NELSON PSYCHOLOGY
VCE UNITS 1 + 2
3rd edition



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INTRODUCTION

Nelson VCE Psychology Units 1 & 2 (third edition) has been specifically written to the requirements of the VCE Psychology Study Design 2016–21. A highly experienced author team from diverse teaching backgrounds has written this comprehensive text as part of Nelson's VCE Psychology series.

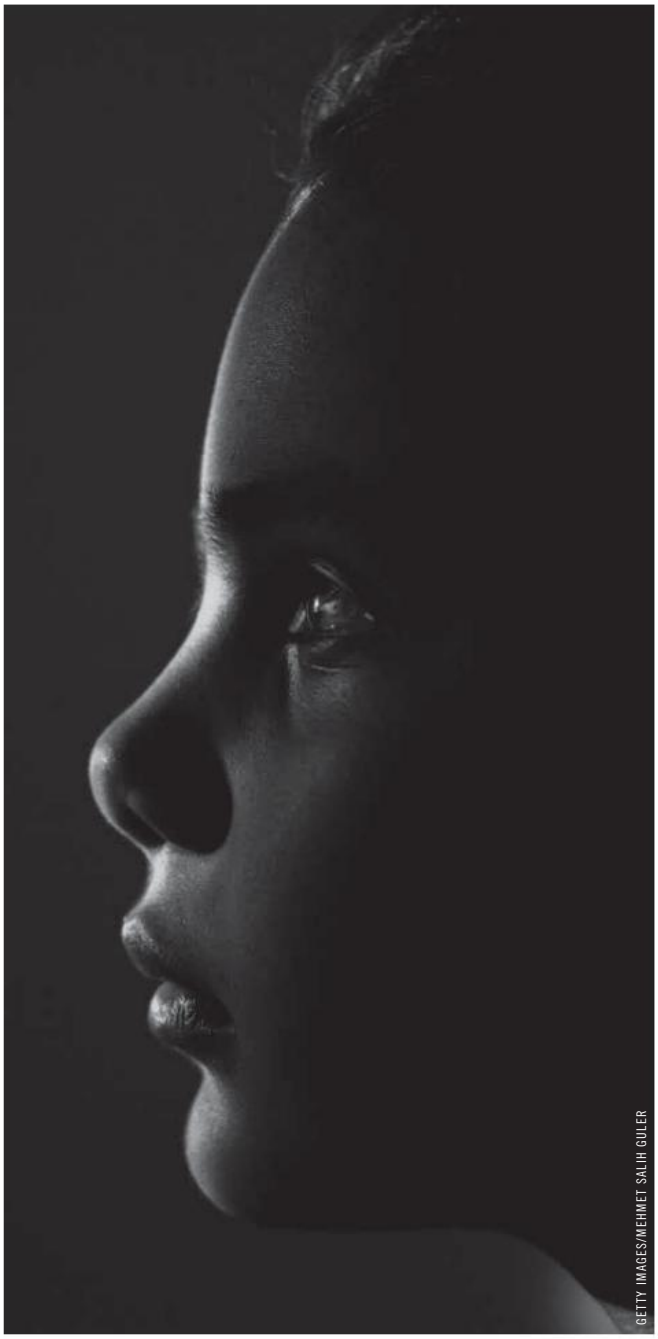
Our author team has produced a book that is engaging and easily accessible to all students of psychology. It provides extension opportunities for students who wish to explore concepts in more depth.

Our author team has developed their content within an Australian context. However, as the study of Psychology is universal, research and interesting examples from overseas have also been included. The inclusion of a variety of features in addition to the innovative user-friendly language and colourful design features set the standard for Psychology texts in Victorian schools.

The key science skills associated with the scientific research that underpin the study of Psychology have been brought together in the chapter titled 'Scientific research methods'. These skills have also been woven through all the chapters so students can practise applying them in context.

Key Knowledge, taken directly from the VCE Psychology Study Design 2016–21, is listed on each chapter opening page.

Nelson Psychology VCE Units 1 & 2 (third edition) gives students a comprehensive grounding in psychology and thoroughly prepares students for success at Units 3 & 4.



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HOW TO USE THIS BOOK

Try it yourself boxes provide the opportunity to test out some of the ideas and concepts covered within the chapter.

2.1 TRY IT YOURSELF >>

PSEUDOSCIENCES

Conduct an Internet search on the following pseudosciences: astrology, palm reading and tarot

Key terms are highlighted and those used in the previous two pages of a chapter are identified in a glossary on the bottom right-hand corner. A full **glossary** containing these terms is found at the back of the book.

Check your understanding questions, spread throughout each chapter, provide the opportunity to review manageable sections of material. After completing these questions students can feel confident they have understood the material before they move on to new areas of content. Answers to Check your understanding questions can be found at the back of the book.

1.5 CHECK YOUR UNDERSTANDING >>

1 Indicate the scale of measurement that would be most appropriate in the following examples.
   a The 'top-ten' songs played in Australia this year

Psychology is a body of knowledge accumulated through scientific research. **Focus on research** boxes relate the material contained within the chapter to an interesting piece of relevant research.

FOCUS ON RESEARCH 2.1

BRAIN DAMAGE CAUSED BY SEVERE SLEEP APNOEA IS REVERSIBLE

Obstructive sleep apnoea is a destructive, potentially life-threatening sleep disorder. Warning signs include snoring, choking and repeated gasping or silent breathing pauses during sleep. A recent neuroimaging study using a form of magnetic resonance imaging (MRI) is the first to show that white matter damage caused by severe obstructive sleep apnoea can be reversed by continuous positive airway pressure (CPAP),

The **Chapter summary** at the end of each chapter provides a summary of the content related to the relevant Key Knowledge listed at the beginning of the chapter. This summary provides students with an excellent overview of the concepts that have been covered within the chapter.

CHAPTER SUMMARY

The brain

- The brain is a complex organ that controls all our cognitions, perceptions, emotions, and voluntary and involuntary bodily responses.

Philosophical origins of brain research

- Philosophical debate – known as the mind–body debate – about the relationship between the mind, the brain and behaviour dates back to ancient times. Ancient philosophers also argued about whether the heart or the brain controlled behaviour. This debate was known as the brain–heart debate. These philosophical debates were based on logic and reasoning but they lacked scientific evidence. In the 2nd century CE, Galen used vivisection and experiments to demonstrate that some behaviours were controlled by the brain.

This is followed by an Apply your knowledge section, which contains four parts:

- Section A: Multiple-choice questions
- Section B: Short-answer questions. These provide excellent practice and preparation for the formal written examination at the end of the Unit.
- Section C: Extended-response question
- Section D: Assessment task. A suggested assessment task designed to be completed in class. These activities provide a practical demonstration of one of the key concepts of the chapter. The assessment tasks are selected from the list provided by the VCAA in the VCE Psychology Study Design 2016–21.

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NATASHA YOUNG

Thanks to my husband, Robbie, for supporting me through the seemingly endless hours of researching and writing.

OUTCOMES

		CHAPTER										
		1	2	3	4	5	6	7	8	9	10	11
UNIT 1	**AREA OF STUDY 1:** **How does the brain function?** Advances in brain research methods have led to new ways of understanding the relationship between the mind, brain and behaviour. In this area of study students examine how our understanding of brain structure and function has changed over time and how the brain enables us to interact with the external world around us. They analyse the roles of specific areas of the brain and the interactions between different areas of the brain that enable complex cognitive tasks to be performed. Students explore how brain plasticity and brain damage can affect a person's functioning.		●	●	●							
	AREA OF STUDY 2: **What influences psychological development?** The psychological development of an individual involves complex interactions between biological, psychological and social factors. In this area of study students explore how these factors influence different aspects of a person's psychological development. They consider the interactive nature of hereditary and environmental factors and investigate specific factors that may lead to development of typical or atypical psychological development in individuals, including a person's emotional, cognitive and social development and the development of psychological disorders.					●	●					
	AREA OF STUDY 3: **Student-directed research investigation** In this area of study students apply and extend their knowledge and skills developed in Areas of Study 1 and/or 2 to investigate a question related to brain function and/or psychological development. Students analyse the scientific evidence that underpins the research in response to a question of interest. They then communicate the findings of their research investigation and explain the psychological concepts, outline contemporary research and present conclusions based on the evidence.							●				

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		CHAPTER										
		1	2	3	4	5	6	7	8	9	10	11
UNIT 2	**AREA OF STUDY 1:** **What influences a person's perception of the world?** Human perception of internal and external stimuli is influenced by a variety of biological, psychological and social factors. In this area of study students explore two aspects of human perception – vision and taste – and analyse the relationship between sensation and perception of stimuli. They consider how biological, psychological and social factors can influence a person's perception of visual and taste stimuli, and explore circumstances where perceptual distortions of vision and taste may occur.								●	●		
	AREA OF STUDY 2: **How are people influenced to behave in particular ways?** A person's social cognition and behaviour influence the way they view themselves and the way they relate to others. In this area of study students explore the interplay of biological, psychological and social factors that shape the behaviour of individuals and groups. They consider how these factors can be used to explain the cause and dynamics of particular individual and group behaviours, including attitude formation, prejudice, discrimination, helping behaviour and bullying. Students examine the findings of classical and contemporary research as a way of theorising and explaining individual and group behaviour.										●	●
	AREA OF STUDY 3: **Student-directed practical investigation** In this area of study students design and conduct a practical investigation related to external influences on behaviour. The investigation requires the student to develop a question, plan a course of action to answer the question, undertake an investigation to collect the appropriate primary qualitative and/or quantitative data, organise and interpret the data and reach a conclusion in response to the question. The investigation relates to knowledge and skills developed in Areas of Study 1 and/or 2 and is undertaken by the student using either quantitative or qualitative methods, including experiments, surveys, questionnaires, observational studies and/or rating scales.	●										

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CHAPTER 01

SCIENTIFIC RESEARCH METHODS



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KEY SCIENCE SKILLS REQUIRED TO CONDUCT PSYCHOLOGICAL RESEARCH

Develop aims and questions, formulate hypotheses and make predictions:

- determine aims, research hypotheses, questions and predictions that can be tested
- identify and operationalise independent and dependent variables

Plan and undertake investigations:

- determine appropriate types of investigations: experiments (including use of control and experimental groups); case studies; observational studies; self-reports; questionnaires; interviews; rating scales; access secondary data, including data sourced through the internet that would otherwise be difficult to source as raw or primary data through fieldwork, a laboratory or a classroom
- use an appropriate experimental research design including independent groups, matched participants, repeated measures and cross-sectional studies
- select and use equipment, materials and procedures appropriate to the investigation
- minimise confounding and extraneous variables by considering type of sampling procedures, type of experiment, counterbalancing, single and double blind procedures, placebos, and standardised instructions and procedures
- select appropriate sampling procedures for selection and allocation of participants including random sampling, stratified sampling, convenience sampling and random allocation of participants to groups

Comply with safety and ethical guidelines:

- understand the role of ethics committees in approving research
- apply ethical principles when undertaking and reporting investigations, including consideration of the role of the experimenter, protection and security of participants' information, confidentiality, voluntary participation, withdrawal rights, informed consent procedures, use of deception in research, debriefing and use of animals in research
- apply relevant occupational health and safety guidelines while undertaking practical investigations

Conduct investigations to collect and record data:

- work independently and collaboratively as appropriate and within identified research constraints
- systematically generate, collect, record and summarise both qualitative and quantitative data

Analyse and evaluate data, methods and scientific models:

- process quantitative data using appropriate mathematical relationships and units
- organise, present and interpret data using tables, bar charts, line graphs, percentages, calculations of mean as a measure of central tendency and understanding of standard deviation as a measure of variation around the mean
- recognise the difference between statistics that describe a specific sample and the use of statistics to make inferences about the population from which the data were drawn
- use basic principles of reliability and validity in evaluating research investigations undertaken
- explain the merit of replicating procedures and the effects of sample sizes in obtaining reliable data
- evaluate investigative procedures and possible sources of bias, and suggest improvements, with reference to identification of potential extraneous and confounding variables including individual participant differences, non-standardised instructions and procedures, order effects, experimenter effect and placebo effects
- explain how models are used to organise and understand observed phenomena and concepts related to psychology, identifying limitations of the models
- distinguish between scientific and non-scientific ideas

Draw evidence-based conclusions:

- determine to what extent evidence from an investigation supports the purpose of the investigation, and make recommendations, as appropriate, for modifying or extending the investigation
- draw conclusions consistent with evidence and relevant to the question under investigation
- identify, describe and explain the limitations of conclusions, including identification of further evidence required
- critically evaluate various types of information related to psychology from journal articles, mass media and opinions presented in the public domain
- discuss the implications of research findings and proposals

Communicate and explain scientific ideas:

- use appropriate psychological terminology, representations and conventions for reporting research, including standard abbreviations, graphing conventions and the components of a scientific report with reference to inclusion of an abstract, an introduction and sections for method, results and discussion
- discuss relevant psychological information, ideas, concepts, theories and models and the connections between them
- identify and explain formal psychological terminology about investigations and concepts
- use clear, coherent and concise expression
- acknowledge sources of information and use standard scientific referencing conventions

Psychology Area of Study Key science skills points derived from *VCE Psychology Study Design 2016*, pp. 11–12; © The Victorian Curriculum and Assessment Authority (VCAA). Used with permission.

PSYCHOLOGY AND THE SCIENTIFIC METHOD

Students of VCE Psychology are required to apply the principles of scientific research to investigations of psychology. They should understand how to propose and investigate hypotheses, collect and analyse data and draw conclusions.

Most people agree that biology, chemistry and physics are all sciences. However, many people still write off psychology as 'just common sense'. Yet psychologists employ the same type of scientific method used in biology or chemistry experiments. In this chapter we look in detail at the many methods and conventions psychologists use when doing experimental research.

FROM COMMON SENSE TO CONTROLLED OBSERVATION

Scientific method consists of a series of systematic steps used by researchers to plan, conduct, interpret and report research. Seven steps are used in psychological research to test the truth of a proposition using careful measurement and controlled observation – these are outlined in Figure 1.1.

THE SEVEN STEPS OF PSYCHOLOGICAL RESEARCH

Step 1: Identify the research problem

Researchers must identify the area in which to conduct a study. This involves deciding on the population of research interest. For example, a researcher may be interested in the causes of eating disorders in adolescent females. The researcher must first conduct a literature search, which involves reading relevant research and literature. Research that has already been completed can provide secondary data that can be used as a baseline for later comparison with the proposed research. A literature search might show that factors such as low self-esteem and previous use of weight-control measures are related to future eating disorders in adolescent females. Next, a testable research question (an aim) needs to be developed. In this case it might be: 'Do factors such as self-esteem and laxative use predict the likelihood of eating disorders in adolescent females?'

Step 2: Formulate a hypothesis

A hypothesis is a testable prediction of the relationship between two variables (events or characteristics) that is developed before the research is conducted, and is written as a specific statement. A hypothesis is based on the information gathered in the literature search; it is not just a guess made without any prior knowledge or investigation. An example might be: 'It is predicted that adolescent girls with low self-esteem are at higher risk of suffering from an eating disorder than are adolescent girls with high self-esteem'.

Step 3: Design the method

When designing the method of testing the hypothesis, the researcher must determine the following:

- Who is the population of research interest?

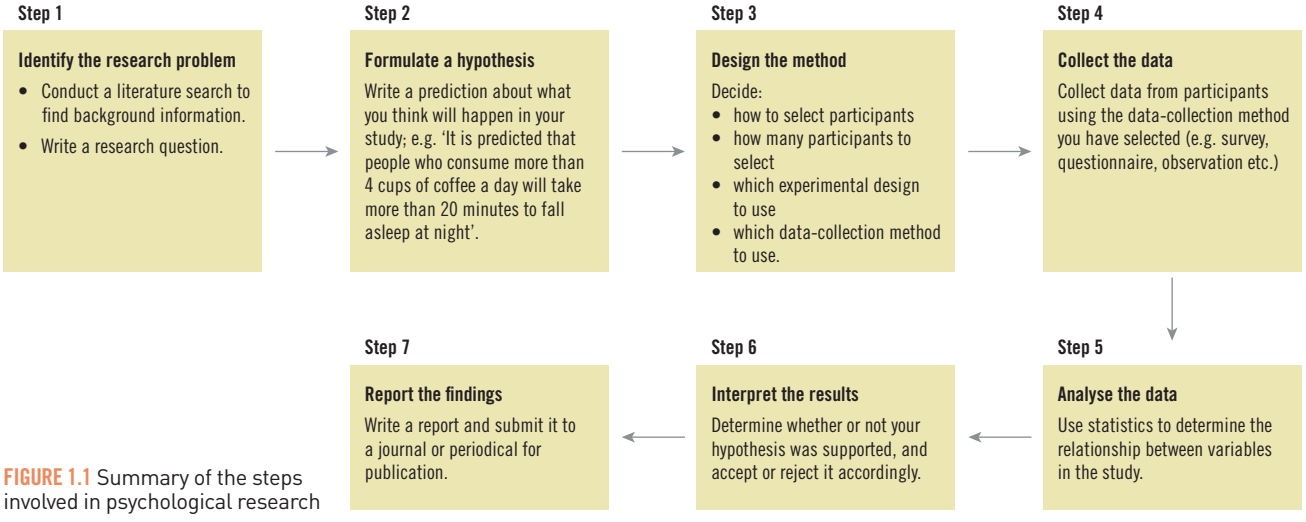


FIGURE 1.1 Summary of the steps involved in psychological research

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- Who will make up the sample; that is, which participants will be studied?
- How many participants will be involved?
- How will participants be selected from the nominated population?
- How will participants be allocated to various groups in the study?

After selecting the participants, the researcher must then choose the most appropriate research design (see page 11) and method of data collection. For example, for the eating disorders research, the researcher might give every female aged between 10 and 14 years attending any of three Melbourne secondary schools a survey about their eating behaviours, such as their use of laxatives or frequency of vomiting, and then measure each participant's height and weight. Two years later, they could test the girls again.

Alternatively, the researcher could use an experimental method to test the relationship between self-esteem and eating disorders. The participants from all three schools might be compiled into a list, then divided into two groups. One group might be given a training seminar on how to improve self-esteem, and the second group might watch a latest-release movie that has nothing to do with self-esteem. All participants could also be given surveys and interviews in which they rate their eating habits.

Step 4: Collect the data

Researchers can use a variety of data-collection techniques, including case studies, observation, questionnaires, rating scales, interviews, longitudinal and cross-sectional studies, and experiments. The data collected can be qualitative or quantitative. For the eating-disorders research, the researcher might choose to test the participants' level of self-esteem using the self-reporting method of a questionnaire, and might determine their eating behaviour using an interview.

Step 5: Analyse the data

Data analysis involves organising, summarising and representing the raw data in a coherent and logical manner. Large amounts of raw data are usually 'broken down' into a smaller set or sets of numbers using descriptive statistics to describe, summarise and organise the data in easily understood forms, such as tables, bar charts, line graphs and frequency polygons. Inferential statistics (see page 18) will be used to decide whether or not the results are significant.

Step 6: Interpret the results

Data need to be interpreted to determine whether or not the results support the hypothesis. A conclusion can then be drawn. This interpretation is based on inferential statistics. For example, if analysis of the data from the eating-disorder research clearly indicated that females who suffered from eating disorders had low self-esteem 2 years before the onset of an eating disorder, then the data might be interpreted as supporting the hypothesis proposed in step 2. The researcher could then conclude that female adolescents aged 10 to 14 years who have low self-esteem are more likely to suffer from an eating disorder in the future than adolescent girls who have a high self-esteem.

Step 7: Report the findings

Finally, the researcher prepares a report that is submitted to a journal or periodical and/or presented at a conference as a poster. Reports describe the background information used to formulate the hypothesis, provide information about the participants, describe the procedures and materials used, and provide data analysis and interpretation. Reports also outline problems or limitations encountered while conducting the study, and indicate how these may have affected the results. In addition, reports present the conclusions that are based on the study's findings, as well as a list of references used in planning the study and preparing the report.

1.1 CHECK YOUR UNDERSTANDING >>

1 What is an experiment?

2 Describe the difference between an aim and a hypothesis.

➜

scientific method A series of sequential, scientific steps used when planning, conducting, interpreting and reporting research

population The larger group of research interest from which a sample has been drawn

hypothesis A testable prediction about the relationship between two variables

variable Any condition (events or characteristics) that can change and that might affect an experiment's outcome

participants The people or animals used in an experiment

raw data The actual data from a study, collected and recorded in their original form

descriptive statistics Statistics used to describe, summarise and organise data; includes tables and graphs

conclusion A statement that makes a judgment about whether or not the results of a study support its hypothesis

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3 Summarise the seven steps of psychological research.
4 Name and describe four data collection techniques.
5 Match the step number and the description of the step.

Step 1	a Collecting the data
Step 2	b Reporting the findings in a journal
Step 3	c Interpreting the results and drawing conclusions
Step 4	d Identifying the topic of research interest
Step 5	e Analysing the results
Step 6	f Designing the experiment
Step 7	g Forming a hypothesis

THE EXPERIMENTAL METHOD

PROPOSING A HYPOTHESIS

The most powerful research tool is an experiment. The experimental method involves a formal trial to confirm or refute a prediction. The prediction is made about a research question; for example, 'What happens to driving ability when the driver is drinking alcohol?' The prediction is known as an experimental hypothesis and it is usually a broad, general prediction about the direction of the relationship between variables. A hypothesis must not be written as a question.

If you predicted that consumption of alcohol decreases driving ability, you are proposing an experimental hypothesis. This very general statement ignores what levels or types of alcohol are being referred to, or how 'driving ability' might be measured. A hypothesis, however, needs to be operationalised, or clearly stated in a way that can be measured; it needs to be a testable prediction of the relationship between two variables and must include the following:

- the population of research interest
- clearly defined independent and dependent variables
- how these variables will be measured
- a direction of their relationship.

An operational hypothesis does this because it is a statement that identifies the population, precisely defines the variables, and describes how the independent and dependent variables will be measured and the effect the independent variable is expected to have on the dependent variable. An example of an operational hypothesis is: 'It is predicted that Year 12 Psychology students who sleep fewer than 6 hours a night will be more likely to score high (more than 8) on Koerner's irritability scale than those who sleep more than 6 hours per night'.

Psychologists who wish to identify a possible cause-and-effect relationship choose the experimental method because it allows them to carefully control experimental conditions. For example, in a controlled experiment investigating the effects of caffeine on sleep, researchers can manipulate the strength and amount of coffee participants consume. Researchers can then test sleep quality in a sleep laboratory that enables them to control variables such as noise and light, so that these do not affect the results. The data from such an experiment give us clear information about cause-and-effect relationships between variables; in this case, sleep and caffeine.

The controlled laboratory setting also provides opportunities for detailed observation. In addition, researchers can manipulate variables without having to wait for a naturally occurring event.

VARIABLES

As stated earlier, a hypothesis predicts the relationship between two variables, but there are three types of variables in an experiment.

Independent variables

An independent variable (IV) is a condition an experimenter systematically *manipulates* in order to gauge its effect on another variable. As a result, the IV is said to cause a change in another variable – the dependent variable (DV). For example, a researcher examining the effects of a new treatment therapy for schizophrenia might divide a sample into two groups. One group would be given the treatment (IV) and the other group would not. The effects of the treatment would then be measured (DV).

Dependent variables

A dependent variable (DV) is the condition in an experiment that is affected by the IV, and it is used as a measure of the IV's effect. A DV 'depends' on another variable – the IV – as to how much it changes. It is the variable that is *measured* by the experimenter. These effects are often revealed by measures of performance, such as test scores. Consider, for example, testing the effectiveness of a new memory drug. The experimenter will manipulate whether a subject receives the memory drug or a sugar pill. Receiving a drug or sugar pill is therefore the IV. The experimenter will *measure*

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the number of words remembered. This result is therefore the DV.

Extraneous variables

An extraneous variable (EV) is any randomly occurring variable other than the IV that might cause changes in the DV. Extraneous variables may include differences between research participants (individual participant variables), such as memory, motivation or personality. They can also include differences in how the experimenter treats the participants (experimenter effects), or how the participants react to the experimental environment (situational variables).

Extraneous variables may be present without the researcher knowing, and they may not be identified (if at all) until after the experiment is complete. If many EVs are present in a study, a conclusion, that the manipulation of the IV has or has not affected the DV, may be inaccurate, and therefore invalid.

A confounding variable (CV) is a type of extraneous variable that unexpectedly causes changes to the DV. For example, if a study divided students into groups of males and females, sex may confound the results and make conclusions inaccurate and possibly invalid. It confounds the experiment as the experimenter will not know whether the change in the DV was due to the IV or the unexpected CV.

The effect of extraneous variables must be kept to a minimum. Careful design of the experiment and anticipation of variables that may have an effect are important. If the experiment is repeated or administered by several researchers, it is also important that they use the same procedure. Having standardised instructions ensures the experiment is run in the same way by each researcher.

LIMITATIONS OF THE EXPERIMENTAL METHOD

Although experiments are a way of establishing a cause-and-effect relationship between two variables, they may be artificial because they are not naturally occurring. If a researcher wanted to examine the effects of a new drug on sleep patterns, participants would be required to sleep overnight in a sleep laboratory so that their sleep patterns might be monitored. However, some people do not sleep 'normally' out of their own beds, so the results of such a study may be affected by the sleep laboratory's unfamiliarity. Participants may also behave differently if they know their behaviour is being observed. For example, a child who is being asked to play with toys may play more noisily if there are adults in the room watching.

How participants are selected and the way they are allocated to different groups in the study is very important.

The placebo effect

If a participant believes they are being given a drug to improve sleep quality, they may report an improvement in their sleep quality. This is an example of the *placebo effect*, which refers to a change in a participant's behaviour because they believe they have been exposed to a treatment that will affect them in some way. It is overcome by the use of a placebo, which is a fake treatment that has no active effect. For example, a placebo could be a pill that looks identical to the pill containing a drug, but that does not contain the active ingredient. In a well-designed experiment, participants do not know if they are being given the real drug or a placebo. This is called a single blind experiment – the researcher knows who is getting the real drug, but the participants do not.

Sometimes, researchers may unwittingly be biased in their treatment of the experimental group. If this is possible, a double blind procedure is used. In this kind of experiment, neither the participants nor the researcher is aware of which participants are receiving the real drug and which are receiving a placebo.

1.2 CHECK YOUR UNDERSTANDING >>

1 In the following examples, identify the independent variables (IVs) and dependent variables (DVs).
   a Is there a relationship between exposure to television at ages 0–4 years and the level of social interaction the child has in primary school?

➜

experimental method A method whereby a formal trial is undertaken to confirm or reject a hypothesis

experimental hypothesis A broad and general prediction, based on prior knowledge, about the direction of the relationship between variables in an experiment

operational hypothesis A precisely defined and described prediction about what will happen when an independent variable is manipulated and the effect it is expected to have on the dependent variable

independent variable The variable manipulated by the experimenter

dependent variable The variable that is measured in an experiment. It is dependent on the independent variable, as indicated by the results of the experiment

extraneous variable Any variable, other than the IV, that might change the DV in an unwanted way

confounding variable Any variable, other than the IV, that does change the DV in an unwanted way, making it impossible to determine the cause of the change in the DV

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b Does a sufferer of post-traumatic stress disorder have a different level of resilience if their episodes of anxiety are more frequent?

c A study investigating the relationship between the level of daily vitamin C intake and the incidence of breast cancer in women

d The relationship between the frequency of headaches experienced and the volume of music listened to in the car

2 Is it possible to have more than one independent variable in a study? Explain using an example.

3 Professor Thurston completed a study that involved testing students' reading abilities. He divided the sample into two groups. Group 1 learned a new reading technique designed to improve comprehension and increase reading speed. Group 2 was not taught any new technique. Members of each group were given a passage of writing and asked to answer a number of questions and the students' responses were also timed.

Which one of the following was the independent variable?

A How long the students took to comprehend the passage of writing

B The students' responses to the questions about the passage

C The new reading technique versus no new technique

D The passage of writing

4 In question 3 above, what was the dependent variable?

A How long the students took to comprehend the passage of writing

B The students' responses to the questions about the passage

C The new reading technique

D Both A and B are correct.

5 Describe the difference between an extraneous and a confounding variable.

1.1 TRY IT YOURSELF >>

WRITING AN OPERATIONAL HYPOTHESIS

In order to transform an experimental hypothesis into an operational hypothesis, we need to complete the following steps.

STEPS

1 Write an experimental hypothesis (a broad, general statement about how one variable will affect another variable), including the population of research interest.

2 Identify all the variables in the experimental hypothesis.

3 Describe how each variable will be measured in the study.

4 Replace the variables in step 2 with the variables in step 1 so as to form the operational hypothesis.

It may help to model your work on the following example.

SAMPLE HYPOTHESIS

1 It is predicted that consumption of alcohol in P-plate drivers will decrease driving ability.

2 Variables: alcohol consumption and driving ability.

3 Alcohol consumption = five standard alcoholic drinks in 1 hour

Driving ability = number of errors made on a driving simulator

4 It is predicted that the consumption of five standard alcoholic drinks in one hour will decrease the driving ability of P-plate drivers, as measured by the number of errors on a driving simulator.

CHOOSING PARTICIPANTS

A population is the entire group of people or animals belonging to a particular category, such as 'all university students' or 'all Siamese cats'. In experimental terms, it is the larger group of research interest from which a sample is drawn. In this context, the term 'population' is not the number of people living in a particular area, but a group of people with similar characteristics that the researcher is interested in. For example, if you were to conduct a study investigating Victorian Year 12 students' favourite subjects, the population would be 'all Victorian students who are enrolled in VCE'. The sample would then be taken from this population.

Population can also refer to measurement of any characteristic or observable event. For example, a population could be the IQs of all students in a particular school or all the deaths related to eating disorders from 2010 to 2015.

The process of choosing participants is called participant selection or sampling, and participants are collectively referred to as a sample. A sample is a smaller group of participants selected from, and representative of, the characteristics of the larger population of research interest.

Ideally, researchers would like to investigate all members of the population, but this is often impossible because usually there are thousands, if not millions, of people in a particular population. It would take too long and be too expensive to test every population member. A sample, therefore, is always a smaller subsection of a population (see Figure 1.2). A sample must be representative of a population (known as representative sampling) if a researcher wishes to make inferences about the population. This requires correct sampling procedures.

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FIGURE 1.2 A sample is a subset of participants selected from the population of interest.



FIGURE 1.3 Putting the names of each member of the population into a hat and then extracting a set number of participants is an example of random sampling.

SAMPLING PROCEDURES

Random sampling

Random sampling ensures that every member of a population has an equal chance of being selected as a participant in a study. Random sampling therefore increases the likelihood of the sample being a representative sample of the population. In turn this improves the chances of the researcher making accurate inferences about the population based on the results gained from the sample. Two common methods of random sampling are:

- putting the names of each member of the population into a hat and extracting a set number of participants for the sample (see Figure 1.3)
- generating a list of numbers (for example, student-identification numbers) that are in no specific order and choosing every fifth, tenth or hundredth number (and hence participant) to be part of the sample.

