axon or dendrite fibres at the synapse

Standard deviation
a statistic that shows the spread of the data around the mean

Stigma
the feeling of shame or disgrace associated with a personal characteristic that indicates you belong to a culturally devalued group in society – this can be real or imagined

Stimulus
an environmental event that triggers a response in an organism

Storage
retaining information over time

Stratified sampling
first dividing the population into subgroups, and then randomly selecting participants from each subgroup in the proportion that they appear in the population

Stress
a state of mental, emotional and physiological tension, resulting from factors that are perceived to challenge or threaten our ability to cope

Stressor
any event that causes stress or is perceived as a threat and a challenge to our ability to cope

Sung narrative
a story told through singing, music and sometimes dance

Suprachiasmatic nucleus
a master body clock in the hypothalamus that regulates body activities to a daily schedule of sleep and wakefulness

Sympathetic nervous system
a subdivision of the autonomic nervous system that increases our arousal, readying the body for a quick response

Synapse
the point of communication between two neurons or between a neuron and a target cell such as a muscle or gland

Synaptic gap
the space between the axon terminal of the presynaptic neuron and the membrane of the post-synaptic neuron

Synaptic plasticity
specific changes that occur within the synapse, between neurons

Synaptic vesicle
a membrane-bound sphere filled with neurotransmitter molecules

Synaptogenesis
the formation of new synapses that result from the process of sprouting

Systematic desensitisation
a method for treating phobias in which the phobic stimulus is progressively introduced while the person uses relaxation techniques until their fear is replaced by a relaxation response

Systematic error
an error that causes readings to differ from the true value by a consistent amount each time a measurement is made

Table
a way to display data and/or summary statistics clearly

Threat
the anticipated harm/loss in the future because of an event

ISBN 978-1-009-25416-8 Gallagher et al

Transactional model of stress and coping
a model that suggests a stress response is only elicited if an event is perceived to exceed our ability to cope and is based on our appraisal of the situation

True value
the value, or range of values, that would be found if the quantity could be measured perfectly

Ultradian rhythm
biological processes that coordinate the timing of body activities over a period of less than 24 hours

Uncertainty
a lack of exact knowledge of the value being measured

Unconditioned response (UCR)
a response that occurs automatically/involuntarily when the unconditioned stimulus is presented

Unconditioned stimulus (UCS)
a stimulus that consistently produces a naturally occurring, automatic response

Unconscious response
any response of our nervous system that does not require awareness

Vagus nerve
a nerve that connects the brain (central nervous system) to organs within the autonomic nervous system, via nerve fibres that directly link organs such as the lungs, heart, oesophagus and intestinal tract

Validity
whether a measurement measures what it is supposed to measure

Video monitoring
a sleep study tool used to collect qualitative visual and audio information about a person's sleep

Visual cortex
the primary cortical region of the brain that receives, integrates and processes visual information relayed from the retinas

Voluntary participation
an ethical guideline ensuring that each participant freely agrees to participate in a study, with no pressure or coercion

Ways of knowing
methods through which knowledge becomes apparent to us

Wellbeing
a complex combination of a person's physical, social, emotional, mental and spiritual health that is linked to happiness and life satisfaction

Withdrawal rights
an ethical guideline that ensures the participants are free to discontinue their involvement in a study at any point during or after the conclusion of the study, without receiving any penalty

Within subjects design
an investigation design in which all participants in the sample are involved in both the experimental and control conditions

Written culture
a culture in which stories and information are shared and preserved through the processes of reading and writing

Yarn
an Indigenous system of learning that involves continually sharing stories

Zeitgeber
an environmental cue such as light, temperature and eating patterns that can synchronise the body's circadian rhythm

ISBN 978-1-009-25416-8 Gallagher et al

Index

ISBN 978-1-009-25416-8 Gallagher et al

ISBN 978-1-009-25416-8 Gallagher et al

J

K

L

M

N

ISBN 978-1-009-25416-8 Gallagher et al

ISBN 978-1-009-25416-8 Gallagher et al

T

ISBN 978-1-009-25416-8 Gallagher et al

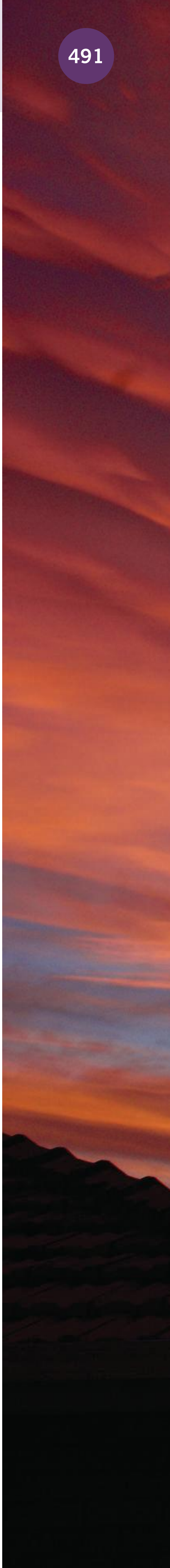
ISBN 978-1-009-25416-8 Gallagher et al

Permissions acknowledgements

The author and publisher wish to thank the following sources for permission to reproduce material:

Cover: © Getty Images / Eric Zheng / 500px (sunset)

Images: © Getty Images / Ted Horowitz, Chapter 1 Opener / Anyaberkut, 1A, 1A-1 / Monty Rakusen, 1A-2 / Marilyn Nieves, 1A-4 (1) / Jenny Dettrick, 1A-4 (2) / Dimitri Otis, 1A-8 / JohnnyGreig, 1B-3 / Scott Barbour, 1B-1 / Yuoak, 1B, 1B-2, 1B-6, 1B-4, 1B-5, 1B-7-8 / Prasert Krainukul, 1B-2 / BSIP, 1B-9 right / Plume Creative, 1B-10 / Maria Casinos, 1B-11 / Dusan Stankovic, 1B-13 / Sturti, 1B-14 / Thomas Barwick, 1B-15 / Lechatnoir, 1B-16 / SDI Productions, 1B-16 (1) / Coneyl Jay, 1B-16 (2) / Bernhard Lang, 1B-17 (1) / Aydinmutlu, 1B-17 (2) / I-Am-Helen, 1B-17 (3) / Erhui1979, 1C-3 (1) / Zero Creatives, 1C-3 (2) / Jacob Wackerhausen, 1C-4 / Westend61, 1C-5, 2A-2, 3C-1, 5B-1, 6B-12 (4), 6D-3 (1), 7A-3 (2), 9B-5, 8A-7, p.377 (2,3), 10B-11 / / Klaus Vedfelt, 1C-6 / Janiecbros, 1C-8 (1) / FroggyFrogg, 1C-8 (2) / Eva-Katalin, 1C-9 / Yuichiro Chino, Chapter 2 Opener / Piranka, 2A-2 (2) / Monty Rakusen, 2A-2 (1) / mevans, 2A-5 / Guido Mieth, 2A-11 / Jasmin Merdan, 2A-17 (1) / Calysta Images, 2A-17 (2) / Cmcderm1, 2A-19 (1) / Jacoblund, 2A-19 (2) / Prykhodov, 2A-20 / katleho Seisa, 2A-23 / Getty, p.80 / Howard Kingsnorth, 2B-2 (1) / urbazon, 2B-2 (2) / Jennifer A Smith, 2B-3 / AzmanL, 2B-4 / MoMo Productions, Activity 2B-1 / Jordan Lye, Section 2B Q / CHRISTOPH BURGSTEDT, Chapter 3 Opener / SEBASTIAN KAULITZKI/Science PL, 3A, 3A-3, 4A-9 / Alan Gesek, 3A-4 / PIXOLOGICSTUDIO, 3A-5, 3A-10, 4A-10, 6B-8 / Michael Willson, 3A-6 / Stocktrek Images, 3A-8 / DrAfter123, 3A-11 / SCIEPRO, 3A-12 / Geber86, 3A-15 (1) / Grazyna Palaszewska, 3A-15 (2) / Hiraman, 3A-17 (2) / Photographer, Basak Gurbuz Derman, 3A-17 (3) / Mtreasure, 3A-17 (4) / George Mdivanian, 3A-17 (5) / OsakaWayne Studios, 3B-1 / De Agnosti Picture Library, 3B-3 / BSIP, 3B-3, 3B, 3B-4, p.136, p.123 (top) / Guan Gaetner, 3B-6 / Sciepro/Science PL, 3B-7 / Daniel Day, 3B-8 / Artpartner-Images, 3C-1 / Marko Geber, 3C-1 / Alred Pasieka, p.143 / PeopleImages, 3B-12 / Dorling Kindersley, 3B-13 / Gallo Images, 3B-14 / Rosinka, 3B-15 / Isarapab Chumruksa, 3B-15 / Chris Ryan, 3B-17 / Peter Dazeley, p.12, 3A-7 , 3A-17 (1) , 3B-18 (1,2), 3B–23, 4B-1, 8C-8 (1), 9C-3 / Adam Hester, 3B-18 (3) / Michael Kraus, 3B-18 (4) / Sanjeri, 3B-18 (5) / Karen Moskowitz, 3B-18 (6) / Matei Alexandru Marcu, 3B-20 / Viktorcvetkovic, 3B-21 / PhotoAlto /Frederic Cirou, 3B–24 / Koto_feja, Chapter 4 Opener / Visoot Uthairam, 4A-1 / Grafissimo, 4A-3 (1) / PeopleImages, 4A-3 (2) / Stock-Eye, 4A-3 (3) / Reed Kaestner, 4A-3 (4) / Klaus Vedfelt, 4A-4 (1) / Yuri_Arcurs, 4A-4 (2) / Wetcake, Activity 4A-1 / Jack191, 4A-7 (1), p.153 (1) / Rudall30, 4A-7 (2), p.153 (2) / VasjaKoman, 4A-7 (3), p.153 (3) / NANOCLUSTERING/SPL, 4B p.153, 4B-5 / Ed Reschke, 4A-12 / Kateryna Kon, 4C-1 / Boonchai Wedmakawand, 4C-2 / D-Keine, 4C-3 / Ttsz, 4B-3 / Christoph BurgStedt, 4B-4 / UnoL, 4B-7 (1,2) / Richard Drury, 4E-1 / Apichart Poemchawalit, 4D-1 / malerapaso, p.176 (2) / Hill Street Studios, p.176 (1) / SDI Productions, 4E-5 / Visualspace, 4E-6 / Mustafahacalaki, p.192 / Andriy Onufriyenko, Chapter 5 Opener / Sean Murphy, 5A-1 (1) / Jetta Productions, 5A-1 (2) / Dimitrios Kambouris, 5A-1 (3) / Christina Reichl Photography, 5A-3 (dog) / Lew Robertson, 5A-3 (dog food) / Stockcam, 5a-3 (metronome) / IgorDutina, Activity 5A-1 / Jupiterimages, 5B-2 / Bettmann, 5B-3 / Mint Images, p.212 / Hallie Bear, 5B-8 (1) / Rebecca Nelson, 5B-8 (2) / Carol Yepes, 5C-1 / Jon Brenneis, 5C-2 / 10'000 Hours, p.222 (top) / Tempura, 5C-4 / Trendmakers, p.223 / Marc Dozier, 5D-2 / Vicki Smith, 5D-6 / William