However, random sampling may not be appropriate for all research. For example, if you wanted to investigate the effectiveness of a new cognitive therapy for anorexia nervosa (an eating disorder), you would need to select only participants suffering from anorexia nervosa. Sometimes, some of the people that are selected to participate are unwilling to participate in experiments, new therapies or research, so the sample becomes biased. A sample can also be biased if it includes only willing participants who, for example, respond to a Facebook post, since they are not representative of the whole population as not all members of the population are on Facebook. Furthermore, a sample is sometimes difficult to obtain for a particular population because the members of the population are not available to participate in the research.

Stratified sampling

Stratified sampling may be used in research that requires the sample to contain the same proportions of participants as found in the population. This sampling procedure involves identifying a variable (such as age, gender or income) that may impact on the study. The population is then divided into distinct groups (or strata) based on the nominated variable. For example, people are divided into three age groups: under 20, 21 to 40 and over 41. Each group is then sampled in the same proportion as they occur in the target population. Often participants are selected randomly within each stratum (group) to ensure each member of the group has an equal chance of being selected for the sample. This is known as random stratified sampling. The stratified sampling procedure is most commonly used when psychological characteristics or attitudes vary greatly among subgroups of the target population.

Imagine that you wanted to investigate the favourite foods of Australians because you believed that someone's favourite food would depend on numerous

population The larger group of research interest from which a sample has been drawn

sampling The process of selecting participants for a study of the population

sample A group of participants selected from a population of research interest

random sampling A sampling technique ensuring that every member of a population has an equal chance of being selected to participate in the study

representative sample A small, randomly selected group that accurately reflects the characteristics of a larger population from which it is drawn

stratified sampling This sampling technique ensures that the sample group contains the same proportions as found in the population

random stratified sampling Participants are selected randomly within each stratum (group) to ensure each member of the group has an equal chance of being selected for the sample

characteristics such as age, ethnic background and religion. Let's say that you predict that the characteristic likely to have the biggest impact on the results is ethnic background. You establish the proportions of the target population in terms of ethnic background are 53 per cent Anglo-Saxon, 21 per cent Italian, 10 per cent Greek, 5 per cent Chinese, 5 per cent Mexican, 4 per cent German and 2 per cent Cuban. Your sample needs to contain 100 participants. Within the Anglo-Saxon ethnic group you randomly select 53 participants, then randomly select 21 participants of the Italian group, 10 participants of the Greek group, 5 participants of the Chinese group and so on. At the end of the sampling procedure there are the same proportions of participants from different ethnic backgrounds in the sample as there are in the target population.

Congratulations! You have created a stratified sample.

Convenience sampling

Convenience sampling (also known as opportunity sampling) chooses participants because they are readily available to the researcher. For example, participants are close by and easily accessed by the researcher. In other words, they are convenient.

Convenience samples are used when researchers want an inexpensive approximation of the truth that will assist them to generate their hypothesis. They may also be working under time constraints or they may be unable to access the nominated population. Before conducting the actual research experiment, researchers may conduct a pilot study using a convenience sample so they can identify any uncontrolled extraneous variables or weaknesses in method, and obtain a general estimate of the results.

Results from research using a convenience sample can be legitimately used provided the limitations are stated. Although this is a quick and inexpensive way for a researcher to select a sample, the sample many not be representative of the population: some groups may be overrepresented while others are underrepresented. If the sample includes volunteers, it may also be biased. For these reasons, results of a convenience sample cannot be generalised.

ALLOCATING PARTICIPANTS TO GROUPS

Following selection, participants are allocated to groups within the experiment. As with sampling, the allocation must be done in a systematic and carefully planned manner to ensure that participants' individual personality characteristics are evenly distributed among the groups. A psychological experiment usually places participants into one of two groups: the experimental group or the control group. When allocating participants to these groups, each participant must have an equal chance of being allocated to either the experimental group or the control group.

Experimental and control groups

The experimental group is the group exposed to a treatment; that is, where the independent variable under investigation is present. For example, in a study to test the effectiveness of music on learning, the experimental group would complete a learning task while listening to music.

The control group is the group exposed to the control condition; that is, where the independent variable under investigation is absent. For the previous example, the control group would be given the same learning task to complete in silence. The control group provides a standard that the performance of the experimental group can be compared with in order to determine whether the treatment (the independent variable) has had an effect on the experimental group's behaviour (the dependent variable). The two groups' scores on the learning test would then be compared. Without a control group it would be impossible to tell whether music had any effect on learning. If the average test score of the experimental group were higher than the average test score of the control group, we would conclude that music improves learning. If the experimental group's average

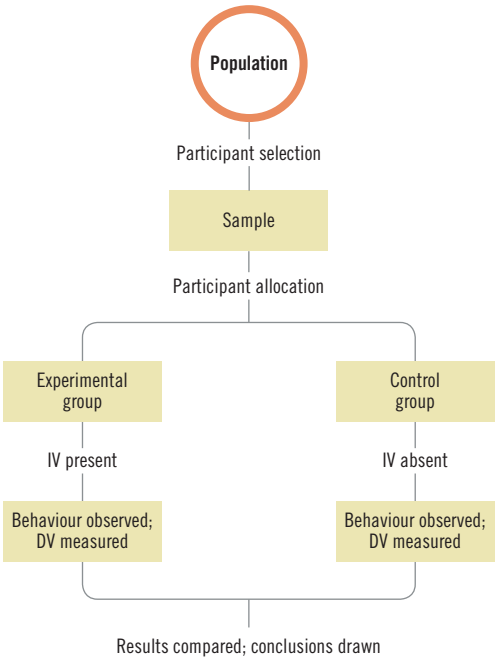


FIGURE 1.4 A summary of an experiment using allocated participants

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were lower than the control group's average, we would conclude that music slows learning. If there were no difference, we would conclude that music has no effect on learning. (See Figure 1.4.)

1.3 CHECK YOUR UNDERSTANDING >>

1 Use an example to explain the difference between an experimental group and a control group.

2 Dr Anderson wanted to investigate the effects of caffeine on concentration. Which of the following would be the best population for this study?
   - A All students under the age of 25
   - B All adults between the ages of 18 and 50 years who consume caffeine on a regular basis
   - C All children living in Melbourne
   - D Everyone living in Australia

3 Which of the following would be the best sample for the study described above?
   - A Forty female students attending the local high school
   - B Five university students sitting on the tram
   - C One hundred adults who consume caffeine on a regular basis
   - D Twenty-five children who have trouble concentrating

4 One advantage of stratified sampling over random sampling is:
   - A The sample is more representative of the population, when there is a diverse population.
   - B The sample is less biased.
   - C Stratified sampling is much quicker and easier to complete.
   - D Stratified sampling uses fewer participants.

EXPERIMENTAL RESEARCH DESIGNS

When participants are randomly allocated to separate groups (experimental and control), the researcher is using a particular experimental research design known as *independent groups*. Each participant belongs to one group only and is not exposed to the other condition. For example, participants are either given a drug that causes nausea when the participant smokes, or they are given a placebo, such as a sugar pill. There are two other research designs that are used in different circumstances.

Matched participants

A matched participants design is used when the researcher believes that a particular extraneous variable related to the participants may confound the experiment. For example, when studying memory, the age of the participant may be considered important because memory ability declines with age. The researcher matches a participant of a particular age in the experimental group with a participant of the same age in the control group. This eliminates the potential confounding variable; in this case, age. The matching of participants takes time, which costs money, so this research design is only used when necessary.

Repeated measures

A repeated measures design is used when the researcher believes that individual participant differences must be controlled. The participants are exposed to the experimental condition and the control condition, so they are used by the researcher twice. For example, a researcher may wish to test the effect of caffeine on concentration. In week one, participants are given a measured dose of caffeine and their concentration is then tested using a problem-solving task. In week two, participants are not given caffeine and their concentration is tested again. Using this research design could cause a better result in week two regardless of the caffeine: participants may score better because they have practised the task in week one, or participants may show boredom or fatigue if they are used repeatedly. These effects are called *order effects*. They can be overcome by dividing the sample into two groups. Both groups complete both weeks, but in different orders: group one completes the caffeine week first, then the no-caffeine week. Group two completes the no-caffeine week first, then the caffeine week. This is called counterbalancing.

NON-EXPERIMENTAL DATA-COLLECTING TECHNIQUES

When a researcher investigates behaviour, they generate data (often referred to as empirical evidence – the information gained from direct observation and measurement), which are used to support research findings or to formulate predictions about future studies. Data come in a number of different types – including qualitative and quantitative data – and examples range from people's attitudes about animal experimentation to the results on an intelligence test.

convenience sampling Participants are selected because they are readily available to the researcher

experimental group In a controlled experiment, the group of participants exposed to the independent variable (IV) or experimental condition

control group In a controlled experiment, the group of participants exposed to all conditions or variables except the independent variable (or treatment)

counterbalancing Used to control order effects in a repeated measures experiment by exposing participants to different orders of treatment conditions

QUALITATIVE VERSUS QUANTITATIVE DATA

Qualitative data are data that describe in detail any changes in behaviour. These types of data cannot be graphed or statistically analysed because they include information that cannot be counted or measured, such as why a participant has answered yes or no to a question. They are often in word form (written or verbal). Qualitative data are open to personal, observer or researcher biases because researchers may choose what pieces of information to record and report. An example of qualitative data is participants' descriptions of their childhood. Each participant would describe to the researcher the events that they could recall. The researcher would record the accounts, then create a report that summarises them.

Quantitative data are data collected through systematic and controlled procedures. These data can be quantified using numbers, and they can be statistically analysed. For example, if a researcher wants to investigate the levels of depression in a sample of women who have just given birth, the researcher could give the participants a depression questionnaire. Each participant's score would range from 0 (not depressed at all) to 15 (very depressed). The mean of depression scores of the sample can then be calculated and compared with that of women of another sample.

DESCRIPTIVE RESEARCH

Case studies (clinical method)

Many experiments that might provide important research findings are impractical, unethical or impossible to perform. An example is where a researcher wished to investigate the level of suicidal behaviour in mental-health patients before suicide. In such instances, information may be gained from a case study, which is an in-depth focus on all aspects of a single participant. Case studies can sometimes arise in the form of natural clinical tests after accidents occur, because they provide much information about the human brain that could not be obtained by other means. Case studies provide valuable insights into behaviour, but this method of data gathering has its limitations.

LIMITATIONS OF CASE STUDIES

Case studies are uncontrolled studies and psychologists generally prefer controlled experiments. This is why they often use laboratory animals for studies of the brain. Case studies also lack formal control groups; this limits the conclusions that can be drawn from clinical observations. It is also difficult to generalise from one individual's behaviour to a whole population, particularly when case studies are often the study of someone who is unique or different in some way.

Naturalistic observation

Psychologists may choose to gather data via the method of naturalistic observation where they actively observe a person or animal's behaviour in their natural setting.

An example of a naturalistic study is one conducted by Boyatzis, Mallis and Leon (1999) who investigated whether boys chose boys more often than girls when playing competitive games. Children were observed playing two games at recess at school, one a competitive game called Red Rover, and one a less competitive game called Duck Duck Goose. The gender of the child who was deemed 'it' was compared with the gender of the child whom they chose to chase. Two independent observers sat away from the game, observing the results in an unobtrusive manner. Boys clearly chose boys more often to chase, especially in the competitive game. The results from this study support previous research that suggests that children prefer to have same-sex friendships during preadolescent years.

LIMITATIONS OF NATURALISTIC OBSERVATION

As this study illustrates, naturalistic observation provides useful descriptions of behaviour that has not been tampered with by outside influences; however, it does have limitations because to explain these observations, we may need information from other research methods.

Another limitation of naturalistic observation is the observer effect – changes in a participant's behaviour caused by an awareness of being observed. For example, if a researcher was interested in the differences between aggressive and non-aggressive schoolchildren, they could not simply stroll onto a playground and start taking notes. As a stranger, their presence would probably change students' behaviour. When possible, the observer effect is minimised by hiding the observer.

Observer bias is another limitation of naturalistic observation. Observer bias occurs when the observer sees what they expect to see, or records only selected details; that is, such bias occurs when an observer's expectations, past experience and motives or other personal factors interfere with the accuracy of their observations. For example, teachers in one study were told to watch a group of primary-school children (all of average intelligence), each of whom had been

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previously labelled as 'learning disabled', 'mentally retarded', 'emotionally disturbed' or 'normal'. The results showed that, depending on the way students had been labelled, the teachers treated them differently (Foster & Ysseldyke, 1976).

1.4 CHECK YOUR UNDERSTANDING >>

1 For each of the following examples, indicate the type of data that might be obtained, whether qualitative or quantitative.
   - a An AFL player's description of his performance in the grand final
   - b The Year 11 VCE Psychology results for the end-of-year exam
   - c An intelligence score obtained by a woman on the performance subscale of the Wechsler Adult Intelligence Scale
   - d A witness description of the man who robbed the local petrol station
   - e A person's interpretation of a painting in an art gallery
   - f A gymnast's score out of 10 for her individual floor performance

2 Mrs King wants to test whether a particular video game improves the pronunciation of words in Grade 3 children. She intends to test the children several times over a semester. Which experimental design should she use? Explain your choice.

3 List two limitations of using a case study.

4 What type of data collection can be influenced by the observer effect?

5 A limitation of naturalistic studies is:
   - A Only quantitative data, which are impossible to analyse, are obtained.
   - B Only qualitative data, which are impossible to analyse, are obtained.
   - C The interpretation of the participant's behaviour can be biased, based on the observer's personal characteristics.
   - D There are no limitations of naturalistic observation.

SELF-REPORT METHODS

Often researchers use self-reports to collect data when investigating attitudes, thoughts, feelings or behaviours. A self-report method involves asking participants about what they are thinking or feeling by posing questions or statements. The questions or statements may be presented verbally or in written form, and the answers supplied by the participants are called self-reports. Self-report methods include questionnaires, interviews and rating scales.

Questionnaires

A questionnaire is a written set of standardised questions that can be administered face to face, by mail, by telephone or via the Internet. For example, market researchers give shoppers questionnaires in shopping centres in order to determine buying behaviour. This allows researchers to collect both qualitative and quantitative information about people's attitudes, beliefs and behaviours by asking them to report specific information about themselves. However, questionnaires have a number of limitations. Questionnaires often need to be administered by a trained professional, they provide limited information because the participants cannot provide detailed answers (as with open-ended or survey questions), and the wording effect can also occur. The wording effect is where participants are influenced to choose a particular answer because of the wording of the question.

Interviews

An interview is a conversation between a participant and an interviewer to collect relevant data for research. One advantage of an interview is that it can be interactive and not necessarily standardised, as with a questionnaire. An interviewer may be able to change the questions or the order of questions to suit what is being discussed by a participant and to suit the research. Another advantage is that participants often gain a rapport with the interviewer; this can allow a trusting environment where a participant can discuss sensitive or difficult information in a supportive environment. Furthermore, both qualitative and quantitative information can be obtained. Interviews have limited effect if the interviewer has not developed good interview skills and has not created a trusting, supportive environment for the participant. Also, the

qualitative data Data that describe the changes in the quality of a behaviour; often written in words

quantitative data Data collected through systematic and controlled methodology; numerical in form

case study An in-depth focus on all aspects of a single person

naturalistic observation Observing an animal or person in their natural environment

observer effect Changes in behaviour caused by an awareness of being observed

observer bias A form of bias that occurs when an observer's expectations, past experience and motives or other personal factors interfere with the accuracy of their observations

self-report method A method asking participants to report what they are thinking or feeling

questionnaire A written set of standardised questions about an individual's attitude, beliefs and/or behaviours; can be administered face to face, by mail, by telephone or by way of the Internet

wording effect The effect that question phrasing and order have on how people answer surveys

interview A meeting between a participant and an interviewer to collect data for research

interviewer may subjectively interpret the participant's answers to the questions. This means that the interviewer may use personal attributes or beliefs to interpret the participant's responses.

Rating scales

If the data gathered are to be useful, they have to be measured and this can be done using a variety of rating scales, including nominal, ordinal, interval and ratio scales.

A nominal scale, which involves putting data into categories or groups, is the simplest measurement scale. Nominal scales classify information by name and they cannot be ranked in order (see Figure 1.5). For example, a researcher who investigates eye colour in a sample of students may classify the data into the following groups, and then assign each group a number for the purposes of encoding and analysing the data:

- green eyes
- blue eyes
- hazel eyes
- brown eyes.



FIGURE 1.5 Eye colour is an example of a nominal scale of measurement because it is categorical data that cannot be ranked.

An ordinal scale organises data into ranked or ordered categories. The Australian Football League (AFL) ladder is a good example as each club is a distinct category and the clubs are ranked in order, from highest to lowest, by their performance in any given season. An important feature of ordinal scales is that the steps (or increments) between categories are not constant, and may not even be known. For example, the AFL team on top of the ladder has obviously played better than the team on the bottom of the ladder, but we do not know by how much.



FIGURE 1.6 The AFL ladder is a good example of an ordinal scale because it ranks football teams based on their performance.

In an interval scale, the data are categorised and ranked, and the categories are evenly spaced but there is no absolute zero. This means that when a measurement reaches zero, it goes into negative numbers rather than stopping. For example, temperature does not stop at zero degrees, but goes into negative degrees.

A ratio scale is one in which data are categorised into groups and ranked with even intervals (see Figure 1.7). A ratio scale has an absolute zero, meaning that two or more sets of data measured by the same ratio scale can be compared with one another. For example, someone who weighs 100 kilograms weighs twice as much as someone who weighs 50 kilograms.

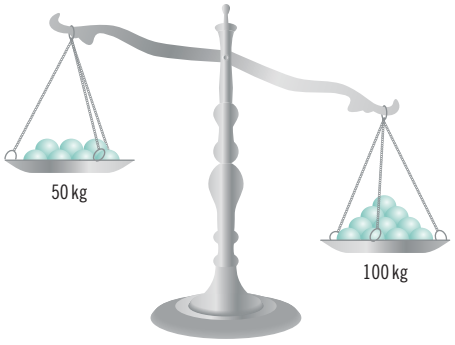


FIGURE 1.7 Weight is an example of data that are measured on a ratio scale — 100 kilograms is twice as heavy as 50 kilograms.

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Table 1.1 summarises the differences among the four scales described here.

TABLE 1.1 Summary of the differences among nominal, ordinal, interval and ratio scales

SCALE	CHARACTERISTICS	EXAMPLES
Nominal	Data are categorised.	Eye colour, hair colour, days of the week
Ordinal	Data are categorised. Data are ranked, but not with even intervals.	Team ladders, ATAR scores Attitudes measured by questionnaires
Interval	Data are categorised. Data are ranked, with even intervals. There is no absolute zero. Data cannot be compared with one another.	Temperature
Ratio	Data are categorised. Data are ranked with even intervals. There is an absolute zero. Data measured by the same ratio scale can be compared with one another.	Weight, height, volume, distance, time

1.5 CHECK YOUR UNDERSTANDING >>

1 Indicate the scale of measurement that would be most appropriate in the following examples.
   - a The 'top-ten' songs played in Australia this year
   - b The times taken to run the 100-metre sprint in the Olympic Games
   - c The scores of your Year 11 class on an IQ test
   - d The preferred university courses of Year 12
   - e The colour of cars sold at a Holden dealership
   - f The minimum temperature of 10 countries around the world

2 Create a summary of the four types of rating scales.

3 Use an example to explain the wording effect.

4 What is an example of a self-report method?
   - A A questionnaire
   - B An interview
   - C A rating scale
   - D All of the above

STANDARDISED VERSUS NON-STANDARDISED TESTS

Some tests and questionnaires are designed to compare participant performance or results. In order to make a comparison that is valid and reliable, these tests must be given in the same way to each person so that any differences can be attributed to the individual and not to extraneous variables such as testing procedures.

Some tests, such as intelligence tests, have specifically written manuals, describing how to conduct, score and interpret the tests. These often describe the exact wording the researcher must use to administer the tests. If the procedures are not followed, then results of standardised tests may not be valid or reliable (see page 19).

Non-standardised tests include more flexible tests and interviews that do not have a set of instructions and administrative procedures. These tests allow for more flexibility and the researcher may change the order or the questions to suit the situation. A disadvantage is that often the results from one participant cannot be directly compared with other participants' results, and the reliability and validity of the results may be compromised.

LONGITUDINAL AND CROSS-SECTIONAL STUDIES

A longitudinal study is a study that involves repeated observations of the same participants over a period of time such as several days, weeks, years or even decades. This type of study is often used in psychology to study developmental trends across the lifespan.

rating scale A list of questions that are generally fixed-response statements about different aspects of an attitude

nominal scale The simplest measurement scale, which involves putting data into categories or groups

ordinal scale A measurement scale where data are organised into ranked or ordered groups or categories

interval scale A measurement scale in which data are categorised and ranked; categories are evenly spaced, with no absolute zero

ratio scale A measurement scale in which data are categorised into groups and ranked with even intervals; has an absolute zero

standardised test An exact test with known reliability and validity that follows a specific set of instructions to administer, score and interpret

non-standardised test A flexible test that allows researchers to change questions depending on participants' responses

longitudinal study A study that collects data over two or more periods in time, using the same participants

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The advantage of a longitudinal study is that it follows the same participants over time, and therefore the differences observed in the participants' behaviours or important characteristics are less likely to be the result of cultural differences across generations or any other factors besides the independent variable. Put simply, the participant extraneous variables are reduced because the same participants are used in each condition.

A cross-sectional study is a study that observes participants in a setting at one point in time. Much psychological research uses the cross-sectional design because it is a lot simpler examining the effect of an independent variable on the results once than doing it repeatedly over time. Also, large amounts of data can be gathered at a relatively low cost to the researcher.

1.6 CHECK YOUR UNDERSTANDING >>

1 a Compare standardised and non-standardised tests. Include an example of each test.
  b What kind of variables affect standardised tests?
2 Compare longitudinal and cross-sectional studies.
3 *Growing up in Australia: The longitudinal study of Australian children* is a study that is being funded by the Department of Family and Community Services. What information would the government get out of this study?
4 Which of the following is an example of a cross-sectional study?
  A A survey of members of the Collingwood football club before and after the grand final
  B A survey of the number of students vaccinated for polio in Victoria in 2014
  C A survey of the number of graduates with full-time employment in January 2015, 2016 and 2017
  D A weekly survey of hours spent watching TV, given to 100 Melbourne residents for one year

DESCRIPTIVE STATISTICS

Once an experiment has been conducted, three things are usually done to the results. First, they are summarised, organised and described using descriptive statistics. Second, the results are interpreted and understood using inferential statistics. Third, the results are explained in terms of the theory behind the prediction.

CALCULATING PERCENTAGES

One of the easiest and most common ways of describing and comparing data is to calculate the percentage of a characteristic. Percentages allow researchers to compare one set of data with another with a common variable – percentage. A percentage is the amount of something out of 100. One hundred per cent is the highest percentage that is possible. For example, phobias have a prevalence of approximately 10 per cent in the community. This means that approximately 10 in 100 or 1 in 10 people suffer from a clinically diagnosable phobia at some point in their lives.

VISUAL REPRESENTATION OF DATA

Tables and frequency distributions

Often large amounts of data are collected in research. On their own, 'raw data' are quite meaningless because they are disorganised and difficult to understand. However, by using a table or frequency distribution, large amounts of information can be neatly organised and summarised. A frequency distribution is made by breaking down the entire range of possible scores into classes of equal size. Next, the number of scores falling into each class is recorded. In Table 1.3, the raw data from Table 1.2 have been condensed into a frequency distribution. Notice how much clearer the pattern of scores for the entire group becomes.

TABLE 1.2 Raw scores of Smith and West's anxiety scores

12	10	27	36	2	34	15
14	4	3	26	45	25	33
19	7	21	22	20	29	3
4	6	14	19	20	34	26

TABLE 1.3 Frequency distribution of Smith and West's anxiety scores

0–5	5
6–10	3
11–15	4
16–20	4
21–25	3
26–30	4
31–35	3
36–40	1
41–45	1

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Bar graphs

A bar graph shows how frequently a particular group or category of data occurs by representing the data using separate bars that are next to, but not touching, one another. On the horizontal (x) axis, the types of categories or groups of data are plotted. The vertical (y) axis indicates the frequency with which each of the categories occurs. If a researcher investigating the weight-loss methods used by adolescent girls suffering from anorexia nervosa interviewed 100 adolescent girls aged between 10 and 14 years, they might categorise the weight-loss methods mentioned by the participants into the following groups: 'exercise', 'diet pills', 'laxatives', 'fasting' and 'dieting'. Then they would graph the frequency of these five behaviours in a bar graph (see Figure 1.8).

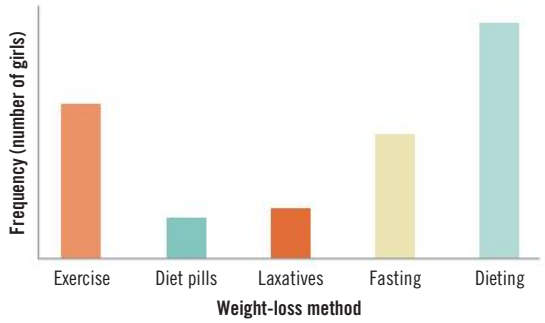


FIGURE 1.8 A bar graph showing the frequency of weight-loss methods used by adolescent girls aged between 10 and 14 years

Line graphs

In a line graph, a line is created connecting each data point on a graph so the change from point to point can be seen, as well as an overall trend. Line graphs are the most useful when graphing data that change continuously over time, such as interval and ratio scales of measurement. On the horizontal (x) axis, the continuous IV is plotted, and the vertical (y) axis indicates the frequency with which the IV occurs. For example, a clinical psychologist interested in measuring the frequency of computer use by an adolescent would graph the frequency of computer use on the y-axis and the time frame of 7 days on the x-axis (see Figure 1.9).

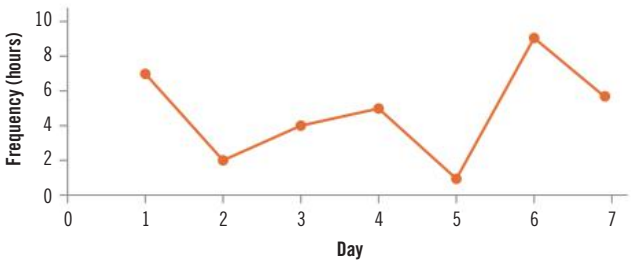


FIGURE 1.9 A line graph showing the frequency of computer use by an adolescent over a 7-day period

1.7 CHECK YOUR UNDERSTANDING >>

1 a What type of graph would you use if you wanted to measure the amount of weight lost over 8 weeks?
  b What is the dependent variable in this study?

2 Chrystal studied for her Maths test. She received a raw score of 46 out of a possible 50 marks. What is the percentage on her test?
  A 46 per cent
  B 50 per cent
  C 86 per cent
  D 92 per cent

3 Which graph is most likely to be used for continuous data?
  A A bar graph
  B A line graph
  C Continuous data cannot be graphed.
  D Both A and B are correct.

4 What is usually plotted on the vertical axis of a line graph?
  A Frequency
  B Continuous data
  C Non-continuous data
  D None of the above

5 Why is raw data considered meaningless?

MEASURES OF CENTRAL TENDENCY

A measure of central tendency is simply a number describing a 'typical score' around which other scores fall; that is, the tendency for a majority of scores to fall in the mid-range of possible values. The mean, median and mode are the most common measures of central tendency.

cross-sectional study A study performed at one set period in time

bar graph A graph that shows how frequently a particular group or category of data occurs by representing the data using bars that do not touch

line graph A graph that represents the relationship between two variables by a line that connects each data point so the change from point to point, and the overall trend, can be seen

measure of central tendency A type of descriptive statistic that displays the typical or average value of a set of scores usually in the form of the mean, median or mode

central tendency The tendency for a majority of scores to fall in the mid-range of possible values

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The mean

The mean refers to the 'average' score in a set of data and it is calculated by adding all the scores for a given group, then dividing the total by the number of scores in the group. The mean is represented by the mathematical notation of $\bar{x}$. As you can see in Table 1.4, the group means reveal a difference between the two groups.

It can also be valuable to measure how spread out the data are. The standard deviation quantifies how much data are spread around the mean. For example, the mean height of horses is 14.2 hands or 144 centimetres. How much a particular horse varies from this mean can be calculated as one or more standard deviations from this height. A low standard deviation indicates the data are close to the mean. A high standard deviation means that the data are spread out over a greater range of values.

TABLE 1.4 Raw scores on a memory test for participants taking Rememberine or a placebo

PARTICIPANT	GROUP 1 (REMEMBERINE)	GROUP 2 (PLACEBO)
1	65	54
2	67	60
3	73	63
4	65	33
5	58	56
6	55	60
7	70	60
8	69	31
9	60	62
10	68	61
Sum of participants	650	540
Mean	65	54
Median	66	60

The median

As the mean is sensitive to very high or very low scores in a distribution, it is not always the best measure of central tendency. In such cases, the middle score in a group of scores – the median – is used instead. The median is found by arranging scores from the highest to the lowest and selecting the score that falls in the middle so that half the values in a group of scores fall below the median and half fall above.

Consider, for example, the following test scores obtained from a small class of VCE students:

55, 62, 60, 79, 50, 72, 70

The median for the group is 62. If there is an even number of scores, there will be no 'middle score'. This problem is overcome by averaging the two scores that share the middle spot, yielding a single number to serve as the median for that data set.

The mode

The mode is the most frequently occurring score in a group of scores. If you were to count the scores in Table 1.4, you would find that group 1's mode is 65, and group 2's mode is 60. The mode is usually easy to obtain; however, it can be an unreliable measure, especially in a small group of scores. The mode's advantage is that it gives the score actually obtained by the greatest number of people.

1.8 CHECK YOUR UNDERSTANDING >>

1 Define 'measure of central tendency'.

2 Explain the difference between the mean and the standard deviation.

3 Calculate the mode and median for the following sets of data.
   - a 10, 13, 15, 17, 28, 16, 24, 15, 16, 27, 27, 27
   - b 23, 25, 77, 87, 94, 84, 96, 74, 90, 57, 85, 88, 86, 87, 85, 87
   - c 22, 25, 26, 27, 27, 28, 29, 39, 40, 40, 40, 40, 34, 25, 26, 27, 56, 54

4 What is the main disadvantage of calculating the mean?
   - A It is the least accurate measure of central tendency.
   - B It is sensitive to very high and very low scores.
   - C It is not sensitive to very high and very low scores.
   - D It is difficult to obtain.

5 What information does the mode provide about a set of data?

INFERENTIAL STATISTICS

Inferential statistics allow the researcher to use mathematical calculations to show whether or not the results obtained are significant. This means the researcher can be objective in deciding how meaningful the results are. A researcher cannot generalise from the results of a study to a population if the statistical significance has not been calculated. The calculation decides whether the difference found from exposure to the independent variable (IV) is real and not due to other confounding variables. A level of significance is set before the experiment. It is known as a *p*

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value (probability value). The most common p value used in research is 0.05. This means that if $p < 0.05$, the researcher is predicting that the probability of the results being due to chance (and not the IV) is less than 5 in 100. Sometimes stricter levels are used, such as a p value of 0.01. So the researcher may predict that if $p < 0.01$, this means that less than one time in 100 the results are due to chance and not the IV. If a p value is calculated such that $p > 0.01$, then no correlation between the IV and DV (dependent variable) can be drawn.

RELIABILITY AND VALIDITY

Before a questionnaire or rating scale is accepted as a credible measure of behaviour, attitudes or personality characteristics, it must be shown to have strong reliability and validity.

RELIABILITY

Reliability refers to whether a questionnaire or scale consistently measures what it is supposed to measure. For example, an intelligence test is said to be reliable if the one person takes it twice, with a month between each testing, and scores the same both times.

If a researcher does not obtain the same results from a test from one time to another, it may be that the test is not reliable, or that other extraneous participant variables are not being controlled from one condition to another.

The reliability of a measurement scale can be measured in a number of ways:

- The test-retest reliability method occurs when participants are given a test or questionnaire at time 1 and then again at time 2. If the test has test-retest reliability, there should be a significant positive correlation between the scores obtained at time 1 and time 2.
- Parallel forms of the same test can also measure the reliability of a measurement scale. One way of achieving this is to give the test to the participants and then correlate the odd and even answers. Again, if the test is reliable, there should be a significant positive correlation. A famous test with parallel forms to ensure reliability is the Stanford–Binet intelligence test.

Inter-rater reliability occurs in studies where data are obtained from observations of multiple raters, rather than by questionnaires of self-report rating scales. Inter-rater reliability is high when the raters are consistent with their observations.

A test is said to have internal consistency reliability if it measures the same variable (such as intelligence) to the same extent every time. One way of testing this is using a test-retest method, where the same test is given a while after the initial test. Results are then compared.

Reliability is influenced by sample size. If a sample is too small, reliability is reduced. Researchers have to weigh up using too small a sample (thus reducing reliability) with the cost of having more participants.

VALIDITY

Validity refers to whether a questionnaire or scale actually measures what it is supposed to measure. There are a number of ways of assessing validity:

- Content validity refers to whether or not the test measures what it claims to measure by looking at the kind of questions it contains. For example, a valid intelligence test measures an individual's intelligence, not reading skills or experience sitting intelligence tests.

mean A measure of central tendency, calculated by adding all the scores in a data set, then dividing the total by the number of scores in the set, that shows the average of all the scores in a data set

median A measure of central tendency, calculated by arranging scores in a data set from the highest to the lowest, and selecting the middle score

mode A measure of central tendency that shows the most frequently occurring score in a data set

reliability Whether a questionnaire or scale measures consistently what it is supposed to measure

test-retest reliability A way to test reliability whereby participants are given a test or questionnaire at time 1 and then again at time 2

parallel forms A way to test reliability whereby the test is given to participants and the responses from the odd-numbered questions are correlated with those from the responses to the even-numbered questions

inter-rater reliability Reliability that occurs in studies where data are obtained from observations of multiple raters, rather than by questionnaires of self-report rating scales; inter-rater reliability is high when the raters are consistent with their observations

validity Whether a questionnaire or scale actually measures what it is supposed to measure

content validity Whether or not the test measures what it claims to measure by looking at the kind of questions it contains

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- Construct validity refers to whether scores on a questionnaire are consistent with the trait (or construct) being measured. For example, given that IQs are supposed to increase with age, an older child will score higher on an IQ test than a younger child if the test has construct validity.
- Criterion validity refers to a significant positive correlation between the test score and a similar actual performance on a task. An example is similar scores on a maths aptitude test and grades when studying Mathematics at university.

Although the concept of validity may seem straightforward, researchers have great difficulty designing intelligence or IQ tests that are not culturally biased.

Cultural bias refers to the tendency for people to perform more poorly on a test developed and standardised for a different cultural group. For example, if there was a question on an IQ test asking the difference between a 'goth' and an 'emo', most adults would have difficulty correctly answering this question. Psychologists aim to develop culturally fair tests, or tests that do not disadvantage the test taker on the basis of their cultural background, so that they are valid across cultures.

Another type of validity is concerned with the conclusions obtained from a research study. In this instance, the results are valid if the conclusions made by the researcher are accurate or correct. For example, in a study investigating whether a new sleeping tablet increases the quantity of sleep in older women, the research is valid only if the new drug actually increases the quantity of sleep.

Researchers always attempt to produce reliable and valid research. This allows them to make accurate conclusions from their results that can be applied to the wider population. Sometimes, however, a research finding may be entirely valid in one setting, but not in another. For example, if a new sleep drug improved the quantity of sleep in a sample of 80-year-old residents in a particular nursing home in Mildura, it is not necessarily the case that it will increase the quantity of sleep in all 80-year-old women. Generalisability describes the extent to which research findings can be applied to settings other than that in which they were originally tested. The more generalisable results are, the more accurate the conclusions of research will be. External validity is obtained when a study is conducted in a similar setting to the setting of the population from which the sample was taken. The more similar the settings, the higher the validity.

ETHICS AND PROFESSIONAL CONDUCT

All psychologists who counsel and treat clients or conduct research using humans and animals are bound by a set of ethical principles. The term ethics refers to moral principles and codes of behaviour that must be followed. The Australian Psychological Society (APS) has developed its *Code of ethics* (2007) – as well as a complementary publication called *Ethical guidelines* (first published in 2007 and regularly updated) – that identifies all the rules, regulations and ethics all psychologists must follow when conducting research and treating clients. These guidelines ensure that participants' physical and psychological welfare is protected during and after an experiment is conducted.

In addition, psychologists must always behave in a professional manner so that no disrepute to their profession or to scientific research occurs. If a psychologist is conducting a study with another professional who is not a psychologist – and who is therefore not bound by the APS's code of ethics – the researcher must ensure that the other professionals agree to follow the code and any other relevant guidelines before beginning the research.

THE ROLE OF ETHICS COMMITTEES

When research is performed in universities and other organisations, the researcher must submit a proposal explaining the nature of the study and how the study is beneficial to society to an ethics committee for approval. These ethics committees review the proposal to ensure all ethical guidelines are followed.

THE EXPERIMENTER'S ROLE

Before starting any research, the researcher submits a research plan to an ethics committee for approval. This ensures that participants' welfare is considered. It is the researcher's responsibility to protect participants' physical and psychological welfare and ensure that occupational health and safety guidelines are adhered to. At no time must a researcher conduct a study that causes severe distress to participants. If a participant does encounter unexpected distress, the researcher

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must immediately stop the experiment and provide the participant with access to counselling or therapy. Also, the potential benefits to society of the research need to be weighed against the risks or discomfort to participants. Once the research plan has been approved, the research may commence. The experimenter is expected to publish any results so that other researchers may be kept up to date. This may also minimise the occurrence of any overlap in research in the same field.

PROTECTION AND SECURITY OF PARTICIPANTS' RIGHTS AND INFORMATION

The researcher must also respect the participants' rights. To achieve this, the researcher should adhere to any relevant ethical guidelines, and to current National Health and Medical Research Council (NHMRC) guidelines.

Confidentiality

Confidentiality refers to the participant's right to privacy in terms of access, storage and disposal of information related to the research. Personal information must be kept securely, which may mean that files on a computer are password protected. A participant cannot be identifiable when results are made public. A participant's involvement in and results from an experiment cannot be disclosed to anyone else unless written consent has been obtained. If a participant is under the age of 18 years, their parent or guardian must provide this written consent.

Voluntary participation

A participant must voluntarily decide to participate in an experiment. Voluntary participation means that participants must not experience any pressure to participate or any negative consequences if they decide not to participate in the experiment. For example, if a researcher pays participants or expects all first-year psychology students at university to participate in at least one experiment, then their participation is no longer voluntary – the researcher is using coercion.

Withdrawal rights

A participant is entitled to withdraw from a study or research at any time, or ask to have their results withdrawn, without suffering any negative consequences. The researcher cannot pressure a participant to enter into or remain in research, even if their withdrawal is detrimental to the study.

The participant's withdrawal rights should be disclosed to the participant as part of the process of obtaining informed consent.

Informed consent

Where appropriate, before an experiment commences, the researcher must inform the participants of the true nature and purpose of the experiment, what they will be expected to do, their rights and any foreseeable risks, and obtain their written consent to participate. If a participant is under the age of 18 years or is legally unable to give consent, their parent or guardian should complete the informed consent form.

The consent form must identify any possible physical or psychological stress that may be encountered during the experiment (see Figure 1.10). The researcher must ensure that any psychologically or physiologically vulnerable person does not participate in the study. Where possible, participants must also be informed about the research procedures employed in the study. In situations where it is considered inappropriate to gain informed consent from participants, the researcher must gain the permission of an ethics committee to withhold information.

construct validity Whether scores on a questionnaire are consistent with the trait (or construct) being measured

criterion validity When there is significant positive correlation between the test score and a similar actual performance on a task

cultural bias The tendency for people to perform more poorly on a test developed and standardised for a different cultural group

generalisability The extent to which research findings can be applied to settings other than that in which they were originally tested

external validity The quality a study has when it is conducted in a similar setting to the population from which the study population was taken or generalised to

ethics Moral principles and codes of behaviour that must be abided by

participants' rights The individual rights of all participants that must be respected by the researcher, as outlined in ethical guidelines relating to psychological research

confidentiality A participant's right to privacy in terms of access, storage and disposal of information related to research

voluntary participation When participants agree to take part in an experiment free from pressure or fear of negative consequences

withdrawal rights Rights whereby participants are entitled to leave an experiment for any reason at any time or have their results withdrawn without any negative consequences from the researcher

informed consent Consent to participate obtained in writing from participants before an experiment; researchers must inform participants of the true nature and purpose of the experiment to obtain it

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Consent form

Dear participant,

You are invited to participate in a project being conducted by the University of Springfield entitled 'Effects of alcohol consumption on driving ability'. The study will be conducted on Friday 13 October.

The purpose of this study is to understand whether the consumption of alcohol affects the number of errors made while driving. Our ultimate goal is to develop the best educational programs possible for preventing young people from drink driving. In this important phase of the research, we are examining how alcohol consumption affects the ability to control a motor vehicle.

On the day of information collection, you will be asked to consume a series of drinks. These drinks may or may not contain alcohol. If you do not want to consume alcohol or caffeinated drinks, please inform the researcher at the start of the test.

Your driving ability will then be tested on a driving simulator. The experiment will take approximately two hours. During this time your vision, ability to detect colour, auditory processes and reflexes will also be tested.

All results will remain completely confidential. You will be assigned a code so that your name will not be identified with or appear on any records. The results will be presented as group results only, and you will not be identified in any reports resulting from this work.

You are free to withdraw your participation at any time. If, after the experiment, you would like to discuss any issues of concern, you may contact one of the chief investigators. All questions will be treated confidentially.

We have found that most people find the experiment interesting and enjoy being involved in research that explores the issues we are investigating. We thank you for your assistance.

Project title: Effects of alcohol consumption on driving ability

Participant consent:

I _____ (participant's name) have read and understood the information above, and any questions I have asked have been answered to my satisfaction. I agree to participate in this research, realising that I may withdraw my consent at any time. I agree that research data collected for the study may be published or provided to other researchers on the condition that my name is not used.

Name of participant: _____
Signature of participant: _____
Date: _____

FIGURE 1.10 An example of a consent form

Deception

Deception is used in cases where giving participants information about an experiment beforehand might influence their behaviour during the study and thus affect the results' accuracy.

An example of deception involved a researcher interested in the effects of guilt on behaviour. Participants were informed that they had broken an expensive piece of machinery during the experiment. As embarrassed participants were about to leave, the experimenter asked them to sign a petition that called for doubling tuition fees at the school. Almost all participants had previously refused to sign the petition; however, because of their guilt after 'breaking' the machine, more than 50 per cent signed (Rubin, 1970). Perhaps guilt could have been studied in some other way; nevertheless, some questions simply cannot be answered without using deception. When this is the

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case, researchers must deceive participants as little as possible. They must also take extra steps to make sure they are treating people ethically (Kimmel, 1998).

Debriefing

Where the participant is not fully informed about the purpose of a study before it has started, the researcher must ensure that participants do not suffer any psychological or physical stress. Participants must always be debriefed. Debriefing is where participants are informed of the study's true purpose once the experiment has ended. During debriefing, a researcher must also correct any mistaken attitudes or beliefs that have been caused by or that relate to the experiment.

Once the study has been completed, the experimenter must provide an opportunity for the participants to gain access to information about the study, including procedures, results and conclusions.

FOCUS ON RESEARCH 1.1

HOW ETHICAL WAS THE TEAROOM SEX STUDY?

In the mid-1960s, sociologist Laud Humphreys recognised that the public and law-enforcement authorities held highly simplistic and stereotyped beliefs about men who commit impersonal sexual acts with one another in public toilets. 'Tearoom sex', as sex in public toilets is called, accounts for the majority of arrests of homosexuals in the United States of America. Humphreys decided that it would be important for society to gain a more objective understanding of who these men are and what motivates them to seek quick, impersonal sexual gratification.

Humphreys set out to answer this question by means of participant observation and structured interviews. He stationed himself in 'tearooms' and offered to keep watch and cough when a police car stopped nearby or a stranger approached. He was able to gain the confidence of some of the men he observed, disclose his role as a scientist, and persuade them to tell him about their lives and motives. Those who were willing to talk openly tended to be better-educated members of the 'tearoom trade'. To avoid bias, Humphreys secretly followed some of the other men he observed and recorded the licence numbers of their cars. A year later, Humphreys appeared at their workplaces, posing as a health-service interviewer and interviewed them about their marital status, race, job, and so on.

Humphreys' findings destroyed many stereotypes. Fifty-four per cent of the participants were married and living with their wives, and analysis suggested that they had good marriages.

Thirty-eight per cent of participants were neither bisexual nor homosexual, but were experiencing tension in their marriages; most of the 38 per cent were Catholic or their wives were, and since the birth of their last child, sexual relations had been rare. Their alternative source of sex had to be quick, inexpensive and impersonal. It could not entail any involvement that would threaten their already shaky family situation. Of the other 62 per cent of participants, 24 per cent were bisexual, happily married, well educated and quite successful in economic terms. Another 24 per cent were single and were covert homosexuals. Only 14 per cent of participants corresponded to society's stereotype of homosexuality; that is, only 14 per cent were members of the gay community and were interested in primarily homosexual relationships (Sieber, n.d.).

Informal inquiry into the long-term effects of this study indicated that the results helped to persuade police to stop using their scarce resources on arrests for victimless 'crimes'. Many see this as a social benefit of the study; however, members of the university at which Humphreys was conducting this research felt that the study was unethical because it invaded the privacy of the participants and threatened their social standing.

QUESTIONS

1. Do you agree that the study was an invasion of the participants' privacy?
2. Did the benefit to society (a reduction in arrests for victimless crimes) outweigh the unethical treatment of the participants in the study?
3. Do you think this study would be deemed ethical by today's ethics committees? Why or why not?

1.9 CHECK YOUR UNDERSTANDING >>

1. What is coercion? Why must coercion be avoided in research?
2. Describe the information that would be included on a consent form.
3. Debriefing:
   - A must occur after every experiment.
   - B occurs only after an experiment where deception has occurred.
   - C does not have to occur.
   - D occurs only when an experiment causes distress.

deception Withholding information from participants about the true nature of and procedures used in a study in cases where giving them this information beforehand might influence their behaviours and affect the results' accuracy

debriefing Where participants are informed of the study's true purpose once an experiment has ended

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4 Deception:
   - A cannot ever occur in a psychological experiment.
   - B can occur only in an experiment using adults.
   - C can occur only if psychological distress is kept to a minimum.
   - D can only occur if distress does not occur and the participants are debriefed after the experiment.

5 What must occur before an experiment is conducted?
   - A The participants are debriefed.
   - B The participants are informed about their rights.
   - C The participants are tested for susceptibility of distress.
   - D The participants are paid for their contribution to the study.

THE USE OF ANIMALS IN RESEARCH

Opinions about the ethics of animal research range widely – from those of medical researchers who routinely conduct animal experiments to those of animal-rights activists who raid laboratories to 'liberate' animals (see Figure 1.11). It is not possible to discuss all of the arguments for and against animal research here (see Table 1.5). However, a brief sketch of the debate may serve as a starting point for further thought and discussion.

One viewpoint comes from scientists who believe human welfare always takes precedence over animal welfare. These scientists believe they have a moral imperative to improve the human condition and to save human lives. To do this, they believe, inescapably involves animal research. Alternatively, members of the animal liberation movement believe animals have a right to live without human interference. Animal liberators oppose all animal research, and the raising of animals for food, hunting, rodeos, zoos and circuses. They regard behavioural research as worthless and cruel, and want to abolish it entirely (Herzog, 1990).

Many other individuals take a more moderate position and accept the necessity for scientific experiments, noting for instance that creating vaccines to end crippling polio epidemics would have been impossible without the use of animals in research. They recognise that animals also benefit from the knowledge gained from scientific research, and primarily seek to ensure humane treatment of animals and to minimise animal use where possible.

Part of the middle ground in this debate is the agreed-upon value of finding alternatives that minimise the use of animals. For example, it may be possible to use computer simulations of animal behaviour for teaching and preliminary research. Also, the use of animals might be limited to critical studies.

If the use of animals in research is approved by an ethics committee, strict guidelines and ethical procedures are employed to protect the animals' rights and welfare to ensure they are treated humanely. These provisions include such things as clean and comfortable cages, and adequate water, food and warmth. Also, a trained professional is expected to care for the animals and to maintain their comfort during the study. In cases where animals are required to endure pain and stress, such as in studies on sleep deprivation, the pain and stress should be permitted only if there is no other way to conduct the experiment and the results are essential to the research. If an animal is to endure pain, painkillers should be administered, and the animal's suffering kept to a minimum. If an animal's life is to be ended, then this must be done quickly and as painlessly as possible.



ALAMY/WILDIMAGE

FIGURE 1.11 Not all people support the use of animals in experiments.

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TABLE 1.5 Summary of arguments for and against using animals in research (note: this list is just a starting point that should be added to and expanded with examples)

ARGUMENTS FOR ANIMAL RESEARCH	ARGUMENTS AGAINST ANIMAL RESEARCH
Human participants are unavailable for some studies because of the risk of severe psychological or physiological harm.	It is impossible to apply the results from animal studies to humans because they are completely different species with different body systems.
Using animals can be a starting point for research because some animal body systems are very similar to those of humans.	It is difficult to generalise results from animal studies to human studies.
Animal behaviour can often be controlled more than human behaviour.	Humans have no right to use other species in research; animals should be respected and protected, not intentionally harmed.
Animals are easier to obtain as participants than are humans.	Many researchers have abused animals through research by conducting experiments with no medical or scientific merit.
Animals do not have expectations about an experiment; human participant expectations often have unwanted effects on results.	Animals are used unnecessarily for testing cosmetics and other household products.

WRITING A REPORT FOR A SCIENTIFIC INVESTIGATION

Psychologists use a set format when formally reporting their research findings. It is important to note that this is a guideline only and often needs to be modified to suit a particular investigation.

Each report has two important characteristics. First, it needs to provide enough information about the study so that another researcher is able to replicate the study. Second, the language used needs to be clear, concise, and written in third person and past tense.

Following are descriptions of each section in a formal report: title, abstract, introduction, method, results, discussion, conclusion and references.

THE REPORT STRUCTURE

Title

The title briefly describes what the investigation is about. Often it is easier to write a title after you have written the aim.

Abstract

The abstract is a brief summary (about 100 words) of the entire report. It should include statements about the aim, participants, method, results and main conclusions.

Introduction

The introduction should be between 200 and 600 words. It should provide background information obtained from literature searches on the topic. All specific terms mentioned should be defined and relevant theories and concepts mentioned should be introduced.

The introduction should lead to the current study's purpose and include an aim. The aim should be a general, non-directional statement about what you want to investigate.

Next, the experimental and operational hypotheses should be written and the independent variable (IV) and dependent variable (DV) identified.

Methodology

The methodology is divided into three subsections that describe how the investigation was conducted. The methodology should be 150 to 200 words in length, and should provide the following information.

PARTICIPANTS

This includes descriptions of:

- the sample – how many, plus any features (e.g. all girls, or all VCE students)
- the population the sample was drawn from
- how participants were selected and allocated to groups.

MATERIALS

Describe questionnaires and other materials used. A sample should be placed in the appendix.

PROCEDURE

The procedure is a detailed description of the steps in the experiment that is presented in a logical sequence. It is written in past tense. Other information required in this section includes:

- how the IV was manipulated
- the researcher's role
- the instructions given to participants. A sample consent form should be placed in the appendix.

Results

The results section should be about 150 to 200 words in length, and is a description of the main results. As well as this written summary, results can be displayed in tables, charts, graphs and as mathematical calculations.

The results should only be summary data, not raw, original data, which belong in the appendix.

All charts, graphs and tables must be labelled accurately. Each table or graph needs a descriptive title so the reader can understand the data without having to read the body of the report. Each graph must have the axes labelled correctly. The title of the table is placed above the table, and the title for a figure is placed below the actual figure. If mathematical or statistical calculations are performed as part of the study, these also need to be reported in the results section.

Discussion

The discussion section should be 200 to 600 words long. The results are explained and a statement about whether the hypothesis was rejected or accepted, based on the results, must be included. If the hypothesis was rejected, a suggested explanation as to why the experiment did not support the hypothesis is needed. Any extraneous variables that may have affected the results must be explained and suggestions given about how they can be controlled in future research. Any limitations in the methodology or data are identified and discussed, and any suggested improvements for further studies are presented. Results of the study should be compared with the results of previous research mentioned in the introduction. The discussion should end with a statement about whether the results of the sample can be generalised to the population from which the sample was drawn.

Conclusion

The conclusion section provides an end to the report. It relates to the aim of the research, and provides a response to the research question.

References

Include all references cited in your report, as described in the following paragraphs. In psychology, we use the method specified by the American Psychological Association (APA) (2009) for referencing and citing sources of information.

CITING REFERENCES IN TEXT

All cited references must appear in the reference list and, conversely, every entry in the reference list must be cited somewhere in the text. Text citations are very simple to do. You need to use the author–date format when referencing material within text; that is, give the author's surname and the date of publication for the item you are citing, for example: 'as Smith and Watson (2015) found' or 'Smith and Watson (2015) showed that …'

If you are citing a publication with three to five authors, name all the authors the first time you cite them in the text, and in subsequent citations use the first author's name and the abbreviation 'et al.', followed by the date. For example, you would use 'Smith, Watson, Percy and Jones (2015)' the first time you referred to their publication, and then in subsequent mentions use 'Smith et al. (2015)'. If you are citing a book with six or more authors, or a journal article with eight or more authors, you only need to use the first author's name and 'et al.', followed by the date.

When quoting a source you must include a page reference after the year, for example: 'The author stated, "The effect disappeared within minutes" (Lopez, 2013, p. 311)'.

The reference list

The following examples show how publication details for books, journals and Internet sites are presented in the reference list. While we have described each category separately in the text below, you should place all sources into one reference list. A reference list is alphabetical according to surname.

BOOKS

Use the following format when referencing books.

- Author: The author's surname and initials are given (for example 'Green, A. H.'). If the book has more than one author, then all authors' names are cited in the order that they appear on the book's title page.
- Year of publication: This is enclosed in brackets, followed by a full stop (for example, 'Green, A. H. (1998).').
- Title of the book: This is italicised (or if this is not possible, underlined), and followed by a full stop (for example, 'Green, A. H. (1998). *The beginnings of perception.*').
- City of publication: This is followed by a colon (for example, 'Green, A. H. (1998). *The beginnings of perception.* Melbourne:').

ISBN 9780170365604

- Name of publisher: This is followed by a full stop (for example, 'Green, A. H. (1998). *The beginnings of perception*. Melbourne: Barretts Press.).

An example of a full reference list entry for a book by a single author is: Garner, D. M. (1991). *Manual for the eating disorder inventory*. Odessa, Florida: Psychological Assessment Resources Inc.

An example of a full reference list entry for a book by multiple authors is: Booth, W. C., Colomb, G. G., & Williams, J. M. (1995). *The craft of research*. Chicago: University of Chicago Press.

JOURNALS AND PERIODICALS

Use the following format when referencing material from journals and periodicals.

- Author: The author's surname and initials are given (for example, 'Brown, T. B.'). As already mentioned, a reference list is in alphabetical order according to surname. If there is more than one author, then all authors' names are cited in the order that they appear under the title on the first page of the article.
- Year of publication: This is enclosed in brackets, followed by a full stop (for example, 'Brown, T. B. (1999).').
- Title of the article: This is followed by a full stop (for example, 'Brown, T. B. (1999). From sensation to perception.').
- Title of the journal: This is italicised (or if this is not possible, underlined), and followed by a comma (for example, 'Brown, T. B. (1999). From sensation to perception. *Psychological Studies*,').
- Volume of the journal: The journal's volume number (italicised, or if this is not possible, underlined) and issue number (where relevant) are followed by a comma (for example, 'Brown, T. B. (1999). From sensation to perception. *Psychological Studies, 23*,')
- Page numbers: These are followed by a full stop (for example, 'Brown, T. B. (1999). From sensation to perception. *Psychological Studies*, *23*, 145–152.')

An example of a full reference list entry for a journal article by multiple authors is: Striegel-Moore, R. H., Solberstein, L. R., Frensch, P., & Rodin, J. (1989). A prospective study of disordered eating among college students. *International Journal of Eating Disorders*, *8*, 499–509.

INTERNET SITES

Use the following format when referencing material from an Internet site: Author, year, title of web page, URL. An example of a full reference list entry is: Dewey, R. A. (2002). Psych Web by Russ Dewey. Retrieved from http://www.psywww.com.

Appendices

This is the section where any extra materials that did not fit into the report are placed (for example, the raw data). Each appendix must be numbered, given a title and referred to in the body of the report.

1.10 CHECK YOUR UNDERSTANDING >>

1 What is one advantage and one disadvantage of using animals in research?
2 What three subsections are found in the method section of an experiment?
3 Reference this journal article according to the correct formatting:

Can dogs see colour? Written by John Smith, Peter Smyth and Janet Smithson in 2009. Published in the Journal of Animals and their Perceptive Abilities, volume 21. Found on pages 22–45.

4 What information is found in the introductory section of the report?
5 Approximately what length (in words) should the discussion section be?

CHAPTER SUMMARY

How is experimental research conducted?

- When conducting psychological research, seven steps are followed: identify the research problem, formulate a hypothesis, design the method, collect the data, analyse the data, interpret the results, and report the findings.
- A hypothesis is formed to describe a testable prediction about the experiment. An operational hypothesis, or a detailed hypothesis, needs to be written to describe the relationship between the independent and dependent variables in the research.
- An independent variable is the variable that is manipulated by the experimenter in a study, and the experimental group is exposed to the independent variable.
- The dependent variable is the variable that is measured in a study, and is dependent on the independent variable.
- Extraneous variables often occur in research. They are any variables other than the independent variable that can alter the dependent variable.

What sampling procedures are used?

- People are selected for research using a variety of sampling procedures.
- Random sampling is a common sampling method that ensures that each member of the population of research interest has an equal chance of being selected into a study. This method tries to ensure that the sample is representative of the population.
- Stratified sampling is a method of sampling used when there are several groups or 'strata' in a population and it is important to represent these groups in the same proportions in the sample.
- Convenience sampling is a method of sampling in which participants are chosen because they are close by and easily accessed.

What techniques of qualitative and quantitative data collection are used?

- There are many different types of data, including qualitative (data in words) and quantitative (data in numbers).
- Each type of data has advantages and disadvantages. For example, often qualitative data is more detailed, but is sometimes difficult to analyse and interpret, whereas quantitative data is easy to analyse and interpret, but often does not include a lot of detail.
- Data can be collected in a variety of ways.
- Case studies involve observing single participants with interesting behaviours, attitudes or beliefs. Case studies provide much detail about a specific situation, but are difficult to compare with other situations and studies.
- Observational studies involve watching participants in their natural environment. These types of studies are advantageous when wanting to observe natural behaviours without intervening and putting constraints on the participants' behaviours. These studies, like case studies, are sometimes difficult to analyse and interpret.
- Questionnaires and rating scales are all self-report measures to determine participant beliefs, attitudes and behaviours. They are often written and are usually easy to analyse and interpret.
- Interviews are conducted to identify participant beliefs, attitudes and behaviours. They are often flexible and provide participants with the opportunity of explaining their answers in detail. However, these can be difficult to analyse and interpret, and the interviewer can influence participants' answers.
- Psychological research can either be cross-sectional (one testing in one point in time) or longitudinal (multiple testings over time). The advantage of a longitudinal study over a cross-sectional study is longitudinal studies can often show stronger cause-and-effect relationships between variables.
- Standardised tests are carefully written tests; often questionnaires that provide information that can be compared to various other populations. They have standardised methods of implementing and interpreting the data collected.
- Non-standardised tests are less formally designed tests that have not been tested on large populations, and thus the results from these tests cannot be compared between populations.
- Standardised tests are often said to have reliability (give similar results from one time to another time) and validity (measure what they are supposed to measure) after repeated testing procedures.

How are statistics calculated and displayed?

- Percentages are a basic measure of descriptive statistics that allow different sets of data to be compared.
- Data are meaningless in their raw form, so tabulating and graphing data allows researchers to visualise patterns in data.
- Examples of graphs used in psychological research are bar graphs and line graphs.
- Descriptive statistics do not allow conclusions and generalisations to be made about data.
- There are a variety of measures of central tendency that allow researchers to determine the spread of scores in a data set. The bigger the spread of scores, the more variance in the data set and the more likely scores are further from the central score.

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Ethics and professional conduct:

- Psychologists must follow a code of conduct and ethics when conducting research and treating clients and patients. The code of conduct ensures that the participants' rights are upheld and protected at all times.
- Confidentiality, voluntary participation, withdrawal rights, informed consent procedures and debriefing are all ethical procedures that must be used by psychologists when conducting research. There are ethics committees on staff at universities and various private organisations to control ethics in research.
- Deception can be used in research; however, any psychological or physical distress must be minimised, and participants must be debriefed afterwards.
- Debates concerning animal welfare in research using animals are based on personal values and morals, and are, therefore, not easily resolved. Some people believe it is cruel and inhumane to experiment on animals, while others believe animal experimentation is an important aspect of medical research.

APPLY YOUR KNOWLEDGE AND SKILLS

SECTION A: MULTIPLE-CHOICE QUESTIONS

Answer the following questions by writing the correct letter in your workbook. Only one answer is correct for each question.