West, 5D-8 / Kerriekerr, 5D-9 / Olemedia, Chapter 6 Opener / Mediaphotos, 6A-1 / Damircudic, 6A-2 / YinYang, 6A-5 (1) / Wundervisuals, 6A-5 (2) / PeopleImages, 6A-5 (3) / Paul Bradbury, 6A-6 / Digital Camera Magazine, 6A-1 (1) / Andreas Kuehn, 6A-1 (2) / SolStock, 6A-7 / Jeff Overs, 6A-9 / Sean Gladwell, p.252 / Jessie Casson, 6B-2 (1) / Alexander Spatari, 6B-2 (2) / Maskot, 6B-3 (1) / Patrick Sheandell O'Carroll, 6B-3 (2) / Dorling Kindersley, 6B-5 / Enviromantic, 6B-7 / Henrik Sorensen, 6B-9 / Faba-Photograhpy, 6B-10 / Chunumunu, 6B-11 (1) / Creative Nature_nl, 6B-11 (2) / Fcafotodigital, 6B-11 (3) / Rafael Ben-Ari, 6B-12 (1) / Longhua Liao, 6B-12 (2) / Jessie Casson, 6B-12 (3) / Lorado, 6B-13 / Life On White, p.264 / Matthew Horwood, 6D-1 / Daizuoxin, 6D-2 / Complexio, 6D-3 (2) / Scott Barbour, 6D-5 (2) / Mikroman6, 6D-6 / Torsten Blackwood, 6D-8 (2) / Fotostorm, 6C-1 / David Freund, 6C-2 (1) / WPA Pool, 6C-2 (2) / Andrew Brookes, 6C-2 (3) / John Eder, 6C-3 (1) / Judith Haeusler, 6C-3 (2) / MoMo Productions, 6C-4 / Klaus Vedfelt, 6C-6 (sun) / Rainer Lesniewski, 6C-6 (map) / Flashpop, 6C-6 (friends) / Ivan, 6C-6 (people/beach) / Eric Yang, 6C-7 (1) / The Good Brigade, 6C-7 (3) / Kathrin Ziegler, 6C-7 (4) / James O'Neil, 6C-8 / Graphic_BKK1979, 6C-10 / Kateryna Kon, 6C-11 / Flashpop, 6C-13 (1) / Image Source, 6C-13 (2) / Mondadori Portfolio, 6C-14 / BSIP, 6C-15 / Mateusz Slodkowski, 6C-15 (1) / Pavlo Gonchar, 6C-15 (2) / Metamorworks, Chapter 7 Opener / Alex-Mit, 7A-1 / JAG IMAGES, 7A-2 / Plume Creative, 7A-3 (1) / MoMo Productions, 7A-3 (3) / Justin Paget, 7A-4 (1) / Tinatini Doborjginidze, 7A-4 (2) / Basak Gurbuz Derman, 7A-4 (3) / Image Source, 7A-5 (light sleep) / Letizia McCall, 7A-5 (deep sleep) / Thomas Barwick, 7A-5 (REM sleep) / Tetra Images, 7A-5 (awake) / Yves Forestier, p.313 / Fotografixx, 7B-10 (1) / BSIP, 7B-10 (2), 7B-3 (2,3), 7B-6 (1,2), 7B-7 (1) / PASIEKA/SPL, 7B-3 (1) / pastorscott, 7B Engage / Graphic_BKK1979, 7B-4, 7B_5, Table 7B-1 / Pastorscott, 7B-7 (3) / Vaclav Hykes, 7C-1 (1) / Henrik Montgomery, 7C-1 (2) / TefiM, 7C-3 / Elenabs, p.325 / Pp7, 7C-5 / Milan Markovic, Table 7C-1 (1) / Skaman306, Table 7C-1 (2) / PeopleImages, Table 7C-1 (3) / Aliaksandra Ivanova, Table 7C-1 (4) / Jacopinm, Activity 7C-1 / Microgen Images, 7D-1, 9C-14 / Katrinaelena, 7D-2 / Jallfree, Table 7D-1 (1) / Morsa Images, Table 7D-1 (1-4) / Wundervisuals, Table 7D-2 (1) / JBryson, Table 7D-2 (2) / FatCamera, Table 7D-2 (3) / Baona, Table 7D-2 (4) / Damircudic, Table 7D-2 (5) / Alvarez, Table 7D-2 (6) / Ljupco, Table 7D-2 (7) / DEV IMAGES, Table 7D-2 (8) / Hans Neleman, Table 7D-2 (9) / Andriy Onufriyenko, Chapter 8 Opener / Dragana991, 8A-1 / Carmen Martínez Torrón, 8A-2 / Elena Shlyapnikova, 8A-3 / Tatyana_tomsickova, 8A-4 / Martin-Dm, 8A-5 / Imgorthand, 8A-6 / Zave Smith, 8A-8 (1) / KatarzynaBialasiewicz, 8A-8 (2) / Miodrag Ignjatovic, 8A-8 (3) / Mikroman6, 8A-9 / C.J. Burton, 8B-2 / Tara Moore, 8B-5 / Photo And Co, 8B-7 / Gravity Images, 8B_8 / Serts, 8B-9 (1) / Somboon Kaeoboonsong, 8B-9 (2) / Extreme Photographer, 8B-9 (3), p.358 (2) / Walstrom, Susanne, p.358 (1) / Maskot, 8C-1 / Luis Alvarez, 8C-2 / PeterHermesFurian, 8C-4 (1) / Pavel Bezkorovainyi, 8C-5 (1) / LWA/Dann Tardif, 8C-6 (1) / Photo And Co, 8C-6 (2) / Burak Karademir, 8C-8 (2) / Yutthana Gaetgeaw, 8C-9 (1) / Wildpixel, 8C-9 (2) / Charlie Rogers, 8C-11 / EvgeniyShkolenko, p.369 / Andriy Onufriyenko, Chapter 9 Opener / Nick David, p.377 (1) / 10'000 Hours, p.377 (4) / David Lees, 9A-2 / Wdstock, 9A-3 / Klaus Vedfelt, 9A-4 / Mike Harrington, 9A-5 /