1 Which of the following best defines the term 'hypothesis'?

- **A** A thoughtful, testable prediction about the likely results of a research study
- **B** A prediction about the results of a research study that may or may not be able to be tested
- **C** A way of collecting data on the social and emotional wellbeing of people
- **D** A way of describing the results of a study, so that the conclusion is inaccurate.

Questions 2 and 3 refer to the following information.
Paul wants to conduct a study to investigate the effects of a new drug on the memories of university students. He predicts that the drug will work only for students who sleep more than six hours a night, because it relies on the release of a certain amount of hormone to be effective. This hormone is only released into the bloodstream during the night. Therefore, he tests 150 university students by asking them how many hours they sleep on average a night, and he also tests their short-term memory. Participants who sleep more than six hours a night are allocated to group 1, and participants who sleep less than six hours are allocated to group 2.

Paul gives participants in group 1 the new drug and then he tests their short-term memory by asking the participants to remember as many words as possible from a list. Participants in group 2 are given a sugar pill and then their short-term memories are tested in the same manner.

2 What is/are the independent variable(s) in this study?

- **A** The drug
- **B** The sugar pill
- **C** The average number of hours of sleep a night
- **D** Both A and C

3 What is an extraneous variable that might have affected the results?

- **A** The participants' ability to sleep was not screened before the study.
- **B** The groups did not comprise an equal number of males and females.
- **C** Group 1 was given the real drug and group 2 was given the sugar pill.
- **D** People in group 2 had poorer short-term memory than people in group 1.

4 Professor Black conducted a study investigating languages spoken throughout Melbourne. He collected data from groups of different ethnic backgrounds, based on the relative percentage of the groups in the Melbourne population. This is an example of:

- **A** stratified sampling.
- **B** random sampling.
- **C** biased sampling.
- **D** random stratified sampling.

5 Felicia wanted to investigate whether chimpanzees use tools to catch and collect food in the wild. She set up camp in the forest, and followed a group of chimpanzees for 6 months. She found that chimpanzees use many tools in day-to-day life – much like humans. What type of study did Felicia conduct?

- **A** An experimental design
- **B** A survey
- **C** A naturalistic observation
- **D** A correlational study

6 An advantage of using a standardised questionnaire over an interview to collect data is:

- **A** Interviews provide data that can be difficult to quantify, whereas questionnaires often provide data that is easy to quantify.
- **B** Questionnaires provide data that can be difficult to quantify, whereas interviews often provide data that is easy to quantify.

C Interviews are unreliable.

D Questionnaires are standardised whereas interviews are non-standardised, thus producing invalid results.

7 Longitudinal studies are used to:

A determine how one variable affects another variable at a particular point in time.

B determine how more than one variable affects another variable at a particular point in time.

C determine how one variable affects another variable over time.

D None of the above

8 Which measure of central tendency is most affected by extreme scores?

A Range

B Mode

C Mean

D Median

9 If you know that your weight is the median weight for your age, then your weight is:

A at the extreme end for people of your age.

B the average for everyone your age.

C higher than half the people your age and lower than the other half.

D the most common weight for your age.

10 Measures of variability are used to find out the:

A frequency distribution of a set of scores.

B spread of scores from the mean for the set of scores.

C average or middle point of a set of scores.

D most commonly occurring score(s) in a set of scores.

11 Which of the following research would be classified as qualitative data?

A The amount of study completed by Year 12 students a week before mid-year exams

B The results of a Year 10 Maths test undertaken by Year 7 students

C The results obtained for the VCE Psychology exam

D The way students felt on the day of the VCE Psychology exam

12 Which of the following statements about descriptive statistics is incorrect?

A They include tables, graphs and percentages.

B They allow summaries and conclusions to be made.

C They allow data to be described.

D They assist in the interpretation of data.

13 In a scientific research report, which three subsections are found in the methodology section?

A Results, materials, conclusions

B Materials, hypothesis, procedure

C Procedure, participants, conclusions

D Participants, materials, procedure

14 Which of the following references is correct?

A Smith, Peter (2009). The Journal of sleep, Identifying sleep patterns in felines, volume 3, pages 2–34

B Naughty and Nice, The Journal of Bad behaviour, written by Carole Norton in 2008

C Carbohydrates in Pregnancy, West and Wayner, 2008, Volume 1, pages 22–24

D Christopher, P., & Blackwood, T. (2009). Orthodontic applications in pregnant newts. *Journal of Dentistry*, *1*, 1–11.

15 Which is true about experimentation using animals?

A It is alright to physically or psychologically harm an animal for any reason in experiments.

B All animals behave in similar ways to humans, so experiments should be completed on animals, not humans.

C All human and animal body systems are similar, so animals can be used instead of humans in experiments and the results can be generalised to humans.

D Sometimes animals are used in research because many of their lifespans are much shorter than humans, so the effects of the independent variable can be observed over a whole lifetime more easily than if humans were used.

SECTION B: SHORT-ANSWER QUESTIONS

1 In an experiment on memory, 10 participants were tested on how many items in a list of 10 words they could remember 1 month after learning the words. The psychologist collected the following data from the participants.
1, 4, 7, 5, 7, 2, 3, 7, 1, 3
For this set of scores, find the:
a mean. **b** median. **c** mode.

2 Describe an experiment that would require a random stratified sample.

3 Explain the difference between 'reliability' and 'validity' in research.

4 Draw a graph that has high variance in the data (you do not need to include labels and headings) and another graph that has low variance. Describe the difference between the two graphs.

5 Explain four benefits of using animals in experiments.

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6 In the following study, identify and explain any possible extraneous variables. Explain how these variables could be overcome in future studies.
Teachers are interested in the average IQ of each year level at Sunnybank College. Students in each year level are given a one-hour IQ test during class. Students in Year 7 completed the IQ tests in February. Many of the students complained that the rooms were too hot and stuffy. Years 8 to 11 were given their IQ tests in June, and Year 12 students were given their IQ tests a week before their end-of-year exams in November. The results indicated that Years 7 and 12 students had the lowest IQs in the school.

7 A researcher is sitting near a playground observing children playing. As a part of the study the researcher counts how many children are playing together in a group. The results are outlined in the table below.

5	6	8	12	0
9	1	11	14	2
8	10	5	8	10
6	15	0	4	3
9	0	4	12	11
3	8	9	12	5
15	10	0	1	18

The table above shows the amount of time children spent in groups in a 20-minute period, as opposed to playing alone.
Choose a suitable graph to represent this data. Include labelled axes and a title for your graph.

8 What are descriptive statistics and why are they important for data collation?

9 Explain what correlation means.

10 Dr Johns wants to investigate university students' attitudes to politics.

a Explain how Dr Johns could conduct an observational study to investigate university students' attitudes to politics.

b Explain how Dr Johns could conduct a survey study to investigate university students' attitudes to politics.

SECTION C: ASSESSMENT TASK

THE ACCURACY OF ASTROLOGY IN PREDICTING BEHAVIOUR AND TRAITS

Directions

You are to write a scientific report on the issue of the accuracy of astrology in predicting people's behaviours and personality traits. In order to write the report, you will need to collect data about people's views on the accuracy of astrology. Before you collect any data, you will need to write an informed-consent form for the participant to read and sign (see page 22 for an example). Photocopy the star-sign descriptions on pages 32–3. Give the appropriate star-sign description to each of your five participants and have them read it.

Ask the participants to complete the questionnaire (page 34), starting with an assessment of how accurate the overall description is of them. The participants should then assess the accuracy of each of the individual descriptors (for example, 'You have a tendency to be critical of yourself') in the star-sign descriptions. The descriptors are numbered to assist this process. The participants should then return their questionnaire to you.

You will have a week to collect the data, after which you will bring the data to class for collation into a class set. You will write your report based on the class data, not on your five participants.

Use your own notes on research methods as well as the notes below to help you write your report.

Writing your report

- Title: What is your study about?
- Introduction: One to two paragraphs about the accuracy of astrology in predicting human behaviour. Explain the differences between astrology and psychology (see Chapter 2, pages 37–41 for more information about the differences between pseudo-psychologies and sciences that use an empirical approach).
- Aim
- Hypothesis: Do you think most people believe in astrology? Sometimes? Or always? Remember, your aim is a general statement about what you will be investigating, and your hypothesis is a specific statement that predicts results in a particular direction.
- Method:
  - participants
  - materials
  - procedure
- Results:
  - a class set of self-report data
  - tables with headings and labels
- Discussion:
  - whether or not the operational hypothesis was supported
  - answers to remaining questions
  - extraneous variables, if any
  - future directions (for example, how to overcome extraneous variables)
  - generalisations
- Conclusion: Provide a response to your research question.
- References: a list of references compiled to American Psychological Association (APA) standards
- Appendices: These should include such things as raw data or informed-consent forms.

Aries

1 You have a tendency to be critical of yourself.
2 You have a great deal of unused ability that you have not used to your advantage.
3 You are a born leader.
4 You have found it unwise to be too honest when revealing your thoughts and feelings to others.
5 You have secrets that no one else knows.
6 At times you have serious doubts as to whether you have made the right decision or done the right thing.
7 At times you have trouble making decisions.
8 Some of your aspirations tend to be unrealistic.

Taurus

1 You have a tendency to be critical of yourself.
2 You have a great deal of unused ability that you have not used to your advantage.
3 You are a born leader.
4 You have found it unwise to be too honest when revealing your thoughts and feelings to others.
5 You have secrets that no one else knows.
6 At times you have serious doubts as to whether you have made the right decision or done the right thing.
7 At times you have trouble making decisions.
8 Some of your aspirations tend to be unrealistic.

Gemini

1 You have a tendency to be critical of yourself.
2 You have a great deal of unused ability that you have not used to your advantage.
3 You are a born leader.
4 You have found it unwise to be too honest when revealing your thoughts and feelings to others.
5 You have secrets that no one else knows.
6 At times you have serious doubts as to whether you have made the right decision or done the right thing.
7 At times you have trouble making decisions.
8 Some of your aspirations tend to be unrealistic.

Cancer

1 You have a tendency to be critical of yourself.
2 You have a great deal of unused ability that you have not used to your advantage.
3 You are a born leader.
4 You have found it unwise to be too honest when revealing your thoughts and feelings to others.
5 You have secrets that no one else knows.
6 At times you have serious doubts as to whether you have made the right decision or done the right thing.
7 At times you have trouble making decisions.
8 Some of your aspirations tend to be unrealistic.

Leo

1 You have a tendency to be critical of yourself.
2 You have a great deal of unused ability that you have not used to your advantage.
3 You are a born leader.
4 You have found it unwise to be too honest when revealing your thoughts and feelings to others.
5 You have secrets that no one else knows.
6 At times you have serious doubts as to whether you have made the right decision or done the right thing.
7 At times you have trouble making decisions.
8 Some of your aspirations tend to be unrealistic.

Virgo

1 You have a tendency to be critical of yourself.
2 You have a great deal of unused ability that you have not used to your advantage.
3 You are a born leader.
4 You have found it unwise to be too honest when revealing your thoughts and feelings to others.
5 You have secrets that no one else knows.
6 At times you have serious doubts as to whether you have made the right decision or done the right thing.
7 At times you have trouble making decisions.
8 Some of your aspirations tend to be unrealistic.

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Libra

1 You have a tendency to be critical of yourself.
2 You have a great deal of unused ability that you have not used to your advantage.
3 You are a born leader.
4 You have found it unwise to be too honest when revealing your thoughts and feelings to others.
5 You have secrets that no one else knows.
6 At times you have serious doubts as to whether you have made the right decision or done the right thing.
7 At times you have trouble making decisions.
8 Some of your aspirations tend to be unrealistic.

Scorpio

1 You have a tendency to be critical of yourself.
2 You have a great deal of unused ability that you have not used to your advantage.
3 You are a born leader.
4 You have found it unwise to be too honest when revealing your thoughts and feelings to others.
5 You have secrets that no one else knows.
6 At times you have serious doubts as to whether you have made the right decision or done the right thing.
7 At times you have trouble making decisions.
8 Some of your aspirations tend to be unrealistic.

Sagittarius

1 You have a tendency to be critical of yourself.
2 You have a great deal of unused ability that you have not used to your advantage.
3 You are a born leader.
4 You have found it unwise to be too honest when revealing your thoughts and feelings to others.
5 You have secrets that no one else knows.
6 At times you have serious doubts as to whether you have made the right decision or done the right thing.
7 At times you have trouble making decisions.
8 Some of your aspirations tend to be unrealistic.

Capricorn

1 You have a tendency to be critical of yourself.
2 You have a great deal of unused ability that you have not used to your advantage.
3 You are a born leader.
4 You have found it unwise to be too honest when revealing your thoughts and feelings to others.
5 You have secrets that no one else knows.
6 At times you have serious doubts as to whether you have made the right decision or done the right thing.
7 At times you have trouble making decisions.
8 Some of your aspirations tend to be unrealistic.

Aquarius

1 You have a tendency to be critical of yourself.
2 You have a great deal of unused ability that you have not used to your advantage.
3 You are a born leader.
4 You have found it unwise to be too honest when revealing your thoughts and feelings to others.
5 You have secrets that no one else knows.
6 At times you have serious doubts as to whether you have made the right decision or done the right thing.
7 At times you have trouble making decisions.
8 Some of your aspirations tend to be unrealistic.

Pisces

1 You have a tendency to be critical of yourself.
2 You have a great deal of unused ability that you have not used to your advantage.
3 You are a born leader.
4 You have found it unwise to be too honest when revealing your thoughts and feelings to others.
5 You have secrets that no one else knows.
6 At times you have serious doubts as to whether you have made the right decision or done the right thing.
7 At times you have trouble making decisions.
8 Some of your aspirations tend to be unrealistic.

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Questionnaire

Star sign: _____

Sex (circle): M F

Age: _____

Please circle one of the following statements to indicate how accurate you think the overall description of your personality was.

1 Very accurate

2 Fairly accurate

3 Neither accurate nor inaccurate

4 Mildly inaccurate

5 Very inaccurate

Please rate each of the numbered descriptors on the star sign card.

Circle the appropriate number.

Descriptor	Very accurate	Fairly accurate	Neither accurate nor inaccurate	Mildly inaccurate	Very inaccurate
1	1	2	3	4	5
2	1	2	3	4	5
3	1	2	3	4	5
4	1	2	3	4	5
5	1	2	3	4	5
6	1	2	3	4	5
7	1	2	3	4	5
8	1	2	3	4	5

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UNIT 1

HOW ARE BEHAVIOUR AND MENTAL PROCESSES SHAPED?

AREA OF STUDY 1:
HOW DOES THE BRAIN FUNCTION?

AREA OF STUDY 2:
WHAT INFLUENCES PSYCHOLOGICAL DEVELOPMENT?

AREA OF STUDY 3:
STUDENT-DIRECTED RESEARCH INVESTIGATION



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CHAPTER 02

THE ROLE OF THE BRAIN IN MENTAL PROCESSES AND BEHAVIOUR



KEY KNOWLEDGE INCLUDES:

- the influence of different approaches over time to understanding the role of the brain, including the brain vs heart debate, mind–body problem, phrenology, first brain experiments and neuroimaging techniques
- the basic structure and function of the central and peripheral nervous systems as communication systems between the body's internal cells and organs and the external world
- the role of the neuron (dendrites, axon, myelin and axon terminals) as the primary functional unit of the nervous system, including the role of glial cells in supporting neuronal function.

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INTRODUCING THE BRAIN: MASTER AND COMMANDER

The human brain is the most complex and remarkable organ of the human body. It is the source of all our behaviour, and it operates as the command centre of the body.

The brain is composed largely of billions of nerve cells that receive and transmit electrical and chemical signals all over the body. It is the largest and most important part of our central nervous system (CNS) and it is linked to our senses, and thus our body parts, through the CNS's connection to the peripheral nervous system (PNS).

To fully understand how the brain controls behaviour, we must understand the relationship between the brain and the mind. Theories relating to the nature of this relationship began centuries ago and emerged from the world of philosophy. These theories provided insight into the brain, mind and behaviour but they lacked evidence. However, during the last few centuries the application of scientific method to the study of brain structure and function has provided psychologists and neuroscientists with evidence that the brain is indeed the source of all behaviour.

PHILOSOPHY	versus	SCIENCE
• Makes predictions about human behaviour based on logic and observation • Does not have empirical evidence to support its claims • Is not reliable		• Makes predictions about human behaviour based on empirical evidence • Is reliable

FIGURE 2.1 Philosophy versus science

FROM CLASSIC PHILOSOPHY TO MODERN SCIENCE

For centuries, philosophers and scientists have tried to explain human behaviour as well as the nature of the relationship between the mind and its mental processes, and the body and its physical processes. In ancient times, anatomical studies conducted during autopsies or surgical procedures provided information on the structure of the brain. Early medical practitioners could also observe the behavioural effects of injury to the living brain; however, they had no means of verifying how the brain actually functioned.

During ancient times it was believed that the mind and the soul were the same thing, but many questions regarding the relationship between the mind (mental processes) and the body (physical processes) were vigorously debated. For example, where in the body was the mind located? What was the role of the brain? Was the mind separate from or identical to the body? And did the mind or the body govern behaviour?

Today, neuroimaging techniques provide evidence of brain structure and function, which has given us a much greater insight into the relationship between the brain and behaviour. Today we understand that the brain is the source of all physical, emotional and cognitive behaviour, but this was not always the accepted view.

THE BRAIN-VERSUS-HEART DEBATE

Many ancient philosophers debated whether the brain or the heart was the most important organ in the human body. For example, when the ancient Egyptians mummified their dead, they removed the brain through the nostrils and discarded it because they believed it was of little importance (see Figure 2.2).



FIGURE 2.2 The ancient Egyptians did not mummify the brain of the dead person. They believed the brain was an unimportant organ.

philosophy A set of ideals, standards or beliefs used to describe behaviour and thought that is based on logic rather than scientific evidence

psychologist A professional who specialises in creating, teaching and applying psychological knowledge

neuroscientist A scientist who studies the structure and function of the brain and nervous system

However, they preserved the heart because they believed it was the most important bodily organ. They also believed that the mind, or soul, was located in the heart.

Studies of animal anatomy also led the ancient Greek philosopher Aristotle (384–322 BCE) to conclude that the heart, not the brain, was the most important bodily organ. Aristotle described the heart as a three-chambered, hot, dry organ that pumped warmth and vitality to the body. He argued that all other organs simply existed to cool the heart, and because the heart seemed more responsive than the brain during strong emotional experiences, this indicated that the heart was the site of mental processes. Aristotle suggested that the heart, not the mind, was the seat of thought, reason, intelligence, knowledge, sensation and movement.

Aristotle also believed that the body and mind are inseparable and interacted through the heart. He argued that the mind is located in the heart, therefore it is a function of the body. So, when the body (and heart) died, so did the mind.

THE MIND–BODY PROBLEM

The mind–body problem, which looks at the relationship between the biological (body and brain) and the psychological (mind), has been in existence for thousands of years. Three questions lie at the heart of this debate:

- Is the mind part of the physical body or is it something else?
- If the mind and body are separate entities, what is the nature of their relationship?
- If they are separate, which one is in control of the other?

The ancient Greek philosopher Plato (429–347 BCE) attempted to answer these questions. Plato adopted the widely held belief of his time that humans had a body and a soul (a mind) and that they were two separate and distinct entities.

Plato proposed that there are two types of substance – physical substance and mental substance. Physical substance is something that is of the body. It is observable, measureable and has a finite life span. Plato said a mental substance comes from the self or soul. It has no physical representation, therefore it cannot be observed or measured.

Plato argued that the brain was an important body organ and that it was the physical location of the soul (or mind), but the brain and mind were separate entities. Plato believed that the body is part of the material world because it exists in time and space, while the soul is part of the world of ideas that exists outside of time and space. Furthermore, he argued that because these two entities are separate, when the body dies, the non-material mind or soul is released because it cannot decompose. Therefore, the body can die but the mind (or soul) cannot.

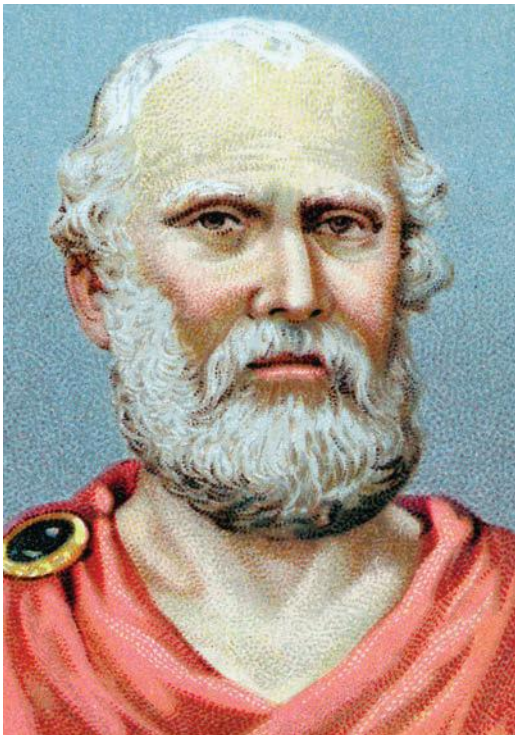

ALAMY/WORLD HISTORY ARCHIVE

FIGURE 2.3 Plato argued that the mind and brain were different and separate entities.

Galen's contribution

In the second century CE, Greek physician and philosopher Aelius Galen conducted many vivisections on animals in order to observe how different organs or body parts functioned. He then generalised his findings to the human body.

In terms of the mind–body problem, Galen argued that the mind and body were the same, and that mental activity occurred in the brain rather than the heart. In one famous demonstration, Galen used a live, squealing pig to demonstrate that speech came from the brain, not the heart, even though sounds seemed to come from the chest (see Figure 2.4). When he tied off the pig's vocal cords, the loud squeals immediately stopped. When he released the ties, the squealing continued. Then, when he severed the laryngeal nerve that connected the brain and the muscles surrounding the vocal cords, the pig was silent. This demonstrated that the laryngeal nerve was controlled by the brain, not the heart. As a result of his experiments, Galen

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FIGURE 2.4 Aelius Galen used a live pig to demonstrate that the brain controlled speech.

concluded that the brain controls all muscle movement by means of its connections to the spine and peripheral nerves – a theory that is still accepted today.

Galen's experiments moved our understanding of the brain's role in behaviour beyond the world of philosophy into the world of experimentation.

Descartes' dualism: Mind and body are separate

In modern philosophy, the French philosopher René Descartes (1596–1650) picked up where Galen left off. Descartes, however, was more interested in understanding the relationship between consciousness and the brain than the structure and function of the brain.

Like many philosophers, Descartes believed mind and soul were synonymous. He suggested that mind and body are two separate realities that interact and influence each other and that the mind controls the body, and therefore behaviour. So, to understand the human mind, we must systematically observe human behaviour. This theory became known as dualism.

In the 17th century, Descartes published his view of the mind–body problem in *Discourse on Method and Meditations on the First Philosophy* in which he raised significant questions such as: What exactly is the relationship between the mind (mental events) and the body (physical events)? Are the mind and the brain separate entities?

In his doctrine of mind–body dualism Descartes argued there were two basic substances in the world: non-physical substances and physical substances. He reasoned that the mind was a non-physical, supernatural entity that did not exist in space and functioned through thought alone. The body, however, was a physical entity that did exist in space. Therefore, the mind and body were separate entities.



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FIGURE 2.5 René Descartes argued that the mind and body were separate but connected entities.

mind–body problem A debate about the relationship between the body, brain and mind

vivisection Experimental surgery carried out on a living organism for research purposes

dualism A philosophical theory that says mind and body are separate entities that interact and influence each other

Descartes also suggested that the mind and brain were parallel entities that interacted and it was this two-way interaction that produced behaviour. Although he had no physical evidence, Descartes reasoned that this interaction occurred in the pineal gland, a small gland located in the centre of the brain. The pineal gland was, according to Descartes, where all mental functions were located and its activity directs all the body's activity. See Figure 2.6 for Descartes' view of the pineal gland's function.

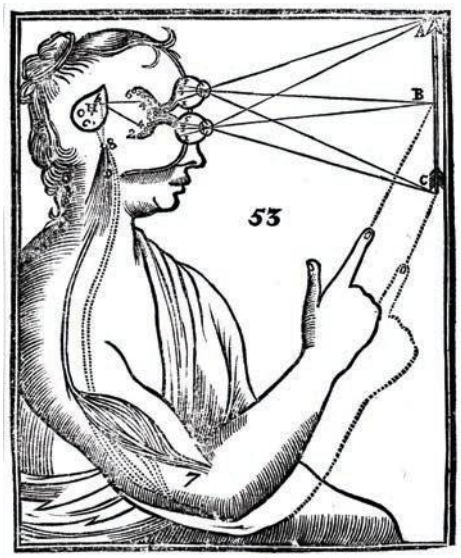


FIGURE 2.6 René Descartes' view of the significance of the pineal gland

During the 17th and 18th centuries, scientists continued their investigations into bodily structures and physiological processes. Fortunately, advances in science led to a more systematic study that enabled scientists to gather empirical evidence to support their theories. By the 19th century it was accepted that some mental processes were linked to the brain's physical processes; however, not all popular theories about the brain's role in behaviour were supported by scientific evidence.

PHRENOLOGY

Phrenology was one of the earliest techniques that tried to *predict* human behaviour. Phrenology involved feeling bumps on a person's skull and using this information to assess their personality and intelligence (see Figure 2.7). Although this technique was very popular in the early 19th century, there was absolutely no scientific merit to it. Thus it became known as a pseudoscience – a fake or false science.

Phrenology was popularised in the 19th century by Franz Gall (1758–1828), a Viennese physician who believed that different areas of the brain were responsible for specific psychological traits. According to Gall, these traits controlled complex mental faculties (or personality characteristics) such as cautiousness, combativeness and agreeableness, and simpler functions such as memory, calculation ability and colour perception. He suggested that the mind was composed of 40 different faculties and their development affected the size and shape of the skull. Therefore, if you were to examine the shape of the skull, you could analyse the bumps and indentations and determine a person's personality and intelligence.

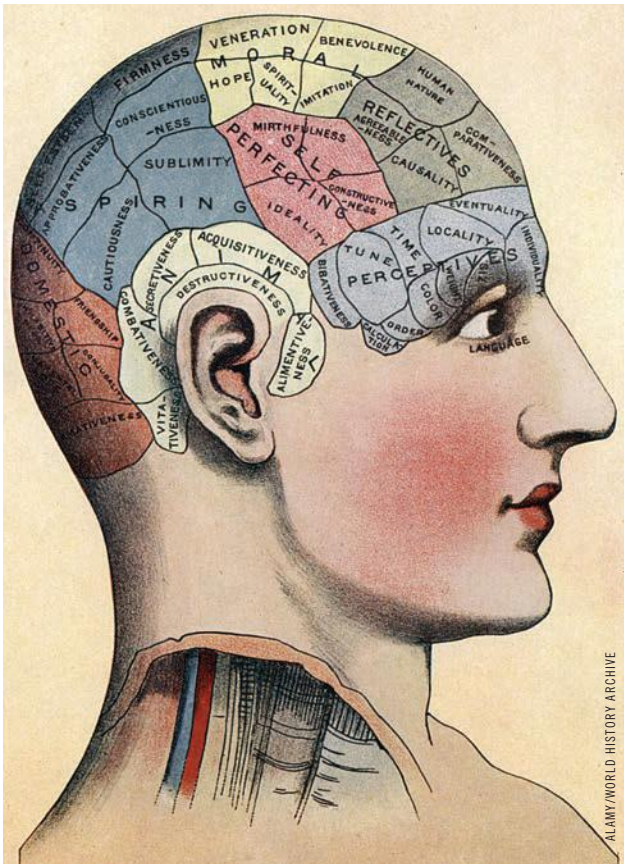


FIGURE 2.7 Phrenology suggested that bumps on a person's head indicated their personality type and intelligence level.

As a child, Gall concluded that memory was located in the brain, just behind the eyes. This conclusion was based on the observation that his friends who had bulging eyes appeared to have superior memories.

As an adult, Gall examined his friend's skulls and noted that those who had bumps on similar locations had similar personality traits. From these observations and further examination of the skulls of criminals and mental patients, Gall created a map of the skull that linked a specific personality characteristic and intellectual ability with a specific

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bump. He assumed, incorrectly, that the bumps and depressions of the skull reflected the amount of brain tissue lying under them. Gall had no means of verifying these speculations.

Gall's student, Johann Spurzheim, popularised the system of phrenology in Europe, and this popularity lasted well into the 20th century. At one point, Britain had 29 phrenological societies, and phrenologists travelled North America giving skull readings.

Today, we may be forgiven for thinking that phrenology was a harmless attempt at studying brain and behaviour. That has not always been the case. Phrenology was very popular throughout Europe, including Germany, in the early 1900s. The Nazis used phrenology to promote racism and eugenics (the study of methods of improving the quality of the human race, especially by selective breeding) and support their claim of German superiority and Jewish inferiority.

Though phrenology lacked scientific evidence, it can be credited with sparking interest in which parts of the brain controlled specific behaviours. Gall's assumption that different parts of the brain control different aspects of behaviour has proved true, but the links he made between specific brain areas and specific behaviours has not. The current understanding that psychological function requires the interaction of several different areas of the brain and that this functioning can be disrupted by damage to one or more of them can also be linked to Gall (Kaas, 1987).

2.1 TRY IT YOURSELF >>

PSEUDOSCIENCES

Conduct an Internet search on the following pseudosciences: astrology, palm reading and tarot card reading. Answer the following questions for each pseudoscience:

- What claims does it make?
- How does it attempt to predict behaviour?
- Why is it considered to be a pseudoscience?

2.1 CHECK YOUR UNDERSTANDING >>

1 Which philosopher focused much attention on the theory of dualism?
- A Plato
- B Aristotle
- C Descartes
- D Freud

2 The view that we consist of two distinct substances (body and mind) and that these two interact is known as:
- A the mind–body problem.
- B the brain versus heart debate.
- C dualism.
- D materialism.

3 Descartes believed that interaction between body and mind took place in:
- A the heart.
- B the nervous system.
- C the pineal gland.
- D the brain stem.

4 Why is phrenology not considered to be a science?

5 Identify two of Galen's theories that are still accepted today.

FROM CASE STUDIES TO BRAIN EXPERIMENTS

As we have seen, early investigations of the brain date back to ancient times when subjective analysis and speculation formed the basis of conclusions. Subjective analysis relies on logic and reasoning, is personalised and unquantified, and the conclusions reached are not supported by reliable or verifiable evidence. Science is based on objective evidence gathered by recording events that can be precisely measured or described and verified under similar circumstances. So, scientific studies are supported by empirical evidence.

It was not until the last two centuries that physicians and scientists began to apply scientific method to systematically research the brain and its functions.

FLOURENS: BRAIN INTERVENTION

Phrenology, despite lacking scientific evidence, caused much interest in localisation of brain function. Around 1825, the French Academy of Sciences asked the leading brain expert of the time, Pierre Flourens (1794–1867), to determine whether phrenology's claims were true.

In response, Flourens developed new experimental methods that directly interfered with the brains of

phrenology A technique used to predict human behaviour that involves feeling bumps on a person's skull and using this information to assess their personality and intelligence

pseudoscience A fake or false science that lacks evidence to support its claims

subjective analysis Analysis based on personal opinions, interpretations, emotions and judgment

objective evidence Information that is based on facts that can be proved through analysis, measurement and observation

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animals by either surgically removing or electrically stimulating specific parts of their brains so he could study the behavioural effects. Flourens also stimulated the brains of some of his human patients while they underwent surgery. The results of these experiments demonstrated that specific brain regions were responsible for specific functions. For instance, when he removed an animal's cerebellum (a structure at the bottom of the brain that sits on top of the brain stem), the animal lost all balance and motor coordination. When Flourens removed one of its cerebral hemispheres, the animal's perceptual ability and thinking were severely affected.

Based on these results, Flourens concluded that phrenology had no scientific or biological basis. He also concluded that the cerebral hemispheres were responsible for all behaviour; the cerebellum regulates and integrates movement; and the brain stem controls vital functions such as circulation, respiration and general bodily stability. However, Flourens was unable to find specific locations for complex behaviours such as memory and cognition. This led to the further conclusion that while some behaviours can be ascribed to specific brain regions, other behaviours are represented throughout the brain (Sabbatini, 1997).

To gather information about the effect specific brain diseases and injuries had on behaviour, Flourens also dissected and analysed lifeless brains during autopsies. In later years, case studies of living people that compared the brain and behaviour of people with intact brains with those who had experienced brain injury also provided useful information about the role of the brain in behaviour.

PHINEAS GAGE: A MEMORABLE CASE STUDY

One remarkable case study is that of Phineas Gage, a 25-year-old foreman on an American railway work crew. One day in 1848, Gage was using a long steel rod to ram gunpowder into a rock. The rod rubbed the rock's side, causing a spark that ignited the gunpowder. As a result, the rod was blown into Gage's left cheek, through his forebrain, and exited from the top of his skull (see Figure 2.8). Amazingly, Gage survived, and within two months he could walk, talk and move normally. Gage lived for another 12 years, with little apparent change in his intellectual abilities, but the injury forever changed his personality. Instead of the honest, dependable worker he had been before, Gage became a surly, aggressive, uncaring, foul-mouthed liar. He eventually left the railway job and spent the rest of his life as part of a travelling side show.

The Phineas Gage case study provided some of the first evidence that different areas of the brain control specific behaviours. It offered insight into the role brain structure plays in behaviour, particularly the role of the frontal lobes (the brain area behind the forehead) in personality, emotion and cognition.

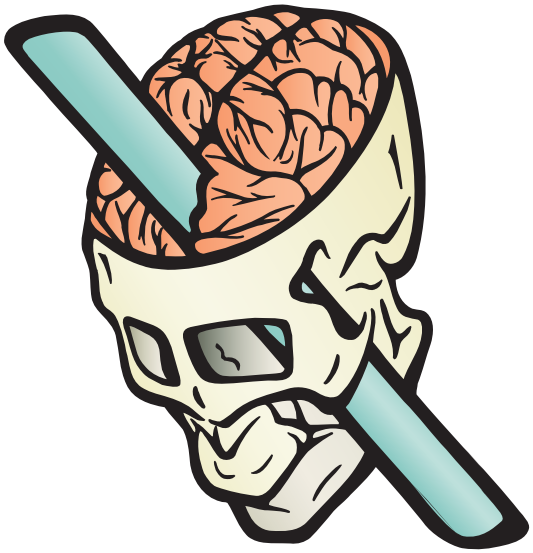


FIGURE 2.8 The path of the rod that pierced Phineas Gage's skull and brain

Scientists now had a greater understanding of how mind and behaviour were linked to brain structures. Physicians, especially those treating mentally ill patients, were also considering how they could use this knowledge of the brain to alleviate a variety of patient conditions.

BURKHARDT AND MONIZ: LOBOTOMY

During the late 19th century and early 20th century, an experimental psychosurgical technique that involved permanently altering the brain gained popularity as a treatment for some mental illnesses. This early form of lobotomy involved severing the nerves connecting the frontal lobes to the emotion-controlling centres of the inner brain to permanently alter behaviour.

In 1892, Gottlieb Burkhardt (1836–1907), the supervising physician of a Swiss insane asylum, lobotomised six mentally ill patients who had hallucinations that caused them to become very agitated. Burkhardt reported that his patients were much calmer after the surgery. At around the same time, American scientists conducting similar

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experiments on chimpanzees also reported that aggressive animals became calm and manageable after their frontal lobes had been surgically altered.

Findings from these experiments inspired the Portuguese neuropsychiatrist Dr Antonio Egas Moniz (1874–1955) to perform similar operations in the 1930s on some of his uncontrollably emotional and violent patients. After placing his patients into a coma, Moniz hammered an ice-pick-like instrument through each eye socket into the brain, then wiggled it, to sever connections to the frontal lobes (see Figure 2.9). The whole procedure was crude but easy and inexpensive, and it took only about 10 minutes to perform. During the 1940s and 1950s, tens of thousands of mentally ill people were lobotomised, and Moniz was honoured with a Nobel Prize (Valenstein, 1986).

Although lobotomy succeeded in calming some disturbed patients, these patients generally became permanently lethargic, acted immaturely and they became impulsive. Because of these negative side effects, lobotomy is only performed in extreme cases. While lobotomies did have drastic results for the patient, they also added to our understanding of the biological basis of psychological behaviour.



FIGURE 2.9 Dr Walter Freeman performing a lobotomy in 1949 using an instrument like an ice pick, which he invented for the procedure. Inserting the instrument under the upper eyelid of the patient, Dr Freeman cuts nerve connections in the front part of the brain. Lobotomy is a controversial procedure. Because of its negative side effects, lobotomy is now only performed in extreme cases.

2.2 CHECK YOUR UNDERSTANDING >>

1 Flourens began experimenting on animals to determine whether:
   - A the mind was located in the heart.
   - B there was a biological basis to phrenology.
   - C the body and brain interacted through the pineal gland.
   - D Galen's assertion that all mental activity occurred in the brain rather than the heart was true.

2 The Phineas Gage case study provided insight into:
   - A personality changes over the lifespan.
   - B the role of the temporal lobe.
   - C the localisation of brain function.
   - D the mind–body problem.

3 Case studies, such as Phineas Gage, have limited applications because:
   - A they cannot be replicated.
   - B they are uncontrolled studies.
   - C they cannot be generalised.
   - D All of the above

4 Explain the difference between subjective analysis and objective analysis.

5 Explain one limitation of lobotomy as a way of treating dysfunctional behaviour.

BROCA AND WERNICKE: LOCALISATION OF LANGUAGE

In the 1800s, a series of clinical discoveries in France and Germany also provided clues that higher mental functions were linked to specific brain areas. The most influential of these were by Paul Broca (1824–1880) and Carl Wernicke (1848–1904) who discovered important brain structures in the left hemisphere responsible for language.

Broca, a French physician, studied the brains of several patients who had suddenly lost their speech ability. In a classical study in 1861, Broca treated a 51-year-old man named Leborgne who was given the nickname 'Tan' because he had a severe speech disorder that made 'tan' the only syllable he could pronounce clearly. After Tan died, Broca autopsied Tan's brain and found damage to a small area of his left frontal lobe. Broca concluded that this area of the brain controls the production of speech, and it became known as Broca's area.

Broca's area An area in the left frontal lobe of the brain that controls the muscles responsible for the production of articulate speech



FIGURE 2.10 Paul Broca (1824–1880) identified the area in the left frontal lobe responsible for speech production.

Broca conducted similar examinations on other patients and reported that after damage to their left frontal lobe, they also struggled to form words but were still able to comprehend speech. Further post-mortem examinations on patients who experienced the same sudden speech loss found that they had similar lesions in this area. Broca named this language disorder Broca's aphasia (from the Greek word for 'speechlessness'). His studies were confirmed by several neurologists of the time.

Broca showed that there was not only a connection between brain structure and behaviour, but that a relationship existed between a specific brain site (left frontal lobe) and a specific behaviour (speech production). This finding also contributed to the understanding that there is a separation of function between the left and right hemispheres of the brain, and that the left hemisphere is specialised for language.

The German neurologist Carl Wernicke examined patients who could hear words but could not recognise them or remember them. These patients spoke fluently but had difficulty comprehending speech and they made little or no sense when they spoke. Upon their death, Wernicke autopsied their brains and found damage to the rear margin of the left temporal lobe (the brain area just above the ears). Wernicke believed this area was connected by nerve fibres to Broca's area, thus forming a complex system responsible for understanding and talking. He concluded that the rear section of the left temporal lobe was primarily responsible for language comprehension but was also involved in speech production. This area of the brain became known as Wernicke's area and the language impairment that resulted from damage to the area became known as Wernicke's aphasia.



FIGURE 2.11 Carl Wernicke (1848–1904) identified the area in the left temporal lobe involved in comprehension of language, later known as Wernicke's area.

FRITSCH, HITZIG AND PENFIELD: MAPPING THE BRAIN

Around the same time that Broca and Wernicke conducted their investigations, German physiologists Gustav Fritsch (1838–1927) and Eduard Hitzig (1839–1907) investigated localisation of brain function by electrically stimulating small regions exposed on the brain surfaces of awake dogs. When they stimulated neurons in the rear of a dog's right or left frontal lobe, muscles in the forelegs or hindlegs on the opposite side of its body would move. When they stimulated other cortical areas, the muscles in the dog's head and neck would contract. This discovery provided the first evidence of finer localisation of motor function in the cortex, and the beginnings of a whole new approach for mapping the brain (Breathnach, 1992).

To further investigate brain localisation, German neurosurgeon Feodor Krause (1857–1937) electrically stimulated the cortex of anaesthetised human patients undergoing brain surgery and found the same results

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regarding localisation of function as Fritsch and Hitzig. Krause's basic mapping of the motor areas of the cortex provided a background for more modern investigations in patients using local anaesthesia, such as the cortical mapping experiments carried out by a Canadian neurosurgeon, Wilder Penfield (1891–1976), in the 1940s and 1950s.

Penfield was interested in the functional organisation of the brain, particularly its relationship to epilepsy, a debilitating condition involving nerve cells in the brain firing abnormally and causing seizures. One of his major contributions to neuroscience was the use of the 'Montreal procedure' for surgically removing scar tissue that caused epilepsy. This involved making an incision through the scalp, pulling it away from the skull, sawing through a portion of the skull and removing a large flap of bone, leaving the cerebral cortex exposed. He then administered a weak electrical current to the exposed cortical area so he could identify which cortical site triggered the seizure. Because there are no pain receptors in the brain, this technique meant patients required only a local anaesthetic at the site of the scalp and skull incision, so they could remain awake during surgery and respond to questions.

Penfield discovered that by stimulating different parts of the brain's cortex (direct brain stimulation), the different sections of the cortex responsible for specific sensory, motor and emotional functions could be identified. For example, when one patient's temporal lobe was electrically stimulated, they vividly experienced a long-forgotten childhood memory. Penfield also found that stimulating specific points on one side of the brain caused movements of, or sensations in, specific parts on the opposite side of the body. For example, when he stimulated specific areas of the right side of the brain, the patient would report a tingling in their left foot.

After stimulating points across the entire cerebral cortex of many patients, Penfield identified how much of the cortex was devoted to specific functions. He demonstrated that cortical areas controlling movement and bodily sensations function *contralaterally*. This means that specific areas on the right side of the cortex receive sensations from and control motor movement in the left side of the body and vice versa.

Penfield used this information to create the first map of the cerebral cortex that accurately identified the site of specific sensory and motor functions (see Figure 2.12). The concept of brain localisation was now firmly established in the neurosciences.

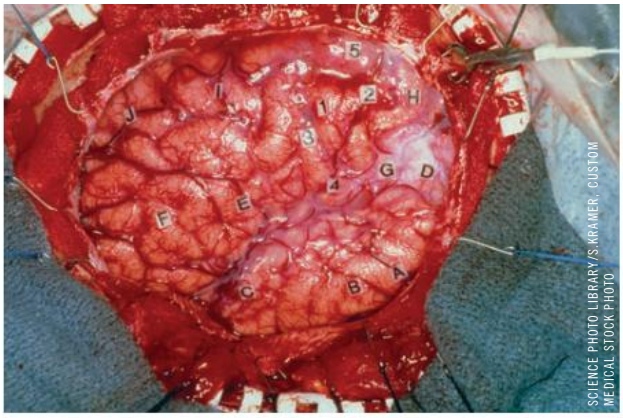


FIGURE 2.12 The exposed cortex of a brain during surgery, with numbered labels showing areas of the cortex that respond to stimulation in specific ways

2.3 CHECK YOUR UNDERSTANDING >>

1 Which of the following terms did Broca use to describe language impairment that results from brain damage?
   - A Agnosia
   - B Aphemia
   - C Apraxia
   - D Aphasia

2 Damage to the left frontal lobe may result in:
   - A Wernicke's aphasia.
   - B Broca's aphasia.
   - C difficulty understanding speech.
   - D difficulty remembering the meaning of words.

3 If a neurosurgeon was going to operate to remove a brain tumour, they might also conduct some research at the same time to test which areas of their patient's brain was involved in experiencing hallucinations. What type of research would this be?
   - A A survey
   - B A case study
   - C Direct brain stimulation
   - D A clinical study

4 Penfield used electrical stimulation of the brain to demonstrate that the right hemisphere controls movement:
   - A on the right side of the body.
   - B on the right and left side of the body.
   - C on the left side of the body.
   - D of muscles involved in speech.

➜

Broca's aphasia An impairment in the ability to produce articulate speech, caused by damage to Broca's area

Wernicke's area An area of the left temporal lobe of the brain responsible for the comprehension of language and the formulation of meaningful sentences

Wernicke's aphasia An impairment in the ability to understand language and formulate coherent, meaningful speech, caused by damage to Wernicke's area

5 Outline how a neurosurgeon could use direct brain stimulation during brain surgery to determine whether their patient had suffered any loss of function as a result of the surgery.

OBSERVING THE BRAIN

Many medical and technological studies of the 20th century have provided useful empirical evidence relating to brain structure and function. These studies complement the previous understanding of brain anatomy and allow psychologists to view the brain as a dynamic entity that is the source of all behaviour.

ADVANCES IN NEUROIMAGING

To examine a living, functioning brain early neuroscientists had to wait to operate on people who had sustained brain injuries. Or they could wait for people to die in order to conduct an autopsy, but this did not allow the brain to be studied in action.

Fortunately, technological advances and the introduction of neuroimaging techniques allow scientists to study the structure *and* function of the human brain in ways that were not previously possible. Today, researchers can electrically, chemically or magnetically stimulate various parts of living brains (both intact and damaged) and see the effects on behaviour.

Some of the most widely used neuroimaging techniques produce static images of brain structure at one point in time, such as computerised tomography (CT) and magnetic resonance imaging (MRI). Other techniques, such as positron emission tomography (PET) and functional magnetic resonance imaging (fMRI), provide images of brain structure as well as activity or function.

Neuroimaging techniques

Computerised tomography (CT) involves a specialised X-ray that provides a clearer image of brain structure than conventional X-rays (see Figure 2.13). When undergoing a CT scan, a person has an iodine-based contrast substance injected into a vein that is absorbed by blood vessels. This makes it easier to identify brain structures when the image is produced. A number of X-rays are taken from different angles and combined to produce a computer-enhanced, high-resolution, black-and-white 2-D image of a cross-section of the brain. CT scans allow neuropsychologists to locate a brain structure and assess the effects of damage caused by strokes, injuries, tumours and disease, but they do not provide information about how the brain actually functions.

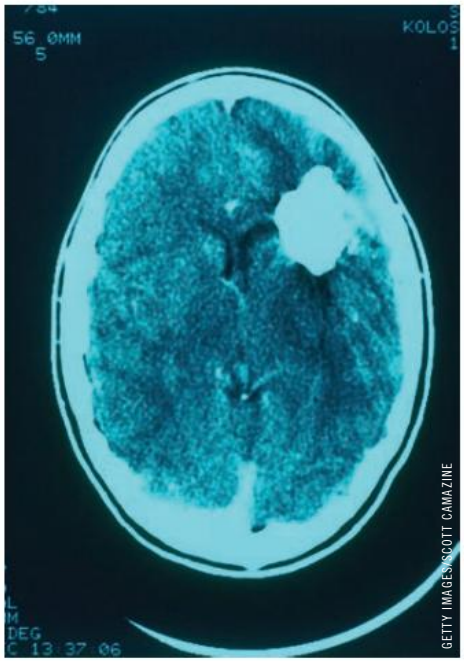


FIGURE 2.13 A pre-operative CT scan of a 16-year-old female's brain, showing a tumour in the frontal lobe

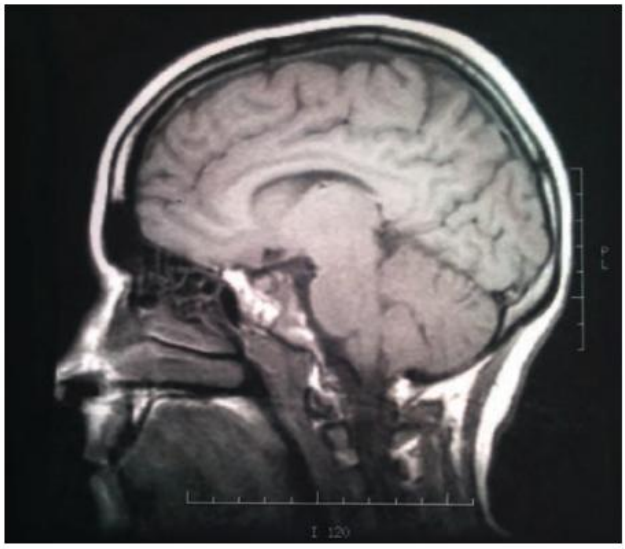


FIGURE 2.14 An MRI image of the brain. Key brain structures can be observed in fine detail.

Magnetic resonance imaging (MRI) reveals the anatomy of the brain in greater detail than a CT scan, and it does not require use of potentially harmful X-rays. An MRI scan requires a person to lie down while their head is placed in a chamber. A harmless magnetic field is created around their head through which radio waves are pulsed to vibrate brain neurons. These vibrations are detected by a magnet inside the chamber and the data is sent to a specialised computer that produces a detailed, still image of a brain area or structure (see Figure 2.14), which can then be further combined to form 3-D images if necessary.

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Although CT and MRI scans provide useful images of brain structures, they do not provide information about the activity level of a brain structure. To obtain images of the functioning brain, neuropsychologists use a range of techniques, including PET and fMRI.

Individuals undergoing a positron emission tomography (PET) procedure have a small, harmless dose of radioactive glucose injected into their bloodstream. They also have positron detectors placed around their head to detect the positrons emitted by the radioactive glucose as it is absorbed by the brain.

The PET procedure tracks which brain areas absorb more glucose, and therefore use more energy, as tasks are being completed. A computer then generates a coloured image of the activity level of various brain areas during the performance of the specific task, such as reading, problem-solving or hand-clapping. A colour code differentiates levels of brain activity. The highest level of activity (and, therefore, highest level of glucose absorption) is shown in red, followed by yellow, then green. Blue indicates the lowest level of activity.

PET data provides information about brain areas or structures involved in performance of specific tasks, as well as which areas interact when these tasks are being completed. As you can see in Figure 2.15, PET scans reveal that very specific brain areas are active when you are reading a word, hearing a word, saying a word, or thinking about the meaning of a word. Unfortunately, PET scans do not provide an image of the health level of brain areas or structure, so we cannot see any abnormality or damage – we can only see the effect of such damage on brain functioning.

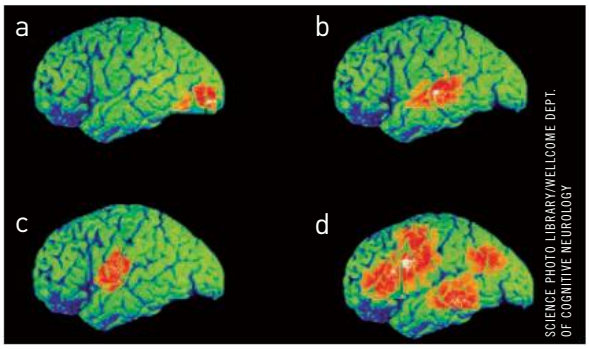


FIGURE 2.15 This PET scan shows which parts of the brain (red) are active when (a) reading a word silently, (b) hearing a word, (c) speaking a word, and (d) thinking about and speaking a word.

neuroimaging A technology that provides images of brain structure and function

computerised tomography (CT) A brain neuroimaging technique that takes clear X-rays of the brain at different angles to produce a computer-enhanced 2-D image of a cross-section of the brain

magnetic resonance imaging (MRI) A brain neuroimaging technique that uses a magnetic field and radio waves to vibrate brain neurons and produce a detailed, still, computer-enhanced 3-D image of brain areas or structures

positron emission tomography (PET) A brain neuroimaging technique involving the injection of radioactive glucose into the bloodstream, tracking the blood flow to the brain and combining the data into a series of computer-generated colour-coded images of the level of activity in various brain areas while engaged in different tasks

functional MRI (fMRI) A brain neuroimaging technique that detects changes in oxygen levels in the blood flowing through the brain and combines this data into a detailed computer-enhanced 3-D representation of the active brain

FOCUS ON RESEARCH 2.1

BRAIN DAMAGE CAUSED BY SEVERE SLEEP APNOEA IS REVERSIBLE

Obstructive sleep apnoea is a destructive, potentially life-threatening sleep disorder. Warning signs include snoring, choking and repeated gasping or silent breathing pauses during sleep. A recent neuroimaging study using a form of magnetic resonance imaging (MRI) is the first to show that white matter damage caused by severe obstructive sleep apnoea can be reversed by continuous positive airway pressure (CPAP), a treatment that uses mild air pressure to keep airways open.

Results show that participants with severe, untreated sleep apnoea had significantly less white matter in multiple brain areas, which caused impairments to cognition, mood and daytime alertness. Although three months of CPAP therapy produced only limited improvements to damaged brain structures, MRI scans taken after 12 months of CPAP therapy showed there was an almost complete reversal of white matter abnormalities. Treatment also produced significant improvements in nearly all cognitive tests, mood, alertness and quality of life.

The study involved 17 men with severe, untreated obstructive sleep apnoea who had an average age of 43 years. They were evaluated before treatment and after both three months and 12 months of CPAP therapy. Each time, they underwent a neuropsychological evaluation and a diffusion tensor imaging (DTI) examination – a form of MRI that measures the flow of water through brain tissue.

Source: Adapted from American Academy of Sleep Medicine. (2014, September 8). Brain damage caused by severe sleep apnea is reversible. *ScienceDaily*. Reproduced with permission.

QUESTIONS

1. Identify a suitable sampling technique for this research.
2. Write a hypothesis for this study.
3. Explain why the participants were evaluated before and after CPAP treatment.
4. What were the results?
5. What conclusions can be drawn from the results?

A functional MRI (fMRI) procedure follows the standard MRI procedure but it also makes brain activity visible on a computer screen. By detecting the differences between oxygenated and deoxygenated blood, an fMRI records changes in blood flow to and from different parts of the brain as it undertakes different activities. A computer combines this data and creates a three-dimensional image of the active brain.

Psychologists use fMRI images to pinpoint which brain areas and structures are most active when a person is engaged in cognitive or physical activity (see Figure 2.16). For example, the motor cortex will be highlighted in an fMRI image when a person taps their fingers. This is because the motor cortex is more active than other brain areas during a movement task, so it will require more blood flow, meaning its blood oxygen level will be higher than that of other brain areas.

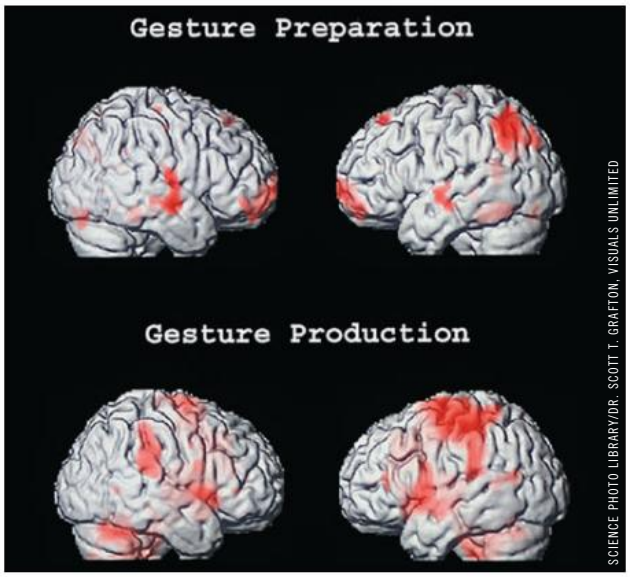


FIGURE 2.16 These fMRI images show areas of the brain that are active when thinking about an activity (top) and areas that are active when performing this activity.

2.2 FOCUS ON RESEARCH

STORIES MAY CHANGE THE BRAIN

Researchers at Emory University have used functional magnetic resonance imaging (fMRI) to demonstrate that reading a novel may cause brain changes that last for a few days after reading the story. Previous research using fMRI data had identified brain networks associated with reading stories while participants read them; that is, while they were in the fMRI scanner. The Emory study, however, focused on the lasting neural effects of reading a novel.

Twelve female and nine male subjects between the ages of 19 and 27 participated in the study. Each morning for 19 consecutive days, the participants underwent an fMRI scan of their brains in a resting state. For the first 5 days and the last 5 days of the study, participants did not perform any task other than to have their brains scanned. On the middle 9 days, their task was to read a section of a novel (1/9 each day) during the evening. Before their scan the next morning, participants also completed a quiz and self-report to confirm that they had done the reading and report on how arousing the reading was.

The chosen novel was *Pompeii: A Novel*, a 2003 thriller by Robert Harris, based on the eruption of the volcano Mount Vesuvius, which buried the cities of Pompeii and Herculaneum in ancient Italy. The researchers chose this novel due to its dramatic plot: its main protagonist is outside the city of Pompeii when he notices steam around the mountain. Sensing something is amiss, he tries to return to Pompeii to save the woman he loves. Meanwhile, nobody in Pompeii realises the volcano is about to erupt.

The researchers found that, following the reading assignments, even though participants were not actually reading while they were in the scanner, the fMRI showed heightened connectivity in the left temporal cortex, an area of the brain associated with language. The primary sensory motor region of their brain also showed increased connectivity. These increases in connectivity persisted for several days after completion of the reading.

'The neural changes that we found associated with physical sensation and movement systems suggest that reading a novel can transport you into the body of the protagonist,' says neuroscientist Gregory Berns, the lead author of the study. 'We already knew that good stories can put you in someone else's shoes in a figurative sense. Now we're seeing that something may also be happening biologically.'

Berns says that the neural changes were not just immediate reactions, because they persisted the morning after the readings and for the five days after the participants completed the novel.

'It remains an open question how long these neural changes might last,' Berns says. 'But the fact that we're detecting them over a few days for a randomly assigned novel suggests that your favourite novels could certainly have a bigger and longer-lasting effect on the biology of your brain.'

Sources: Berns, G. S., Blaine, K., Prietula, M. J., & Pye, B. E. (2013). Short- and Long-Term Effects of a Novel on Connectivity in the Brain. *Brain Connectivity*, 3(6): 590-600. doi:10.1089/brain.2013.0166; Clark, C. (2013). A novel look at how stories may change the brain. *eScienceCommons*. Emory University. Retrieved from http://esciencecommons.blogspot.com.au/2013/12/a-novel-look-at-how-stories-may-change.html

QUESTIONS

1. What was the aim of this research?
2. Create a hypothesis for this research.
3. What was the purpose of the first series of resting-state fMRI scans?
4. What were the results of the study?
5. What conclusion can be drawn from the results?

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2.4 CHECK YOUR UNDERSTANDING >>

1 A neuroscientist is investigating the relationship between the frontal lobe and other parts of the brain in problem-solving. Which neuroimaging technique would be most useful in this research?
   A CT scan
   B PET scan
   C MRI
   D fMRI
2 Which of the following neuroimaging techniques provides the most detailed information on brain structure and function?
   A MRI
   B CT scan
   C fMRI
   D PET scan
3 Outline how a neurosurgeon could use a PET scan to determine whether a structural abnormality was the cause of a patient's language impairment.
4 Identify one advantage of a PET procedure.
5 Identify and explain two ethical principles that a neuroscientist would need to follow when using a neuroimaging technique with a patient.

2.2 TRY IT YOURSELF >>

COMPARING NEUROIMAGING TECHNIQUES

Construct a table that compares the following neuroimaging techniques: CT, MRI, fMRI and PET.

In your table:

» describe the technique
» state what type of image it provides
» identify at least one advantage of the technique
» identify at least one disadvantage of the technique.

THE HUMAN NERVOUS SYSTEM

The human nervous system is a complex physiological structure composed of billions of interconnected neurons. A neuron is an individual nerve cell that receives, transmits and processes information so quickly that we are not aware of its activity. A single neuron cannot do very much on its own, but when millions of neurons work together in vast networks, they produce all the psychological and physical behaviours we are capable of.

The nervous system is a hierarchical structure. It reacts to changes both outside and inside the body, and uses electrical and chemical means to send and receive messages. Each component of the human nervous system has a sensory role and a motor role that enable the nervous system to function as the physiological communication system between the body's internal cells and organs and the external world. We depend on the nervous system to receive sensory information from the environment, process the information and transmit motor messages around our body that, in turn, determine our reaction to that information. For example, if a friend offers you an ambiguous object that looks a bit like a lolly and a bit like a dog biscuit, the information received – a small object offered by a friend – is integrated with what the person knows about the appearance of lollies and dog biscuits, and about whether the friend is a practical joker. The result of this information processing will be a decision to either refuse the object or to reach out for it, while preparing the mouth and stomach to receive food (see Figure 2.17). This decision and subsequent actions will be due to the interaction of the divisions of the human nervous system.



FIGURE 2.17 The nervous system receives sensory information, processes or integrates it, then transmits motor messages around the body to determine our reaction to that information.

As we will see later in this chapter, neurons communicate with one another through the transmission of electrochemical messages (neural impulses) from neuron to neuron.

nervous system A system of networks of specialised cells (neurons) that connect different parts of the body to each other and the brain via electrochemical signals

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The nervous system can be divided into two major components or divisions (see Figure 2.18): the central nervous system (CNS) and the peripheral nervous system (PNS). Although these divisions are separate physiological structures, their functions are interconnected and both divisions play a significant role in determining our behaviour.