AleksandarGeorgiev, 9A-6 / FatCamera, 9A-7 / PhotoAlto/Frederic Cirou, 9A-8 / Maskot, 9A-9 / Barcin, p.387 / Sergei Iaremenko, 9B-2 / Jonathan Kitchen, 9B-3 / Karan Kapoor, 9B-4 / Ezra Bailey, 9B-6 / Maskot, 9C-1 / Matt Cardy, 9C-4 / Akinbostanci, 9C-5 / Aleli Dezmen, 9C-6 / Klaus Vedfelt, 9C-8 / Vicki Smith, 9C-9 / Izusek, 9C-10 / Oscar Wong, 9C-12 / Compassionate Eye Foundation/Gary Burchell, 9C-13 / Yusufsarlar, p.410 / Richard T. Nowitz, 9D-1 / Chameleonseye, 9D-2 / Ol'ga Efimova, p.418 (1) / Getty, p.418 (2) / KT Design, Chapter 10 Opener / Kristian Bell, 10A-1 (1) / Joel Sharpe, 10A-1 (2), 10A-12 / Andriy Onufriyenko, 10A-1 (3) / Marko Geber, 10A-1 (4) / Chris Amaral, 10A-6 (2) / Dobrila Vignjevic, 10A-6 (3) / Jami Tarris, 10A-10 / Benjamin Probert, 10A-11 / John Fedele, 10A-13 / Pixelfit, 10A-14 / Tara Moore, 10A-15 / Burazin, p.442 / Pablo Dolsan, p.441 / Ted Streshinsky, 10B-1 / Jon Feingersh Photography Inc, 10B-5 / Archive Photos, 10B-7 / RyanJLane, 10B-8 / Martin-Dm, 10B-9 / FatCamera, 10B-12 / Shapecharge, 10B-13 / Richard Drury, p.165 / Klaus Vedfelt, p.216 / Brand X Pictures, p.318 / Flavio Coelho, p.335; © Allstar Picture Library Ltd/Alamy, 1C-1; © NHMRC/CC by 3.4 Int'l Licence, 1C-7; © Tyler Vigen/CC By 4.0 Int'l License, 2A-1; © Steven Rose/CC 4.0 License, 2B-8; © Dan Winters, 3C-1; Courtesy of Tyson Yunkaporta, 5D-1; © Donna Hensen, 5D-3; © Sandra Hickey, 5D-7; © Michael Connolly/Copyright Agency, 2022, IMAGE: Courtesy Kullilla Art, 6D-7; © Josephine Watjara Mick/Copyright Agency, 2022, IMAGE Coutresy NMA; SLEEP FOUNDATION © 2022 OneCare Media, LLC. All rights reserved, 7B-9; © Antonio Garcia Recena/ Alamy, 10A-6 (1); © Vibha C Kashyap/CC By 4,0 Int'l License, 10A-7; From 2022 American Association for the Advancement of Science. Image © FRANK WILLETT. Allan RS, Smith CM, Belz GT, van Lint AL, Wakim LM, Heath WR, Carbone FR. Epidermal viral immunity induced by CD8alpha+ dendritic cells but not by Langerhans cells. Science. 2003 Sep 26;301(5641):1925-8. doi: 10.1126/science.1087576. PMID: 14512632, 3A-1; ISBN 978-1-925362-82-4 (PDF) © Commonwealth of Australia 2017/CC by 4.0 Attribution Commonwealth of Australia 2017. National Strategic Framework for Aboriginal and Torres Strait Islander Peoples' Mental Health and Social and Emotional Wellbeing. Canberra: Department of the Prime Minister and Cabinet, 9A-10 / Hiroshi Watanabe, p.60 / Catherine Falls Commercial, p.444.