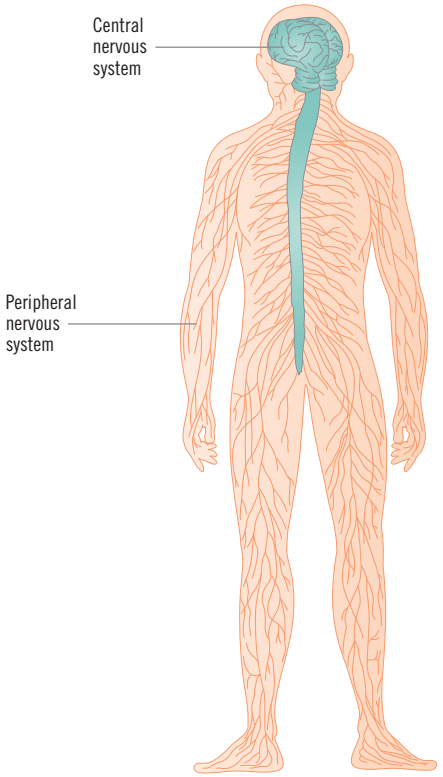


FIGURE 2.18 The components of the human nervous system

THE CENTRAL NERVOUS SYSTEM (CNS)

The central nervous system (CNS) is composed of the brain and the spinal cord (see Figure 2.19).

The spinal cord, an intricate and delicate cable of nerve fibres stretching from the base of the brain to the lower back, connects the brain to the rest of the body via its connection to the peripheral nervous system (PNS). The spinal cord has two key roles in communicating neural information. First, sensory neurons in the spinal cord receive sensory information from the PNS and transmit it up to the brain for processing, in a chain of sensory neurons known as ascending tracts. Second, motor neurons in the spinal cord receive motor messages from the brain, which it transmits to the PNS and, therefore, to the rest of the body, in a chain of motor neurons known as descending tracts. This happens so rapidly and continuously that we are barely aware of it.

If the spinal cord is damaged, the flow of information between the brain and the rest of the body is interrupted. This may result in a loss of sensation in a specific body part or an inability to move a specific body part. For example, damage to the lower section of the spinal cord can result in loss of sensation from, and inability to move, the hips and legs.

THE PERIPHERAL NERVOUS SYSTEM (PNS)

The peripheral nervous system consists of all the nerves outside the CNS; in other words, all the nerves in the rest of the body (see Figure 2.18). The role of the PNS is to carry sensory information from the rest of the body to the CNS, and motor information from the CNS to the rest of the body. It carries out this role via a connection to the spinal cord.

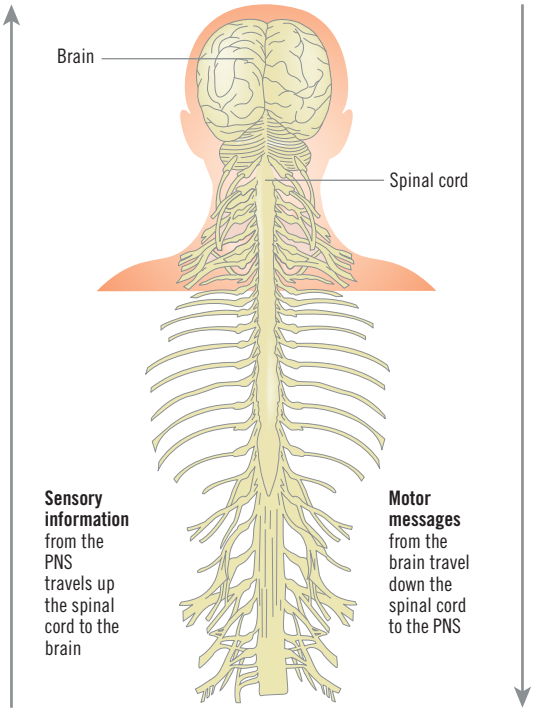


FIGURE 2.19 The central nervous system – sensory information travels up the spinal cord to the brain; motor messages travel down to the muscles.

An example of the way the PNS and CNS work together and connect with the external world is when you are running a shower and you put your hand under the stream of water to test the temperature. Sensory neurons in your skin register the temperature, and that information is transmitted by the PNS to the spinal cord and on to the brain. The brain then determines whether you need to add more hot or cold water.

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The brain sends these motor messages via the spinal cord and the PNS to your hand. Your hand then either adds more hot or cold water depending on the temperature interpreted by the brain.

We can see, therefore, that the CNS and PNS work together in a smooth and integrated way to enable us to perform everyday functions.

The PNS comprises two subdivisions: the somatic nervous system and the autonomic nervous system (ANS).

The somatic nervous system

Like all parts of the nervous system, the somatic nervous system (also known as the skeletal nervous system) has a sensory role and a motor role. Its sensory role consists of receiving sensory information from receptor cells located throughout the body and transmitting it inwards to the spinal cord.

The somatic nervous system controls *voluntary* movement through its control of skeletal muscles (muscles attached to bones). It receives motor messages from the CNS and transports them to skeletal muscles in specific body regions so that our responses to stimuli are appropriate. Tying a shoe lace, kicking a football or cleaning your teeth are all voluntary actions that involve the skeletal muscles controlled by the somatic nervous system.

The autonomic nervous system (ANS)

Imagine that you are strolling along the beach. Your somatic nervous system is controlling the many muscles needed to execute this activity. You are in conscious control of these actions because they are voluntary. Suddenly, the sound of a large wave crashing onto the beach frightens you. Instantly, you jump back from the water. You do not consciously decide to do this; it is not a voluntary decision. This behaviour is due to your autonomic nervous system (ANS).

The ANS contains nerves that are connected to the CNS and the involuntary (or smooth) muscles that control the activity level of our internal organs and glands. By relaying messages between the CNS and our internal systems, the ANS controls all the body's involuntary internal activities that are essential to survival. These activities include heart rate, digestion, kidney function, liver function, glandular activity and perspiration levels.

The word 'autonomic' means self-governing and, as the name indicates, the activities controlled by the ANS are mostly automatic. This means they are self-regulating and generally operate independently of the brain, whether we are awake or asleep. For example, in bright light, the automatic constriction of your pupils to limit the amount of light entering the eye is automatic, whereas raising your hand to shade your eyes from bright light is voluntary behaviour.

An independent and constantly functioning ANS means that the vital organs and body systems we depend on for physical survival are kept functioning more or less automatically and without any conscious effort. Automatic ANS activity also ensures that our changing energy requirements are met and our body is maintained in proper working order according to the demands placed on it. The ANS energises us so we are aroused when we need to be, and lowers our arousal level when we need to calm down.

By automatically regulating the activity level of survival-related internal systems, the ANS leaves our mind free to focus on important external or internal stimuli. Although the ANS acts independently from the brain in many ways, it does still supply information to the brain and receive some commands from it. Some ANS neurons have long fibres through which motor messages are sent. These motor messages regulate the activity level of involuntary muscles, internal organs and glands, and return information to the brain about

central nervous system (CNS) A major division of the nervous system consisting of all the nerves in the brain and spinal cord

spinal cord A part of the CNS that consists of a cable of nerve fibres stretching from the base of the brain to the lower back; connects the brain to the PNS and transmits sensory information from the PNS to the brain and motor messages from the brain to the PNS

peripheral nervous system (PNS) A major division of the nervous system consisting of all the nerves outside the CNS; transmits sensory information inwards to the CNS and transmits motor messages from the brain outwards to the rest of the body

ascending tracts The chain of sensory neurons in the spinal cord that send information from the PNS up to the brain for processing

descending tracts The chain of motor neurons in the spinal cord that receive motor messages from the brain and transmit these to the PNS and the rest of the body

somatic nervous system The division of the PNS that transmits sensory information received from sensory receptor cells inwards towards the CNS, and motor messages from the CNS to the body's voluntary skeletal muscles; also known as the skeletal nervous system

autonomic nervous system (ANS) The division of the PNS that transmits motor messages from the brain to the body's internal organs and glands, which results in involuntary activity of internal organs and glands, and transmits messages back to the brain about the activity level of these organs and glands

their activity level. Other ANS neurons are directly connected to the CNS. For example, if you are wakened by shouts of 'Fire!', sensory neurons in your ears send a message to your brain. Your brain interprets this to mean danger and sends an emergency command to the ANS. The ANS then springs into action, arousing you through its various connections to the involuntary muscles that control the internal organs and glands. This is why you have the extra energy needed (often in the form of an adrenalin rush) to leap out of bed and run to safety.

We can practise certain techniques to influence the ANS. At times when you have wanted to remain calm, you may have exercised some conscious control over your breathing rate; or you may have 'forced' yourself to stop blinking for a period of time. These techniques are often used to reduce stress, to rehabilitate the body after injury or surgical operations and to relieve depression, among other things. The techniques work because it is possible to consciously influence the functioning of the ANS.

The ANS can be further divided into two subdivisions: the *sympathetic nervous system* and the *parasympathetic nervous system*.

2.5 CHECK YOUR UNDERSTANDING >>

1 Which of the following activities is a function of the somatic nervous system?
   - A Writing a text message
   - B Digesting after eating a large bowl of pasta
   - C Your heart rate elevating when watching a horror movie
   - D Your breathing rate decreasing after turning off a horror movie

2 Which of the following statements about the nervous system is not true?
   - A The CNS has two major divisions.
   - B The CNS is composed of the somatic nervous system and the peripheral nervous system.
   - C The autonomic nervous system regulates the activity of your involuntary muscles, internal organs and glands.
   - D The spinal cord carries incoming sensory information to the brain and outgoing movement messages from the brain to the rest of the body.

3 Which of the following activities is not a function of the autonomic nervous system?
   - A You sneeze in response to dust.
   - B You sweat when it gets hot.
   - C The sun comes out and your pupils constrict.
   - D The sun comes out and you put on your sunglasses.

4 Describe the structure of the human nervous system.

5 Briefly explain how the spinal cord tracts assist the transmission of sensory and motor information between the CNS and PNS.

THE SYMPATHETIC NERVOUS SYSTEM: READY FOR ACTION!

In many ways, the sympathetic nervous system is the body's 'emergency' or 'arousal' system. This is the branch of the ANS that dominates during times of high emotion. The sympathetic nervous system mobilises the body's internal resources to provide the extra energy we need for vigorous action, especially in times of stress or threat.

When the sympathetic nervous system dominates, it arouses or energises the body and prepares it for emergency action. It does this by increasing the activity level of some bodily systems while others are slowed down.

Physiological changes in response to a perceived threat begin when a motor message is sent to the adrenal glands. This stimulates them to release the stress hormones adrenaline and noradrenaline into our bloodstream. This rush of hormones increases our heart rate and blood pressure, causing the blood carrying the adrenal hormones to move around our body at a fast rate. When this happens, various other systems are activated. Fats and sugars are released into the bloodstream for additional energy. Our heart rate and breathing rate quicken, and this gives us the extra oxygen needed to convert the released fats and sugars to energy.

This energy-charged blood is quickly carried to our skeletal muscles, enabling them to move at a fast rate. Our mouth feels dry because the activity level of our salivary glands has slowed. Our sweat glands produce more perspiration and our bladder and bowels relax. At the same time, we are unaware that our digestion slows as our stomach decreases its contraction rate in order to conserve energy. Blood flow to skeletal muscles increases but the flow to the skin decreases to reduce bleeding, and our pupils dilate to allow extra light to enter the eye so we can see better.

By initiating these changes and regulating internal activity, the sympathetic nervous system energises us and physically prepares us for action: to stay and 'fight' the situation or to engage in 'flight' by running to safety (referred to as the 'fight-or-flight response').

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TABLE 2.1 Physiological responses to activation of the sympathetic and parasympathetic nervous systems

SYMPATHETIC RESPONSE – AROUSING	BODY ORGAN	PARASYMPATHETIC RESPONSE – CALMING
Releases hormones (adrenaline and noradrenaline) to stimulate or repress activity of internal organs	**Adrenal glands attached to kidneys**	Decreases hormone activity
Increases heart rate and pumps blood faster	**Heart**	Decreases heart rate to normal functioning
Increases expansion of lungs and rate of oxygen production; relaxes the airways	**Lungs**	Decreases oxygen production; constricts airways
Produces and releases increased level of sugar	**Liver**	Returns to normal functioning
Decreases contractions and slows digestion	**Stomach**	Returns to normal functioning
Decreases production of saliva	**Salivary glands**	Normal production of saliva
Increases perspiration	**Sweat glands**	Inhibits perspiration
Increases production of bile	**Gall bladder**	Inhibits production of bile
Dilates pupils to take in more light	**Eyes**	Constricts pupils; gives near vision
Slows contraction rate and relaxes	**Bladder**	Returns to normal functioning
Stimulated	**Sex organs**	Unstimulated

THE PARASYMPATHETIC NERVOUS SYSTEM: KEEPING US CALM

Once the need for high arousal has passed, the parasympathetic nervous system reverses the effects of the sympathetic nervous system. This reversal returns our body to its normal level of arousal, or a more relaxed state when the period of high emotion or need for physical activity has passed. Our heart and breathing rates, the level of sugar and fats in our bloodstream, the size of our pupils, our blood pressure and digestion rate and many other functions all return to their normal level of activity.

In maintaining vital functions such as heart rate, breathing rate and digestion at normal levels, the parasympathetic nervous system plays a major role in keeping us in a state of wellbeing, or homeostasis. Homeostasis refers to our balanced and healthy state and, luckily, this is the physiological state that we spend most of our time enjoying.

You may have noticed that you take longer to calm down than to become aroused. This is because the parasympathetic nervous system's response is slower than that of the sympathetic nervous system. Increased levels of adrenaline and other hormones needed for sudden increases in activity are quickly activated by the sympathetic nervous system. But although they instantly enter our bloodstream, they take some time to disappear. Therefore, the effects of the parasympathetic nervous system are not experienced until sometime after the need for extra energy has disappeared. That is why increased heart rate, muscle tension and other signs of arousal may not fade for 20 or 30 minutes after you feel an intense emotion (such as fear) or engage in increased physical activity.

We have learned that, depending on whether the sympathetic or parasympathetic system is activated, organs, muscles and glands will respond in a particular way. Though both of these divisions are always active, one usually dominates, functioning similarly to the accelerator and brakes on a car. Table 2.1 provides a more comprehensive overview of these and other responses. Figure 2.20 shows a summary of how some organs are activated by each division of the ANS.

sympathetic nervous system The branch of the ANS that alters the activity level of internal muscles, organs and glands to physically prepare our body for increased activity during times of high emotional or physical arousal

parasympathetic nervous system The branch of the ANS that maintains an energy level appropriate for normal bodily functioning and physically calms us after high arousal by reversing the changes in bodily functioning caused by the domination of the sympathetic nervous system

homeostasis The body's balanced and healthy state

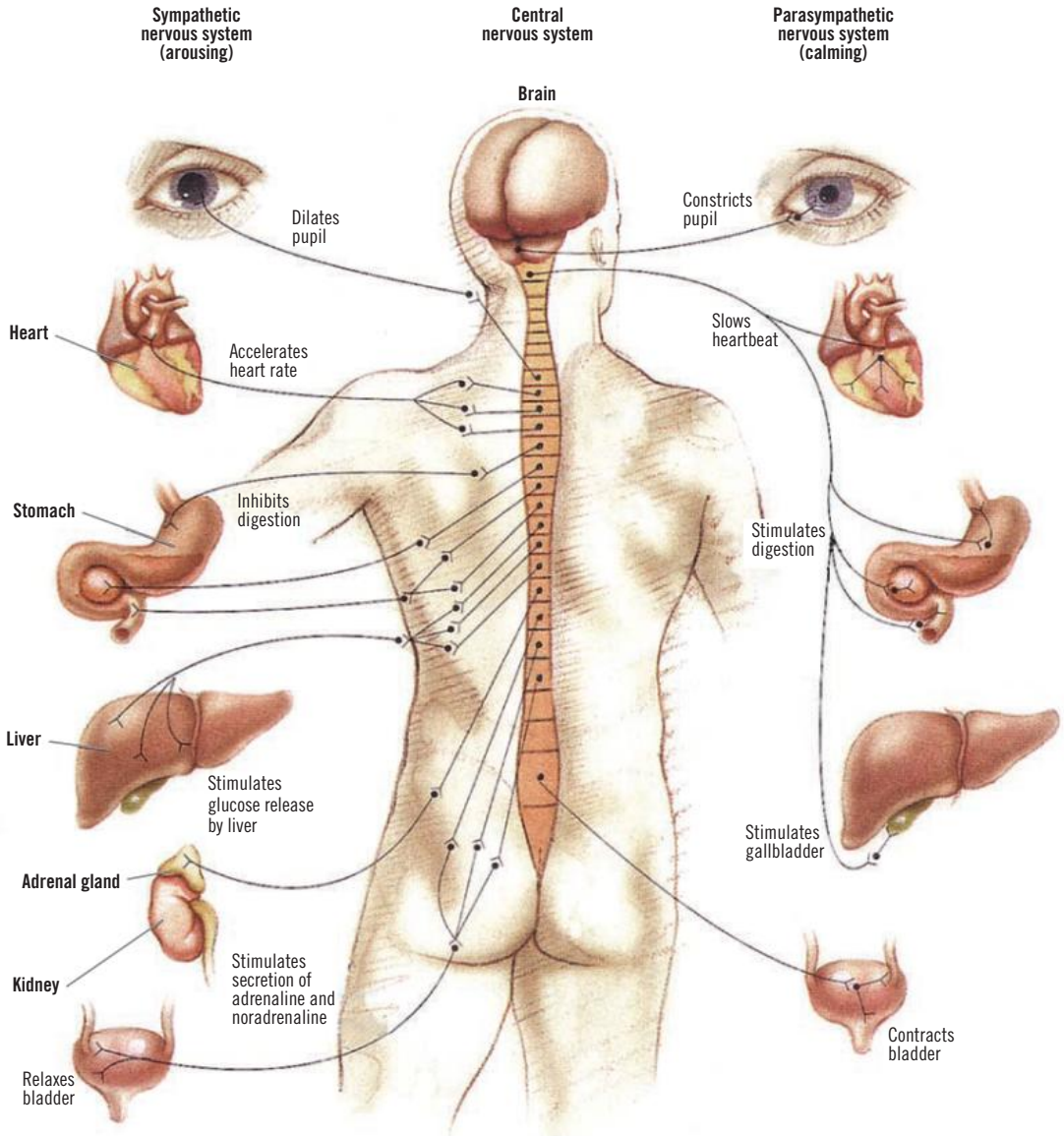


FIGURE 2.20 The sympathetic and parasympathetic divisions of the ANS have different effects on organs to arouse and extend energy or calm and conserve energy as necessary.

An overview of the divisions of the human nervous system and how they link together is shown in Figure 2.21.

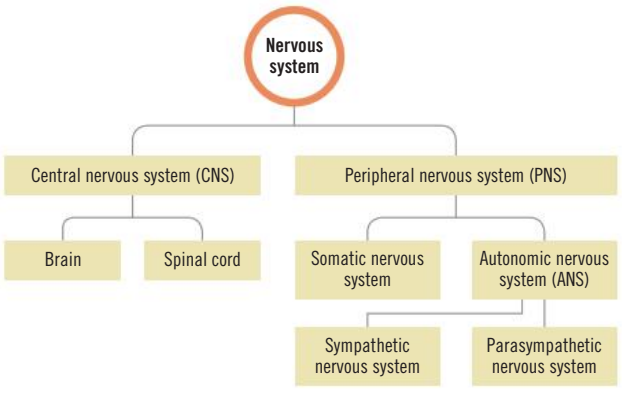


FIGURE 2.21 The divisions of the nervous system

2.6 CHECK YOUR UNDERSTANDING >>

1 Which of the following is not likely to occur when the sympathetic nervous system is dominating?
- A Dry mouth
- B Increased heart rate
- C Increased respiration rate
- D Decreased perspiration

2 After Tia has played in the grand final of the netball season, she is likely to want to calm her body down. Which of the following statements is not true about this process?
- A Her pupils will constrict.
- B Her heart rate will drop.
- C Her body will slowly achieve homeostasis.
- D She will decrease her production of saliva and increase perspiration.

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3 Identify which function will be present when the sympathetic nervous system is activated.
   A Your breathing rate slows.
   B Your adrenal glands release adrenaline and noradrenaline.
   C Your airways constrict.
   D Your mouth is salivating.
4 Why is the 'fight-or-flight' response given this name?
5 Explain which system (sympathetic or parasympathetic) is quicker in its activation and why.

BRAIN FUNCTION: THE ROLE OF NEURONS AND GLIAL CELLS

In order to understand the relationship between the body and behaviour, we must understand how the brain communicates with the body and the role the nervous system plays in this.

NEURONS: THE BASIC BUILDING BLOCKS OF THE NERVOUS SYSTEM

At the basic level, the nervous system is made from billions of interconnected neurons that communicate with each other in an electrical and chemical form and transmit information around the body. A neuron is an individual nerve cell that is specialised to receive, transmit and process information. To carry out their complex task, neurons receive assistance from a range of supporting cells, known as glial cells.

To better understand how neurons work to transmit information throughout the body, it is essential to know the different parts of a neuron and what function they perform.

Structure and function of the neuron

Although no two neurons are alike, most neurons are composed of common basic parts (see Figure 2.22) and each part plays a specific role in communicating information in an electrical and chemical form throughout the body. Every neuron has a soma (cell body) that contains a nucleus (control centre for processing). Among other functions, the nucleus stores DNA and generates energy used by the neuron. Each soma has a number of projecting branches. At one end, a single axon protrudes from the soma. At the other end, there may be up to 10 000 protrusions known as dendrites. The more dendrites a neuron has, the more information it can receive.

Dendrites receive messages from other neurons and transmit the messages inwards towards the soma for processing. Axons are thin fibres that carry messages, in the form of electrical nerve impulses, away from the cell body. Some axons are coated with myelin.

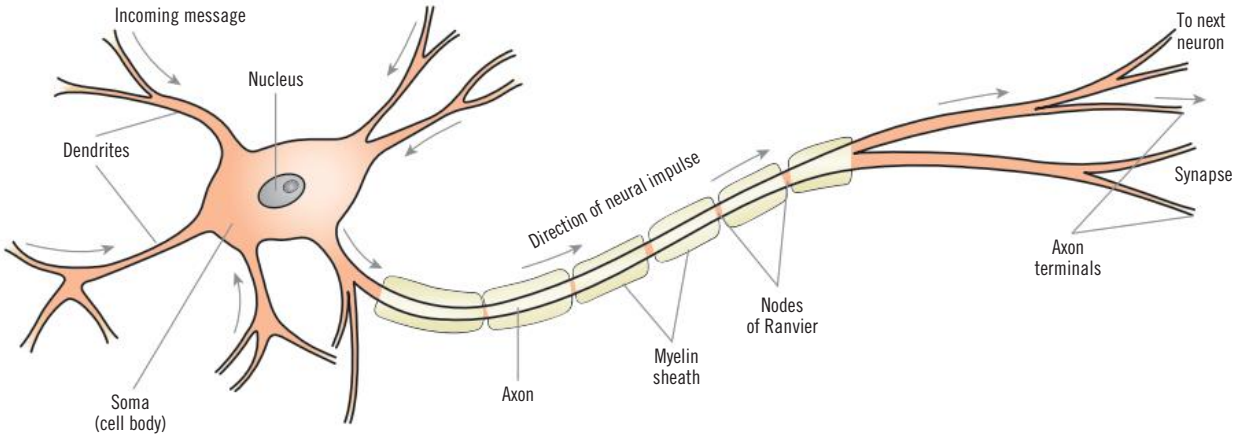


FIGURE 2.22 A typical neuron showing all its component parts

The myelin sheath is an insulating fatty layer that protects the axon and speeds transmission of the electrical impulse down the axon, so less energy is used in transmission. Small gaps, called nodes of Ranvier, occur

neuron An individual nerve cell that receives, transmits and processes information

glial cell A cell that supports a neuron and influences transmission of impulses but does not transmit impulses

soma The main cell body of a neuron

axon The fibre that carries information away from the cell body of a neuron

dendrite A neuron fibre connected to the soma that receives incoming messages

myelin A fatty layer coating some axons that protects the axon and assists with the speedy delivery of the electrical nerve impulse

myelin sheath The layer of myelin wrapped around the axon

nodes of Ranvier The small gaps that occur at regular intervals in the myelin sheath that speed the transmission of the nerve impulse

at regular intervals in the myelin sheath. These nodes increase the speed of the electrical impulse because, instead of passing down the entire length of the axon, the impulse leaps from gap to gap. The nodes of Ranvier also help keep the axon healthy because they allow nutrients and waste products to enter and leave the axon.

When the electrical impulse travels down the axon it is known as an action potential. The speed of the action potential is influenced by the amount of myelin insulating the axon.

When the action potential reaches the end of the axon, the axon branches out into a number of axon terminals that link with the dendrites of other neurons. This linking is important as it allows the impulse to pass from neuron to neuron. However, the axon terminals of one neuron do not physically connect with the dendrites of another neuron. A microscopic gap, or synapse, exists between the axon terminals of the sending neuron (pre-synaptic neuron) and the dendrites of a receiving neuron (post-synaptic neuron). These synapses form the information processing networks that are responsible for all our thoughts, sensations, feelings and behaviours. When the action potential reaches the axon terminal, the axon terminal releases chemicals known as neurotransmitters into the synapse (see Figure 2.23). When neurotransmitters are released by the pre-synaptic neuron into the synapse, transmission of the message between neurons begins.

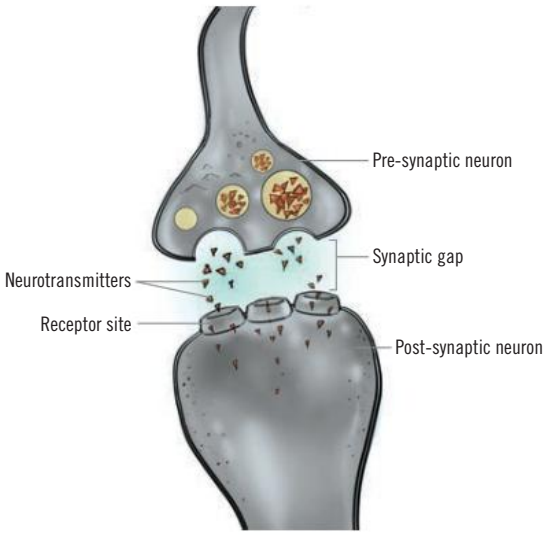


FIGURE 2.23 Neurotransmitters are chemicals that cross the synaptic gap from the pre-synaptic neuron and attach to the receptor sites on the post-synaptic neuron.

When released, neurotransmitters carry the messages across the synapse to the dendrite of the post-synaptic neuron. This part of the transmission is therefore chemical. Neurotransmitters are then absorbed by receptor sites in the receiving dendrite sensitive to specific neurotransmitters. This process alters the post-synaptic neuron's activity level. Some neurotransmitters have an excitatory effect because they stimulate receiving neurons, causing them to fire and pass on the impulse to neighbouring neurons. Other neurotransmitters have an inhibitory effect because they block the activity level of the receiving dendrite, making it less likely to fire and pass on the impulse.

At any moment, a neuron may receive hundreds or thousands of messages. If several excitatory messages arrive close in time, the neuron fires – but only if messages haven't been pushed away from their receptor sites by incoming inhibitory messages. In this way, messages are combined and a neuron either fires the impulse or doesn't fire the impulse. When a neuron is stimulated, a lasting change in the efficiency of the synapse is produced (Kandel & Schwartz, 1982). The receiving neuron becomes more likely to fire again in the future, thus making it easier for nerve impulses to travel the same pathway again.

2.7 CHECK YOUR UNDERSTANDING >>

1 Which part of a neuron is responsible for receiving information from other neurons?
   - A The cell body
   - B The soma
   - C The axon
   - D The dendrite

2 Which parts of a neuron release neurotransmitters?
   - A The synapses
   - B The axon terminals
   - C The somas
   - D The dendrites

3 Explain how damage to the myelin sheath will affect neural transmission.

4 What are neurotransmitters and what role do they play in neural transmission of information around the body?

5 Explain the function of axons and dendrites in the transmission of information around the body.

Types of neurons and their functions

All neurons have the same basic structure and function but they are also specialised to perform a range of different functions. The three main types of neurons in the nervous system are sensory neurons, motor neurons and interneurons.

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SENSORY (AFFERENT) NEURONS

Sensory neurons are specialised to detect and respond to specific forms of external energy (such as sound, light, pressure and chemical energy) and internal stimulation from the body's muscles, organs and glands. For example, sensory neurons in your ear only respond to sound waves; sensory neurons in your nose only respond to chemical energy; and sensory neurons in your eyes only respond to light rays.

Sensory information is first received by sensory receptor neurons that are specialised to detect specific sensory information from the environment. Receptor neurons are located in our various sense organs and they transmit messages from each of our senses inwards to the CNS by sensory neurons in the PNS. Sensory neurons, known as afferent neurons, transmit the information to the brain for higher processing. Afferent neurons exist in tracts. These tracts, known as ascending tracts, are composed of bundles of axons that transmit the information upwards towards the brain for higher processing.

MOTOR (EFFERENT) NEURONS

Motor neurons, known as efferent neurons, carry motor messages (relating to movement and how the body should respond to sensory information) from the CNS to the rest of the body. When sensory information reaches the brain, it is interpreted and decisions are made about what an appropriate response will be. Usually this response involves some degree of movement. The information about this movement is known as motor information or efferent information. This is because 'efferent' means 'moving away from or outwards'.

Once the brain has decided on the appropriate response, it is transmitted down the descending tracts of the spinal cord and out to the relevant muscles, glands and organs via specialised motor neurons known as efferent neurons. This efferent information causes the muscles to relax or contract, glands to increase or decrease their secretions, and it affects the activity level of internal organs so a specific type of movement can be enacted.

When you want to slice a loaf of bread your brain sends the messages needed to perform this action via efferent neurons. These neurons carry the information down the spinal cord and out to the muscles in your arms, hands and fingers so that you are able to manipulate the knife.

INTERNEURONS

Most human behaviours are reasonably complex and involve interpretation and decision-making by the brain. They also involve sensory information being transported from the PNS to the CNS and from the CNS to the PNS. However, some single behaviours, called involuntary reflex actions, do not involve the brain. These basic behaviours are initiated by interneurons.

Interneurons are specialised neurons located primarily in the spinal cord that form a direct connection between motor neurons and sensory neurons (see Figure 2.24). Interneurons are activated when sensory neurons receive an intense sensation. This would happen, for example, if a hot coal rolled out of an open fire onto your bare foot. In situations such as this it is important for your survival that you react quickly, so your automatic response would be to pull your foot away from the coal. In order for this to happen, interneurons have relayed the information from sensory neurons directly to motor neurons. The involvement of the brain in interpreting the sensory information and deciding on an appropriate response has been bypassed. So, you would experience the intense sensation either as you moved your foot or after you moved it.

action potential The electrical impulse that travels down the axon

axon terminal The end (or terminal button) of the pre-synaptic neuron's axon fibre that forms a synapse with the dendrite of the post-synaptic neuron; also releases neurotransmitters into the synapse

synapse The microscopic gap between neurons, over which messages pass

pre-synaptic neuron The neuron that sends the impulse

post-synaptic neuron The neuron that receives the impulse

neurotransmitter Any chemical released into the synapse by a neuron's axon terminals that alters activity in other neurons

receptor sites That part of a dendrite's surface that absorbs a neurotransmitter

sensory neurons Specialised neurons (afferent neurons) that carry information inwards towards the CNS

afferent neurons Sensory neurons located in the spinal cord that receive information from the PNS and carry it up towards the brain

motor neurons Specialised nerve cells that carry motor commands from the CNS to muscles, glands and organs

efferent neurons Motor neurons located in the spinal cord that receive motor commands from the brain and carry them towards the PNS

efferent information The motor information carried by motor neurons from the brain to the neurons in the PNS

interneurons Specialised neurons located in the spinal cord that relay information from sensory neurons directly to motor neurons

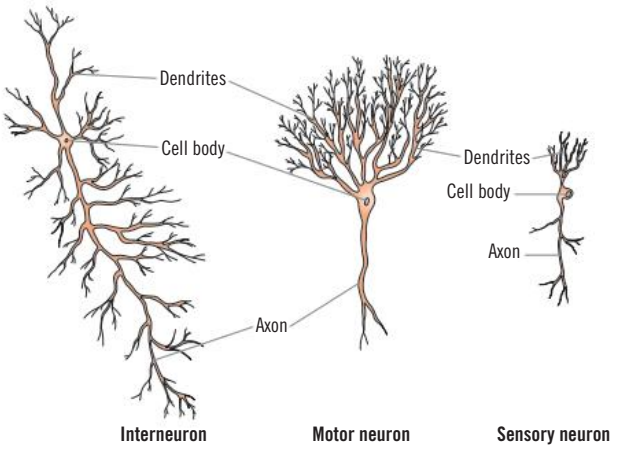


FIGURE 2.24 Neurons – the basic unit of the nervous system

Table 2.2 provides a summary of the three main types of neurons in the nervous system.

TABLE 2.2 The location and role of sensory neurons, motor neurons and interneurons

TYPE OF NEURON	LOCATION	ROLE
Sensory (afferent) neuron	Located primarily in the PNS	Detect energy from the environment and carry information about it to the CNS
Motor (efferent) neuron	Located primarily in the PNS	Carry commands from the brain to the body's muscles, organs and glands to enable movement
Interneuron	Located primarily in the spinal cord	Carry information directly between sensory and motor neurons; involved in reflex actions

As we have seen, the neuron is the primary functional unit of brain structure and, therefore, of behaviour. Before the advent of modern technologies, scientists were unable to directly study the neuron because it was too small to observe with the naked eye, and there was no way to record its electrical impulses. Today, however, advances in science and technology have enabled investigation of the electrical properties of the brain's neurons and the electrochemistry of the synapse. These technologies have also helped scientists discover a second category of cells essential for brain function, the glial cells, discussed earlier in the chapter.

2.8 CHECK YOUR UNDERSTANDING >>

1 Where are interneurons located?
- A In the brain
- B In the spinal cord
- C In the brain and spinal cord
- D Outside the CNS

2 _____ neurons transmit information about external stimuli to the central nervous system and _____ neurons transmit instructions about movement from the central nervous system to muscles, organs and glands.
- A Efferent; motor
- B Motor; afferent
- C Sensory; ascending
- D Sensory; motor

3 Ascending tracts are columns of nerves found in the spinal cord. Their role is to carry:
- A motor information up the spinal cord to the brain.
- B sensory information up the spinal cord to the brain.
- C motor commands from the brain down the spinal cord to the PNS.
- D sensory information from the brain down the spinal cord to the PNS.

4 Explain the role of interneurons.

5 Explain the function of ascending tracts and descending tracts in the transmission of information around the body.

2.3 TRY IT YOURSELF >>

TRANSMITTING A NEURAL IMPULSE

Ask five or six of your friends to stand in a line and hold hands and close their eyes. The first person in line should squeeze the hand of the next person. As soon as the second person receives that message, they should squeeze the hand of the next person and so on. The 'squeeze' should not be passed on until it has been received first. When the last person receives the message, they should call out 'Stop'. Have one friend time the transmission of 'squeezes' from the first to the last. How long does it take before you hear 'Stop'?

Repeat this activity, but this time sit on the floor in such a position that each person can touch the ankle of the person next to them. Instead of squeezing hands, ask each person to tap the ankle of the person next to them. Again, have one person timing how long it takes before you hear 'Stop'.

Compare the 'transmission' of hand squeezes with the 'transmission' of ankle taps.

1 What is the difference?
2 Can you suggest why one takes longer than the other?
3 What would happen if some of the neurons did not transmit the impulse?

GLIAL CELLS: SUPPORTING THE NERVOUS SYSTEM

Glial cells are often referred to as 'supporting cells' because their primary function is to support neurons so they can transmit information around the nervous system. Glial cells, collectively called glia (Greek for 'glue'), are found throughout the nervous system. They make up more than half the volume of the brain, and

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they are the most abundant cells in the central nervous system – there are between 10 and 50 times more glia than neurons in the CNS of vertebrates (Kandel, Schwartz, & Jessell, 2000). Glial cells do not have the same cellular structures as neurons, so they are structurally and functionally different to neurons. They do not have axons, dendrites and synapses, therefore they cannot generate action potentials or conduct nerve impulses. Glial cells do not transmit information themselves but they influence the transmission of information in several ways.

Glia provide the structural framework that allows the networks of neurons that make up the nervous system to remain connected. Glia also assist in the nervous system's development, repair and maintenance, and they provide essential metabolic functions.

Broadly speaking, glial cells surround neurons and anchor them in place. This helps to insulate and protect neurons from each other. They supply nutrients and oxygen to the neurons so they have the energy needed to transmit information. Glial cells maintain a healthy environment for neurons by destroying and removing the carcasses of dead neurons and by soaking up excess neurotransmitters that might clog the communication lines between neurons.

Glial cells also provide structural support for synapses by forming a barrier that blocks the entrance of toxic substances into the brain. They do this by forming a layer around the brain's blood vessels that contribute to the blood–brain barrier. The blood–brain barrier is a biological structure that prevents potentially harmful materials from the blood from entering the brain while allowing useful materials to enter. This helps to maintain a stable environment for the brain and protect it from harmful foreign substances.

Glial cells have a number of subtypes, each with different functions. In the CNS these include astrocytes, microglia and oligodendroglia (also known as oligodendrocytes). Satellite cells and Schwann cells are located in the PNS.

Central nervous system glial cells

Glial cells in the CNS protect and nourish neurons. Figure 2.25 shows the position of astrocytes, microglia and oligodendroglia in relation to a neuron in the CNS.

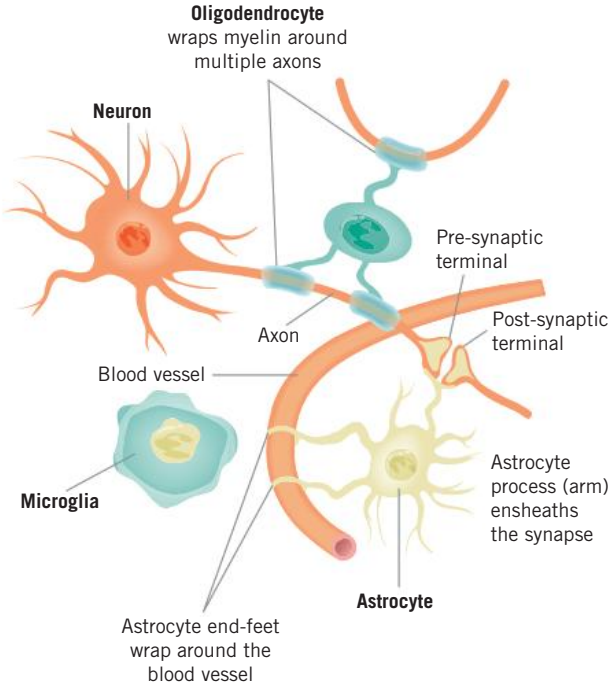


FIGURE 2.25 Neurons in the CNS are protected, nourished and supported by astrocytes, microglia and oligodendroglia.

ASTROCYTES

Astrocytes (star-shaped cells with many long, thin projections) are the largest group of CNS glial cells. Their main role is to provide physical and nutritional support for CNS neurons. Astrocytes provide brain neurons with physical support by forming a matrix that keeps the neuron in place and isolates it from synapses. This assists in the smooth transmission of messages between neurons because it limits how far neurotransmitters released by axon terminals are spread. Astrocytes provide nutritional support by filtering nutrients out of the blood and transporting them to the neuron. They also receive glucose from capillaries (blood vessels), breaking it down into lactate (the chemical produced during the first step of glucose metabolism), and then releasing the lactate into the extracellular fluid surrounding the neurons so they can use it for energy.

glial cells Nervous system cells specialised to provide structural and nutritional support to neurons and maintain a healthy environment for neurons so they can transmit information around the body

blood–brain barrier A layer of tightly packed cells that make up the walls of brain capillaries and prevent potentially harmful substances in the blood from diffusing freely into the brain

astrocytes CNS glial cells that provide physical support and nutrition to neurons

Astrocytes help control the chemical composition of fluid surrounding neurons by digesting parts of dead neurons by performing phagocytosis. Phagocytosis occurs when an astrocyte contacts a piece of neural debris and then pushes itself against the debris, eventually engulfing and digesting it. Once the dead tissue has been broken down, a framework of astrocytes is left in the vacant space and specialised astrocytes will form a scar tissue around the structure. Phagocytosis is an important function because it soaks up waste substances secreted into the synapses between neurons so that the next signal will be a clean one. When CNS nerve cells are injured, astrocytes also support them by filling the space to form a glial scar, repairing the area and replacing the CNS cells that cannot regenerate.

MICROGLIA

Microglia are the main immune cells and the smallest glial cells in the CNS. Microglia operate as immune cells in the CNS because they fight infection and respond to injury. They do this by protecting the brain and spinal cord from disease-causing micro-organisms. Microglia are typically oval shaped, and have a number of thick fibres that project from the cell body. These projections repeatedly extend and retract to check their surrounding environment for signs of disease or injury.

When microglia are activated, they migrate to the site of an infection or injury to assist in phagocytosis. During phagocytosis, microglia destroy pathogens and act like scavengers because they digest parts of dead neurons and remove most of the waste and cellular debris from the CNS. Because microglia help fight infection, they help protect the CNS from invading micro-organisms.

Microglia assist in maintaining normal brain function and research suggests they help stave off neurological disorders such as Alzheimer's disease. One of the characteristics of Alzheimer's disease is a build-up of abnormal beta-amyloid proteins outside and between nerve cells. When microglia lose their ability to function, amyloid-beta proteins can build up in the brain, leading to toxic inflammation. So, a steady decline in the normal functioning of microglia cells may contribute to Alzheimer's disease.

It is also known that microglia function well in young people but tend to function less effectively as people age. This degeneration is predominantly due to a protein that triggers inflammation, known as EP2. In a recent study involving mice, the researchers found that blocking the action of the EP2 protein restored the ability of microglia to do their job. More specifically, they found that blocking the EP2 protein reduced brain inflammation and cleared toxic markers that cause cell death, as well as prevented cognitive decline in Alzheimer's-afflicted mice (Johansson et al., 2015).

A recent study using rat pups suggests that microglia are involved in testosterone production during a foetus's critical period for sexual differentiation. The findings suggest that microglia activity is particularly important for forming masculine features and structures in the perinatal stage (the period shortly before and after birth) (Welberg, 2013).

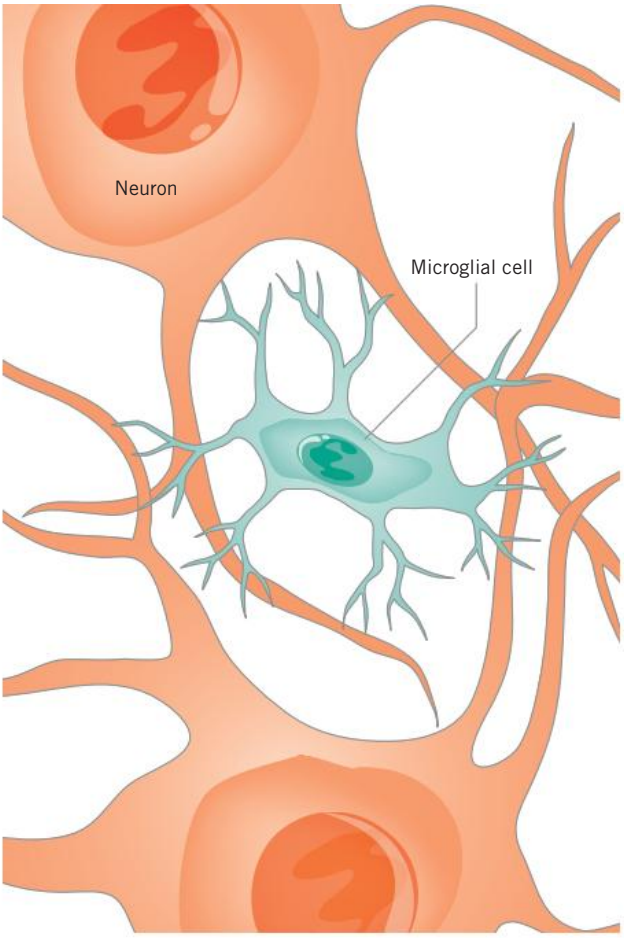


FIGURE 2.26 Microglial cells support the immune system by migrating towards neurons being attacked by harmful bacteria and destroy the bacteria.

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OLIGODENDROGLIA

Oligodendroglia, or oligodendrocytes, are a group of CNS glial cells that produce the myelin sheath that insulates the neuron's axon so that the action potential can be efficiently and speedily conducted down the axon. Myelinated axons transmit nerve signals much faster than unmyelinated axons, so oligodendroglia accelerate the communication speed of the message. Oligodendroglia draw their name from 'oligo', which means few, and 'dendro', which means arms. Therefore, an oligodendrocyte is a cell with a few arms, and each arm ends in a sheath of myelin that wraps around a segment of an axon. As can be seen in Figure 2.27, the processes (arms or projections) of a single oligodendrocyte wrap themselves around portions of the surrounding axons. As each process wraps itself around, it forms layers of myelin. Each process thus becomes a segment of the axon's myelin sheath. Because each oligodendrocyte has a number of processes, it can provide myelin for multiple neurons at a time.

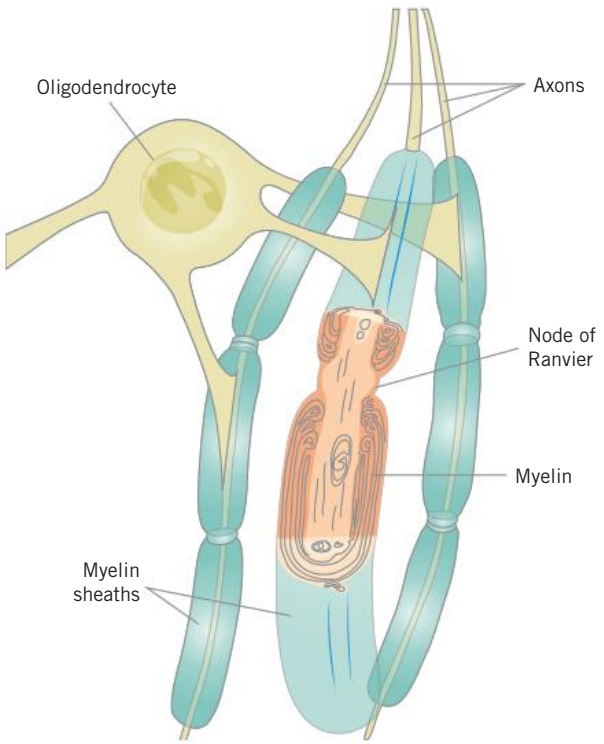


FIGURE 2.27 Oligodendroglia insulate the axons of PNS neurons with a layer of myelin.

2.9 CHECK YOUR UNDERSTANDING >>

1 The _____ are the glial cells that provide myelin in the CNS.
   - A astrocytes
   - B oligodendroglia
   - C microglia
   - D Schwann cells

2 Phagocytosis is the process by which:
   - A astrocytes build myelin around the neuron's axon.
   - B oligodendroglia build myelin around the neuron's axon.
   - C astrocytes clean up neuronal debris and keep neurons healthy.
   - D oligodendrocytes clean up neuronal debris and keep neurons healthy.

3 The purpose of myelin is to:
   - A promote the axon terminal's release of neurotransmitters.
   - B insulate axons to increase the speed of electrical impulses.
   - C insulate axons to increase the speed of chemical impulses.
   - D nourish the soma.

4 How do microglia support neurons?

5 How do astrocytes support neurons?

Peripheral nervous system glial cells

There are two main groups of glial cells in the PNS: satellite cells and Schwann cells. These glia support and protect neurons outside the nervous system's brain and spinal cord so they can receive, process and transmit information between body parts and the CNS.

SATELLITE CELLS

Satellite cells are so called because they surround and cover the cell bodies, or soma, of PNS neurons (see Figure 2.28). The cell body contains the nucleus and other organelles (specialised subunits within a cell that perform specific functions), and it coordinates the metabolic activity of the neuron. The soma (cell body) does this by producing all the proteins needed for the construction of other parts of the neuron and

phagocytosis The process whereby specialised glial cells engulf and digest harmful micro-organisms so neurons can function in a healthy environment

microglia CNS glial cells that support the immune system by performing the bulk of phagocytosis in the brain and spinal cord

oligodendroglia CNS glial cells specialised to myelinate axons; also known as oligodendrocytes

satellite cells Specialised PNS glial cells that support neurons by covering their cell bodies and supplying them with nutrients

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providing energy to the rest of the neuron. The soma receives incoming signals from its various dendrites, joins them and transmits them to the axon. Because of these functions, the soma acts as the neuron's engine room or control centre.

A satellite cell's primary function is to maintain the cell body and keep the neuron functional. It does this by supplying nutrients to the unmyelinated soma and providing it with structural support by operating as a protective, cushioning cell. Satellite cells are capable of self-renewal, so they play a crucial role in the growth, repair and regeneration of skeletal muscles found in the somatic nervous system. After exercise or when muscles are damaged, the new cells are drawn to the weak or damaged site, where they fuse to the existing muscle fibre and help to regenerate it. Because skeletal muscles are necessary for voluntary movement, satellite cells also play a crucial role in voluntary movement.

2.3

FOCUS ON RESEARCH

DRUG TO REDUCE SIDE-EFFECTS OF 'BINGE DRINKING' DEVELOPED

A drug that could reduce the harmful side-effects of 'binge drinking', especially by teenagers, has been successfully developed and tested by a team of European scientists. Researchers say that this development may also link to new ways to treat Alzheimer's disease and other neurological diseases that damage the brain.

The key to the breakthrough is a compound, ethane-beta-sultam. This is an effective form of medication that easily enters the bloodstream before it is processed by the body into its active form. This makes it different to many other drugs that find it difficult to get into the brain because of the 'blood–brain barrier', the natural defence mechanism that protects the brain. This barrier presents a formidable obstacle to the medicinal treatment of neurological illness.

Scientists based at universities in Belgium, Italy and the United Kingdom have discovered that when ethane-beta-sultam is administered to rats on a binge-drinking regime, it reduces the brain cell loss and inflammation that normally result from bouts of heavy binge drinking, leading to symptoms such as decreased memory. These effects can cause long-term damage, particularly to teenagers, whose brains are still in the process of development.

Previous research has shown how human brain functions are impaired by alcohol and this is accompanied by inflammation and loss of cells in the brain. However, the effects were reduced or returned to normal in the rats that also received the ethane-beta-sultam compound.

'One of the things that alcohol does is to destroy some of the brain cells important for navigation and orientation,' said one the researchers. 'But a combination of alcohol and our compound could overcome this damage.' He explained that the brain protects itself using glial cells, which are increased when exposed to alcohol in a binge-drinking regime. 'But a combination of our ethane-beta-sultam given at the same time as the alcohol decreased these levels of glial cells.'

In the longer term, there is a possibility that such compounds could help with the treatment of diseases such as Alzheimer's and dementia, which also result from a loss of brain activity.

Source: Adapted from University of Huddersfield. (2014, November 27). Drug to reduce side-effects of 'binge drinking' developed. *ScienceDaily*. Reproduced with permission.

QUESTIONS

1 What was the aim of this research?
2 Write a hypothesis for this research.
3 Identify the population of interest for this research.
4 Identify one limitation associated with this research.

SCHWANN CELLS

Schwann cells are essential to the development, maintenance, function and regeneration of peripheral nerves. Schwann cells, named after German physiologist Theodor Schwann (1810–1882), are the group of cells that produce the myelin sheath that wraps around the axons of neurons in the PNS (see Figure 2.28).

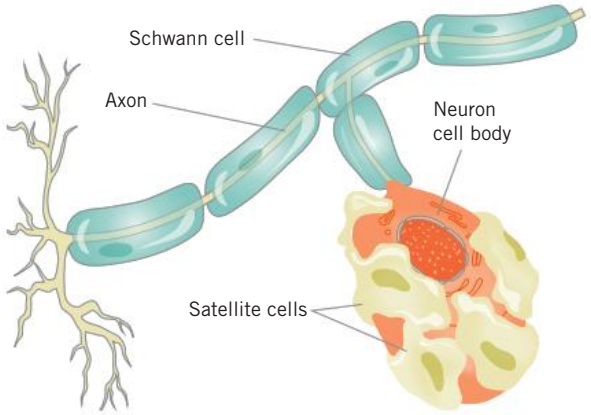


FIGURE 2.28 Schwann cells produce myelin to insulate and protect the axons of peripheral nervous system neurons. Satellite cells protect and nourish the neuron's cell body.

In the PNS, Schwann cells perform a similar protective function to the CNS's oligodendroglia. Both these types of glial cells wrap themselves around the axons of neurons, thereby insulating them. A single

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Schwann cell can only provide myelin for one neuron at a time. Oligodendroglia, on the other hand, wrap themselves around numerous axons at once.

A Schwann cell's membrane wraps around 1 or 2 millimetres of the peripheral nerve's axon several times to provide the axon with an insulating myelin layer. Each Schwann cell myelinates only a small portion of a single axon (from 0.3 to 1.5 millimetres). The minute gaps between them are called nodes of Ranvier (see page 55). To myelinate the entire length of the axon, many Schwann cells line up end to end along the axon. If an axon is thick, a longer area of the axon will be myelinated by a Schwann cell. The number of Schwann cells needed to form a myelin sheath varies and, because nerves can be quite long in the PNS, a few hundred Schwann cells may be required. As a result of this myelination, electrical messages can be swiftly conducted down the axon.

In addition to creating the myelin sheaths of PNS axons, Schwann cells also aid in cleaning up PNS debris and their support is essential for neuronal regrowth of PNS axons after injury. Schwann cells are adult cells. They are not stem cells so they cannot develop into other specialised cell types. When a PNS neuron is injured, its axon loses a portion of myelin sheath, causing the conduction of the electrical impulse down the axon to be blocked. When this happens, Schwann cells help to protect the axon by helping to digest the damaged portion of the axon. They also arrange themselves in a series of cylinders that serves as a guide for sprouts of regenerating axons. The ends of the damaged axons die, but each stump grows many sprouts that head in all directions. If one of these sprouts makes its way to a cylinder, the sprout will grow through the tube at the rate of 3 to 4 millimetres per day, rebuilding the axon. Non-productive sprouts simply wither away. By doing this, Schwann cells help to maintain healthy axons and provide support that is essential for the repair and regeneration of damaged PNS nerves. Myelin repair does not result in the original myelin thickness, so some degree of nerve impairment may be permanent.

Because of the Schwann cell's ability to support nerve regeneration in the PNS, neuroscientists have conducted a number of experimental studies in recent years where they have implanted Schwann cells in the CNS in an attempt to induce re-myelination in damaged CNS nerves. Neuroscientists are particularly interested in implanting Schwann cells into the CNS of people who suffer from multiple sclerosis, a chronic CNS disease caused by the body's immune system attacking and destroying the myelin sheath of its CNS nerves. Because of their capacity to aid nerve regeneration, Schwann cell transplants have also been used in research into recovery from spinal cord injuries.

In summary, Table 2.3 provides an overview of the glial cell types and their function in the nervous system.

TABLE 2.3 Types of glial cells

LOCATION	GLIAL CELL TYPE	FUNCTION
CNS	Astrocytes	» Provide physical and nutritional support for neurons » Perform phagocytosis to maintain a healthy and stable environment for the neuron
	Microglia	» Carry out the majority of phagocytosis in the CNS to maintain a healthy and stable environment for the neuron » Support the immune system by fighting infection and responding to injury
	Oligodendroglia	» Produce the myelin sheath to insulate and protect the neuron's axon (myelination assists with speedy transmission of electrical impulse) » Can myelinate multiple neurons at the same time
PNS	Satellite cells	» Maintain and protect the neuron by covering its cell body in the many peripheral ganglia » Supply nutriments to the cell body » Assist skeletal muscles to repair and regenerate
	Schwann cells	» Produce the myelin sheath to insulate and protect the neuron's axon (myelination assists with speedy transmission of electrical impulse) » Myelinate a single axon » Assist damaged nerves to repair and regenerate

Schwann cells PNS glial cells specialised to myelinate axons and to assist PNS nerve regeneration

2.10 CHECK YOUR UNDERSTANDING >>

1 Which of the following is a PNS glial cell?
   - A A Schwann cell
   - B A microglial cell
   - C An oligodendrocyte
   - D An astrocyte

2 Damaged neurons in the PNS possess limited capabilities for regeneration. What type of glial cell aids in regeneration of damaged PNS neurons by forming a regeneration tube to help restore the former connection?
   - A A Schwann cell
   - B A satellite cell
   - C A microglial cell
   - D An astrocyte

3 Glial cells are primarily responsible for:
   - A the reception of sensory information.
   - B the support of neurons.
   - C the processing of information.
   - D the production of actions or motor outputs.

4 Identify one major functional similarity between Schwann cells and oligodendroglia.

2.4 TRY IT YOURSELF >>

CREATING A POSTER OF THE NERVOUS SYSTEM

On an A3 sheet of paper, draw a colour-coded chart depicting how the human nervous system is organised. Your poster should include all divisions of the nervous system (central and peripheral nervous systems and their associated subdivisions).

Beside each division or subdivision, include a dot-point summary of the role the component plays in the transmission of information around the body.

Display your chart in the area where you study.

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CHAPTER SUMMARY

The brain

- The brain is a complex organ that controls all our cognitions, perceptions, emotions, and voluntary and involuntary bodily responses.

Philosophical origins of brain research

- Philosophical debate – known as the mind–body debate – about the relationship between the mind, the brain and behaviour dates back to ancient times. Ancient philosophers also argued about whether the heart or the brain controlled behaviour. This debate was known as the brain–heart debate. These philosophical debates were based on logic and reasoning but they lacked scientific evidence. In the 2nd century CE, Galen used vivisection and experiments to demonstrate that some behaviours were controlled by the brain.
- Even in the 17th century, Descartes mistakenly argued that the separate entities of the mind and body interacted with each other through the brain's pineal gland. In the 19th century, Gall popularised the pseudoscience of phrenology, claiming that a person's intelligence and personality could be determined by analysing the bumps and indentations of their skull.

Early brain research

- During the 19th and 20th centuries, brain research began using a more scientific approach. Flourens, using an early form of electrical stimulation to activate brain areas, demonstrated that phrenology was baseless. He also provided some evidence that the cerebral hemispheres controlled higher cognitive functions, therefore they controlled behaviour. This claim was supported by the Phineas Gage case study that suggested that personality, emotion and cognition were controlled by the brain's frontal lobe. The use of the surgically invasive technique of lobotomy in the 19th and 20th centuries to treat very agitated, dysfunctional people also supported this claim.
- In the 19th century, Broca and Wernicke advanced the understanding of the brain's role in language. Broca demonstrated that speech production was controlled by the left frontal lobe and Wernicke demonstrated that language comprehension was controlled by the left temporal lobe.
- Also in the 19th century, by electrically stimulating the brains of patients during brain surgery, Fritsch and Hitzig identified the location of motor function in the brain. In the 20th century, Penfield created a map of the brain that identified the specific locations on the cortex that controlled sensory, motor and emotional functioning.

Neuroimaging techniques

- Much valuable information about brain structure and function has been provided by modern neuroimaging techniques. CT and MRI scans provide images of brain structure, and PET scans and fMRI scans provide images of brain structure and their function.

The nervous system and the role of neurons and glial cells in brain function

- The nervous system is a hierarchical structure consisting of the central nervous system (brain and spinal cord) and the peripheral nervous system (somatic nervous system and autonomic – sympathetic and parasympathetic – nervous systems). All parts of the nervous system have a sensory and motor role in the transmission of information around the body.
- The nervous system is composed of billions of interconnected neurons that transmit information around the body. Neurons have basic structures that allow them to communicate electrically and chemically by transmitting sensory and motor messages across a synaptic gap. Glial cells support neurons so they can transmit their information electrically and chemically, but glial cells do not themselves transmit information.

APPLY YOUR KNOWLEDGE AND SKILLS

SECTION A: MULTIPLE-CHOICE QUESTIONS

Answer the following questions by writing the correct letter in your workbook. Only one answer is correct for each question.

1 According to the ancient Greek philosopher Aristotle, _____ was responsible for governing behaviour.

- **A** the mind
- **B** the pineal gland
- **C** the heart
- **D** the soul

2 According to Descartes, the mind or soul is:

- **A** a thinking thing that is part of the body.
- **B** a thinking thing that is separate from the body.
- **C** located in the pineal gland.
- **D** located in the heart.

3 Which of the following statements would Descartes reject?

A Minds and bodies can exist independently of each other.

B The mind and body interact through the pineal gland.

C The only thing that humans can be certain of is that they exist.

D Minds and bodies cannot exist independently of each other.

4 The notion that the mind resides in the pineal gland originated with:

A Plato.

B Aristotle.

C Descartes.

D Galen.

5 Phineas Gage's dramatic behavioural change was the result of damage to:

A his frontal lobe.

B his temporal lobe.

C his hippocampus.

D his amygdala.

6 Which of the following terms describes psychosurgery in which a section of the brain is severed or destroyed?

A A vivisection

B A temporal lobotomy

C A frontal lobotomy

D Electrical brain stimulation

7 Phrenology:

A suggests that the mind and body interact through the pineal gland.

B involves surgical removal of sections of the brain to alter emotional behaviour.

C suggests that the bumps along the skull indicate personality traits.

D is based on accepted scientific method.