Text: Adapted from: Measuring Health and Disability: Manual for WHO Disability Assessment Schedule (WHODAS 2.0) / edited by TB Üstün, N Kostanjsek, S Chatterji, J Rehm. ISBN 978 92 4 154759 8 (NLM classification: W 15) © World Health Organization 2010 downloaded from https://www.who.int/classifications/icf/more_whodas/en/. Pages 48-52 CC By-NC-SA 3.0 IGO, p.381-382;Source Bandura, A. (1994). Self-efficacy. In V. S. Ramachaudran (Ed.), Encyclopedia of humanbehavior (Vol. 4, pp. 71-81). New York: Academic Press. Retrieved from https://www.uky.edu/~eushe2/Bandura/Bandura1994EHB.pdf, p.401.

Every effort has been made to trace and acknowledge copyright. The publisher apologises for any accidental infringement and welcomes information that would redress this situation.

VCAA - Extracts from the VCE Psychology study design (2023-2027) reproduced by permission; © VCAA. VCE is a registered trademark of the VCAA. The VCAA does not endorse or make any warranties regarding this study resource. Current VCE Study Designs and related content can be accessed directly at www.vcaa.vic.edu.au. Readers are also advised to check for updates and amendments to VCE Study Designs on the VCAA website and via the VCAA *Bulletin* and the VCAA Notices to Schools.