8 Which type of research is Wilder Penfield most famous for?

A Severing the laryngeal nerve of a pig to demonstrate brain function

B Examining the contour of the skull as a means by which intelligence and personality can be determined

C Electrical stimulation of the brain in awake patients

D Destruction of brain tissue and nerves in the frontal lobe as a means of treating dysfunctional behaviour

9 PET, MRI and CT are all examples of what?

A Neuropsychological patients

B Glial cells

C Vivisection techniques

D Neuroimaging techniques

10 What does an fMRI produce?

A A 3-D computer-generated image of the brain reflecting blood and oxygen flow produced during cerebral activity

B A still image similar to a black-and-white X-ray

C An active image of which brain areas consume most glucose during cognition

D An active image of the activity of the magnetic field surrounding the brain

11 A sensory neuron in the peripheral nervous system takes nerve impulses to:

A motor neurons.

B interneurons.

C the central nervous system.

D afferent neurons.

12 The spaces between the covered parts of an axon are called:

A synapses.

B dendrites.

C axon terminals.

D nodes of Ranvier.

13 _____ send signals away from the neurons, whereas _____ receive signals from other neurons.

A Synapses; dendrites

B Axons; synapses

C Axons; dendrites

D Dendrites; axons

14 In the central nervous system, myelin is produced by which glial cells?

A Schwann cells

B Astrocytes

C Satellite cells

D Oligodendroglia

15 The brain's supporting cells are known as:

A neurons.

B axons.

C glial cells.

D somas.

SECTION B: SHORT-ANSWER QUESTIONS

1 What is the mind–body problem?

2 What was René Descartes' response to the mind–body problem?

3 Explain one advantage and one limitation associated with the theory of phrenology.

4 What does the statement 'body parts are represented contralaterally on the cortex' mean?

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5 Describe the sensory and motor functions of the somatic nervous system.

6 Outline the key differences between a PET procedure and an fMRI procedure.

7 You are about to deliver a speech at a school assembly and you feel very nervous.

- **a** List three physical symptoms you might experience and identify the part of the nervous system responsible for this.
- **b** Explain how you could influence your autonomic nervous system so that you remain calm.

8 When Victor was removing some biscuits he was baking from the oven, he accidentally brushed his arm against the hot oven door. Immediately, his arm moved away in a reflex action. Identify and explain the processes involved in Victor's reflex action. In your answer, mention the role of sensory neurons, motor neurons and interneurons.

9 Explain the difference between afferent and efferent information. In your answer include:

- **a** where the information originates
- **b** the type of neuron that transmits the information
- **c** which part of the nervous system transmits the information
- **d** where the information is transmitted.

10 Explain the role of glial cells in neural transmission.

SECTION C: EXTENDED-RESPONSE QUESTION

Researchers interested in the cause of autism spectrum disorder (ASD) used an MRI procedure to test their hypothesis that brain size was an early indicator of ASD. The study was performed on 30 infants aged between 6 and 9 months of age. Half of the participants had an older sibling who had been diagnosed with ASD, and half had no family history of ASD.

The researchers did not want to use anaesthesia or medications to immobilise the infants for the procedure, so MRI scans were taken three times for each child while they were asleep. At six-month intervals conducted over a three-year period, the researchers assessed a range of behavioural traits in the children and gave parents questionnaires relating to their child's development. The researchers found that infants who were later diagnosed with ASD had larger brains than other children.

You are required to draft an empirical research report for this study. Your draft should:

- describe the results and conclusions drawn
- identify and explain an extraneous variable that may have affected the results, and provide a suggestion on how this variable could be controlled in future research
- identify and explain the ethical considerations relevant to this study.

This question is worth 10 marks.

SECTION D: ASSESSMENT TASK

ORAL PRESENTATION

With the aid of a PowerPoint display, you are to construct an oral presentation that explains how glial cells support neurons in the nervous system.

In your presentation, you should:

- use two or more types of data; for example, still or moving images, written text or sound
- feature between 10 and 15 slides
- identify how glial cells differ from neurons
- identify the different types of glial cells and the role they play in assisting neural transmission of information
- speak for no longer than 5 minutes.



CHAPTER 03

AREAS OF THE BRAIN

KEY KNOWLEDGE INCLUDES:

- the basic structure and function of the hindbrain (cerebellum, medulla), midbrain (reticular formation) and forebrain (hypothalamus, thalamus, cerebrum)
- the role of the cerebral cortex in the processing of complex sensory information, the initiation of voluntary movements, language, symbolic thinking and the regulation of emotion, including localisation of function.

Psychology Area of Study Key knowledge points derived from *VCE Psychology Study Design 2016*, p. 14; © The Victorian Curriculum and Assessment Authority (VCAA). Used with permission.

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THE STRUCTURE AND FUNCTION OF THE HUMAN BRAIN

The human brain is a remarkable organ. It is responsible for most of what makes us who we are, how we think and feel, how we perceive and react to the world around us, and how we construct our sense of self. It keeps the rest of the body alive by communicating and coordinating various systems within the body. The branches of the peripheral nervous system enable voluntary and involuntary processes. The brain plays a crucial role in directing these systems. For example, structures in the human brain control the autonomic nervous system to regulate breathing, heartbeat and blood pressure. Similarly, the brain coordinates the somatic nervous system to enable movement and execute our actions. Our brain also regulates our sleep cycle, appetite and emotions, as well as managing our cognition and conscious awareness. Given this vast array of functions, it is not surprising that 90 per cent (approximately 100 billion) of neurons of the central nervous system are found in the human brain.

Weighing approximately 1.5 kilograms, with a jelly-like consistency, the human brain may seem tiny compared to that of other animals; that is, until we compare brain weight to body weight. For our size, the human brain is pretty impressive. An elephant's brain is one thousandth of its body weight and the ratio for sperm whales is 1 to 10 000; in humans, however, the ratio is 1 to 60.



FIGURE 3.1 A human brain

Structurally, the human brain can be subdivided into three main regions: the hindbrain, midbrain and forebrain (see Figure 3.2). Each region has its own functions and each is vital for everyday functioning and information processing, which will be discussed in more detail next.

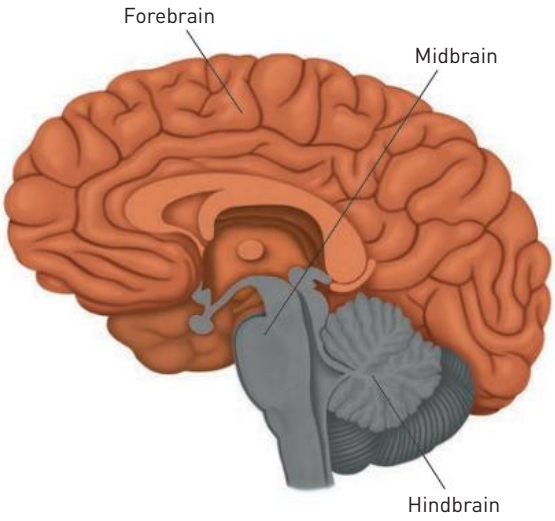


FIGURE 3.2 The location of the hindbrain, midbrain and forebrain structures

THE HINDBRAIN

The hindbrain is often referred to as the 'brain stem'. It is located at the base of the brain near the back of the skull. The hindbrain is an important part of the brain because it controls basic survival functions such as heart rate, breathing, sleep and arousal, as well as coordinating voluntary muscle movements and reflexive actions such as coughing, swallowing and vomiting. These lower-brain functions all occur without any conscious effort. We may be aware of the results of our hindbrain functions, but we are not aware of how these functions occur. The hindbrain consists of a number of structures. Two of the most important are the cerebellum and the medulla.

THE CEREBELLUM

The cerebellum is a brain structure that is often referred to as the 'little brain'. This is mainly due to

cognition Thinking, knowing or mentally processing information

hindbrain An area located at the base of the brain near the back of the skull; often called the brain stem; includes the cerebellum and medulla

cerebellum A hindbrain structure attached to the rear of the brain stem that helps coordinate voluntary movement and balance

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its wrinkly appearance, similar to the outer layer of the entire brain (cerebral cortex). The cerebellum is a hindbrain structure located at the rear of the brain stem (see Figure 3.3) that helps coordinate voluntary movement and balance. It receives information from the spinal cord, sensory systems and other parts of the brain to regulate posture, muscle tone and muscular coordination. The cerebellum is affected by excessive alcohol consumption, which explains why intoxicated individuals often have difficulty balancing and coordinating their movements; movements as simple as walking may appear clumsy and inept.

People who sustain damage to the cerebellum may experience difficulties coordinating their balance and maintaining equilibrium. These people are known to suffer from cerebellar ataxia, which can be caused by viruses that affect the nervous system or from damage to the cerebellum as a result of head trauma or stroke. Symptoms include frequent stumbling; impaired coordination of the arms, legs and back; an unsteady way of walking and dizziness. The prognosis for and treatment of cerebellar ataxia will depend on the cause of the condition.

The cerebellum is also believed to play a role in motor learning that involves the process of improving motor skills through practice. This often leads to improved capabilities as the motor skill is further developed. For example, a football player who learns to kick a football and practises a number of times will remember the specific movements they need to make in order to master this skill. They may need to exert a certain amount of muscular strength in their leg when dropping the ball on their foot to kick the ball, as well as directing their foot on the correct angle in order for them to kick the ball through the goal posts. This process involves voluntary movement and balance, and in order to do this process well, motor learning has often occurred.

THE MEDULLA

The medulla (also known as the medulla oblongata) is a brain structure located at the base of the brain stem, in front of the cerebellum (see Figure 3.3), that connects the brain and the spinal cord. As the medulla is located at the base of the brain stem, it enables neurons to travel through to the midbrain and forebrain.

The medulla plays an essential role because it regulates all the organs vital for life functions. These include involuntary functions such as breathing, heart rate, digestion and swallowing, and even sneezing and vomiting. The medulla communicates with the autonomic nervous system (ANS) and directs various bodily systems to change according to the needs of the body. For example, the sympathetic nervous system is responsible for increasing arousal, preparing the body to fight or flee a potentially threatening situation. In this instance, the medulla in the hindbrain will respond to the information received from the ANS and send signals to nodes in the heart to increase its beating in order to flood the body with oxygen. This is when the sympathetic nervous system will speed up our heart rate, to help us deal effectively with the potential threat.

Damage to the medulla can be fatal because it controls the vital organs. If an individual sustains damage to other parts of the brain, their body will likely still be able to function due to the medulla's role in keeping the body alive. On the other hand, if an individual sustains damage to the medulla, they may need life support machines to regulate body functions such as breathing and heart rate because the medulla is unable to perform its functions. Depending on the damage to the medulla, some individuals may recover; however, many individuals will not recover and instead will be deemed 'brain dead'. When taken off life support, a person who is deemed brain dead will die. A variety of drugs can also affect the functioning of the medulla. Specific drug overdoses are attributed to the inability of the medulla to perform its survival functions.

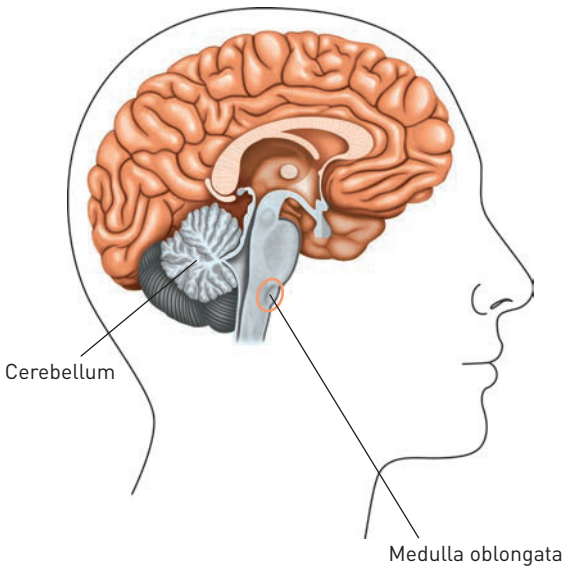


FIGURE 3.3 The location of the medulla and cerebellum

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THE MIDBRAIN

The midbrain is the area of the brain between the hindbrain and the forebrain. Midbrain structures and systems help to keep us alert, awake and vigilant. The reticular formation is one important structure located in the midbrain.

THE RETICULAR FORMATION

The reticular formation is a network of neurons extending from the top of the spinal cord up through the brain stem to the midbrain (see Figure 3.4). Varied in its functions, the reticular formation helps us to selectively focus our attention and alertness, and controls our physiological arousal.

Nerve fibres from sensory neurons have side branches leading into the reticular formation, which filter incoming sensory information, sorting it into two categories: important and unimportant. These side branches stimulate the reticular formation to send its own nerve impulses up towards the cortex, arousing it to a state of alertness and activity. The reticular formation bombards the cortex with important sensory information. This stimulation keeps the cortex active and alert, which we experience as a state of conscious awareness. Once alerted to the fact that new information is on its way, the brain is ready to process the sensory information. Unimportant information is ignored and doesn't receive any further processing. For example, if you were asked to look around the room and identify all the blue objects in it, your cortex would be able to attend to all such objects and identify these. If you were then asked to close your eyes and report on all the brown objects in the room, you may have difficulty identifying these because your reticular formation was directing your cortex to attend to blue objects only. Brown objects may have been filtered out of your attention system as this information was considered unimportant.

Not only does the reticular formation help us to selectively focus attention on the most important sensory stimuli, it also controls our physiological arousal and awareness (French, 1957). It is considered to be involved in the control of sleeping and waking, and is therefore often referred to as the brain's arousal centre. If the reticular formation is removed in animals, they cannot be wakened because of the lack of arousal. If the reticular formation is electrically stimulated in sleeping animals, they will waken immediately (Rosenzweig & Leiman, 1982).

If you have ever been anaesthetised, you will not recall any sensations and perceptions you experienced. The chemical compounds in anaesthetics supress the role of the reticular formation to maintain alertness and awareness. The reticular formation also plays a role in regulating the ANS function, which is why doctors need to carefully monitor your internal physiological systems to ensure they are functioning while you are under a general anaesthetic (Carter, 2014).

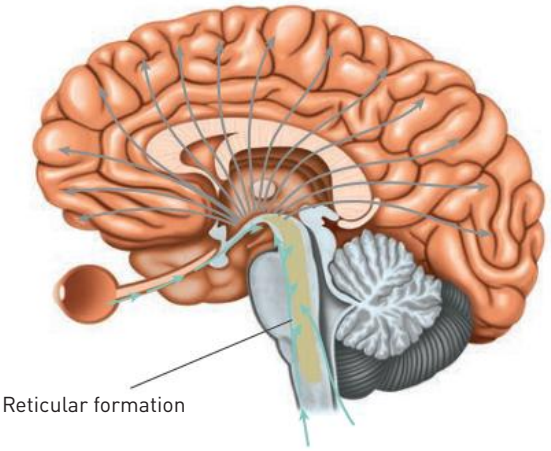


FIGURE 3.4 The location of the reticular formation

3.1 CHECK YOUR UNDERSTANDING

1 The hindbrain structures include the:
- A cerebellum and reticular formation.
- B medulla and reticular formation.
- C cerebellum and medulla.
- D cerebellum, reticular formation and medulla.

2 What are some symptoms experienced by an individual who has sustained damage to their cerebellum?

3 Which of the following is not a function of the medulla?
- A An involuntary response of vomiting when feeling sick
- B Sending signals to the heart to beat according to the amount of oxygen needed
- C Regulating breathing
- D Maintaining posture and balance

→

medulla A hindbrain structure responsible for regulating our internal bodily systems necessary for survival, such as heart rate and breathing

midbrain Located between the hindbrain and forebrain, it consists of and connects many nerve fibre systems, including the reticular formation

reticular formation A network of neurons extending from the top of the spinal cord up to the thalamus; modulates incoming sensory stimuli and redirects them to the cerebral cortex, thereby activating the cortex and influencing our state of physiological arousal and alertness

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4 Where is the midbrain located?
   A Between the hindbrain and forebrain
   B At the base of the brain, which is why it is sometimes referred to as the brain stem
   C At the front of the brain
   D On the outer surface of the brain
5 Explain why the reticular formation is sometimes referred to as the 'arousal centre' of the brain. Use an example to support your answer.

THE FOREBRAIN

The forebrain is located above the midbrain and is divided into two hemispheres. It is the largest and most highly developed part of the brain. The forebrain contains a variety of structures that are responsible for our most complex processes, including emotions, motivations, sensations, perceptions, learning, memory and reasoning. It also contains three distinct areas: the hypothalamus, the thalamus and the cerebrum.

THE HYPOTHALAMUS

The hypothalamus is a peanut-sized structure found just below the thalamus (see Figure 3.5). Although it only weighs approximately 4 grams, it plays a very significant role in controlling many aspects of our body, such as regulating body temperature, the sleep–wake cycle, sex drive, and thirst and hunger needs. The cluster of neurons (nuclei) in the hypothalamus work by communicating and connecting the nervous system and endocrine system. The endocrine system is a network of glands that produce and secrete hormones into our body in order for us to achieve a specific physiological state.

The hypothalamus directs a brain structure known as the pituitary gland (located just below the hypothalamus) to secrete hormones needed in the body. For example, the hormone prolactin is released into the bloodstream of new mothers. This hormone stimulates milk production in the breasts so a new mother can feed her infant. Similarly, the hormone cortisol is released to help energise the body so it can cope when a person is confronted with a stressful situation such as studying for an upcoming exam. Once the student's exam has passed, the hypothalamus will direct the pituitary gland to stop the release of cortisol. This example highlights how the hypothalamus works with the endocrine and nervous systems. When the cortisol release stops, the body can achieve homeostasis (internal physiological stability). Homeostasis is an important function of the hypothalamus.

Nuclei in the hypothalamus have other specialised roles to control certain bodily functions. Some of these nuclei include the:

- *medial preoptic nucleus* – this cluster of neurons in the hypothalamus is said to regulate the production of sex hormones and reproductive behaviour
- *suprachiasmatic nucleus* – this is said to be the brain's internal 'body clock', it helps us to regulate our circadian rhythms and coordinate our sleep–wake cycle
- *ventromedial nucleus* – this region of the hypothalamus controls our appetite and thirst. Research has shown that damage to this area of the hypothalamus can cause overeating and obesity (Carter, 2014)
- *anterior nucleus* – neurons in this region of the hypothalamus receive information from the body's heat receptors to regulate our internal temperature.

THE THALAMUS

The thalamus is a forebrain structure that sits on top of the brain stem. It consists of two small egg-shaped structures (thalami) joined together, which are positioned in the centre of the brain (see Figure 3.5). Its location assists its function because it acts as a relay system for sensory messages on their way to the cerebral cortex (outer layer of the brain). Information from all senses passes through the thalamus, except smell (olfaction), which has its own route to the brain. The thalamus analyses the information and directs it to appropriate sensory areas of the cerebral cortex. For example, visual information from the eyes enters from nerve fibres connecting to the bottom of the thalamus. It is then relayed to an area of the cerebral cortex known as the primary visual cortex from nerve fibres that exit at the top of the thalamus.

Each area in the thalamus is connected to a particular section of the brain's cortex. There is a constant reciprocal flow of information between the thalamus and these different cortical areas of the brain. These connections are rapid and intense, and they are responsible for our ability to perceive the world with clarity and accuracy. That is why damage to the thalamus can cause deafness, blindness or loss of any other sense, except smell.

When you experience a thunderstorm, information about the sound of the thunder, the pounding of the rain, the darkening sky, the flash of lightning and the

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moisture in the air are all relayed to the thalamus, then to the areas of the cortex responsible for registering all those different sensations, then back to the thalamus. This flow of information is so rapid that the numerous sensory inputs from the storm are noted, received, registered, processed and integrated all at once to provide a perception of the intense experience that is a thunderstorm.

The thalamus is capable of modulating itself, so it can attend to some sensory inputs over others. This built-in feature allows us to automatically focus our attention on those stimuli or inputs that are more important, while filtering out unnecessary information. The thalamus does this by working with the reticular formation. This attention function is like an on–off switch and is related to the level of activity in the rest of the nervous system. For example, when we are asleep, the thalamus may 'switch off' this attention function so that our cortex is not bombarded with sensory information, allowing us to have a restful night's sleep.

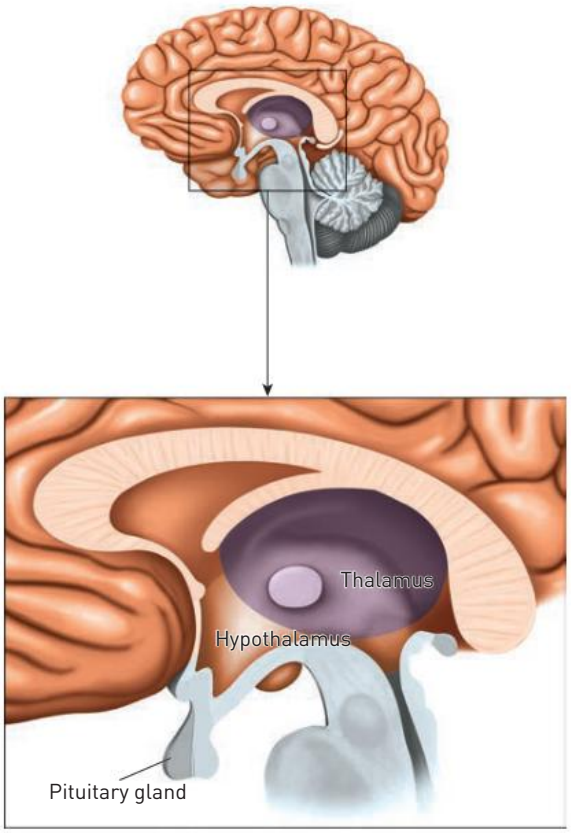


FIGURE 3.5 Forebrain structures – the thalamus and the hypothalamus

THE CEREBRUM

The cerebrum, which is the largest and most highly developed part of the brain, is located at the top of the forebrain (see Figure 3.6). The cerebrum lies over and around most brain structures. Its outer layer consists of the cerebral cortex, the brain area responsible for higher cognitive functions, voluntary movement, emotions and personality. The cerebrum can be divided into two hemispheres, the left and the right hemispheres. Both hemispheres are mostly symmetrical in their anatomical structure; however, they do differ in their functions. The cerebral hemispheres are connected by the corpus callosum, which is a large bundle of nerve fibres that enables messages to be relayed from one hemisphere to the other.

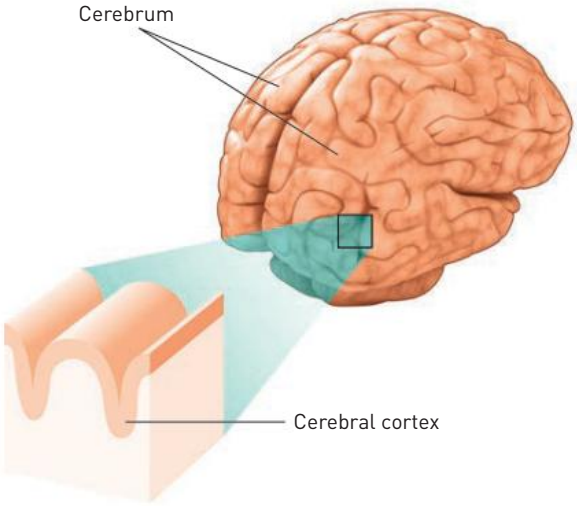


FIGURE 3.6 The location of the cerebrum

forebrain Located above the midbrain, it is the largest and most highly developed part of the brain and responsible for our most complex processes; it consists of the hypothalamus, thalamus and cerebrum

hypothalamus A small structure located in the forebrain responsible for a variety of functions, including regulation of body temperature, sex drive, appetite and the sleep–wake cycle

endocrine system A network of glands that produce and secrete hormones into our body, through the bloodstream, in order for us to achieve a specific physiological state

thalamus A forebrain structure that sits on top of the brain stem through which all sensory information, except smell, passes; the thalamus redirects this information to the appropriate sensory area of the cerebral cortex for processing

cerebrum The two large hemispheres that cover the upper part of the brain

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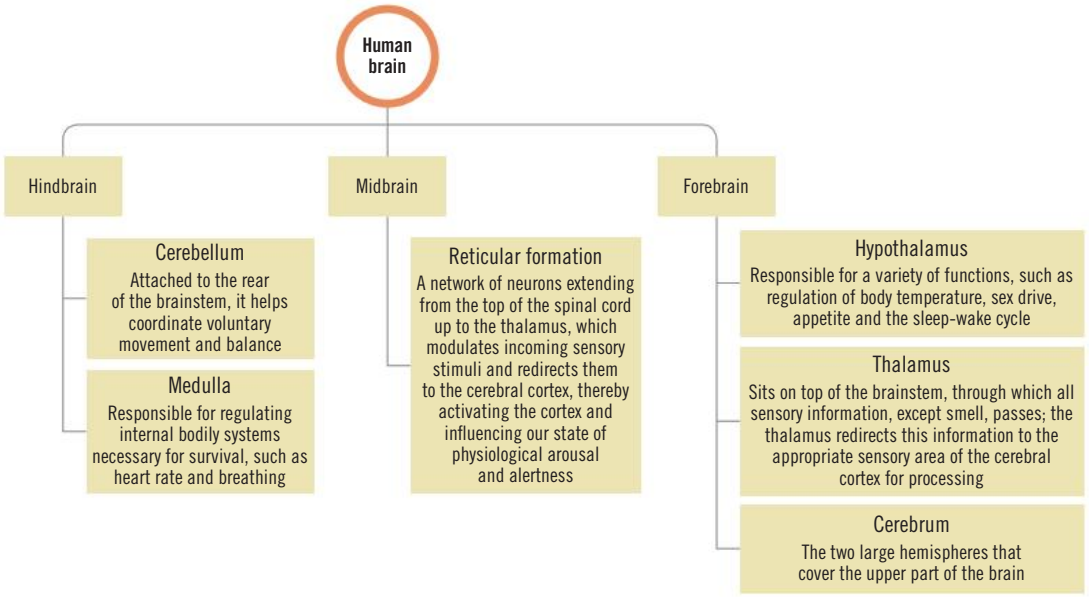


FIGURE 3.7 The structure and function of the human brain

3.2 CHECK YOUR UNDERSTANDING >>

1 The forebrain consists of which three brain structures?
   - A The thalamus, hypothalamus and cerebrum
   - B The thalamus, hypothalamus and medulla
   - C The cerebrum, hypothalamus and medulla
   - D The thalamus, hypothalamus and reticular formation

2 Describe the role of the hypothalamus in communicating with both the endocrine and nervous systems. Use an example to support your answer.

3 Which of the following is not a function of the hypothalamus?
   - A Control of our appetite
   - B Regulation of body temperature
   - C Relaying all sensory information, except for smell, to the cerebral cortex
   - D Maintaining homeostasis

4 When you experience a thunderstorm what sensory information will not pass through the thalamus?
   - A The flash of lightning
   - B The smell of damp pavement
   - C The pounding of the rain
   - D The sound of the thunder

5 What role does the thalamus play when filtering sensory information during sleep?

THE LEFT AND RIGHT CEREBRAL HEMISPHERES

Hemispheric specialisation refers to the two cerebral hemispheres having localised functions and specialties; that is, the left hemisphere has strengths and specialisations as does the right hemisphere. One example of hemispheric specialisation includes the localisation and coordination of motor and sensory control from our brain to our body and vice versa. The left hemisphere of the brain controls voluntary movement on the right side of the body. It also receives sensory information from the right side of the body. Likewise, the right hemisphere controls voluntary movement on the left side of the body and receives sensory information from the left side of the body. This is known as a contralateral form of organisation (see Figure 3.8). Hemispheric specialisation can be illustrated when one side of the brain is injured or damaged. A stroke that causes damage to the right hemisphere can result in some paralysis and loss of sensation on the left side of the body. If a stroke occurs in the left hemisphere, the sufferer may lose sensation in, and have difficulty moving, the right side of their body.

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Research into hemispheric specialisation has provided many valuable insights into the functions of the left and right hemispheres. The left hemisphere is usually the dominant hemisphere for verbal and analytical functions, whereas the right hemisphere specialises in non-verbal, artistic and spatial abilities.

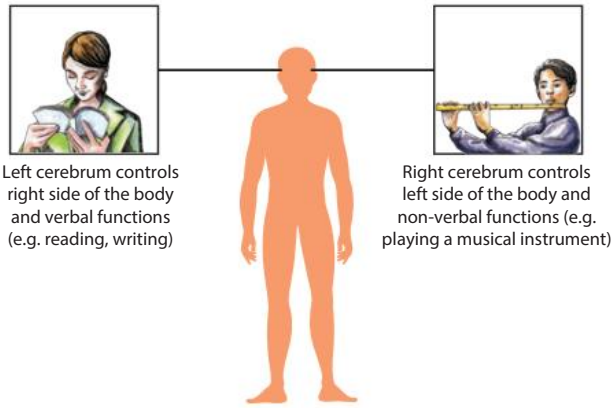


FIGURE 3.8 The contralateral organisation and specialisations of the cerebral hemispheres

THE LEFT HEMISPHERE: VERBAL AND ANALYTICAL FUNCTIONS

One of the first cases to support the left hemisphere's verbal functions comes from the work of Paul Broca and Carl Wernicke in the mid to late 1800s where they identified the importance of the left hemisphere for language functions. Roughly 95 per cent of people have their language centres (Broca's area and Wernicke's area) in the left hemisphere, so most adults use the left hemisphere for speaking, writing, reading and understanding language. In other words, for most of us, the ability to communicate our awareness using spoken or written language depends on left hemisphere function. Interestingly, language lateralisation does not always correlate with hand preference. Paul Broca originally thought that an individual's dominant language hemisphere and hand preference were correlated; that is, people who have left-hemisphere language specialisations were also right-handed. However, more recent research has shown that 95 per cent of right-handers and 70 per cent of left-handers have left-hemisphere language dominance (Corballis, 2003).

The left hemisphere is also believed to be involved in analytical functions; for example, breaking information into parts and processing information sequentially (in order, one item after the next) (Springer & Deutsch, 1998). It is believed that the left hemisphere is superior at mathematics, judging time and rhythm, and coordinating the order of complex movements, such as those needed for speech. Additionally, the left hemisphere focuses on small details, so its focus is local (Heinze et al., 1998; Hellige, 1993; Huebner, 1998).

THE RIGHT HEMISPHERE: NON-VERBAL FUNCTIONS

The right hemisphere appears to process information simultaneously (at the same time) and holistically (all at once) (Springer & Deutsch, 1998). You could say that the right hemisphere is better at assembling pieces of the world into a coherent picture; it sees overall patterns and general connections and it has a global focus (Heinze et al., 1998; Hellige, 1993; Huebner, 1998).

For 95 per cent of adults, the right hemisphere can produce only the simplest language and numbers. To answer questions, the right hemisphere must use non-verbal responses, such as pointing at objects or drawing them. However, although it is poor at producing language, it is superior at some aspects of understanding language. If this hemisphere is damaged, people lose their ability to understand jokes, irony, sarcasm, implications and other nuances of language. Basically, the right hemisphere helps us see the overall context in which something is said (Beeman & Chiarello, 1998).

The right hemisphere also has specialised non-verbal perceptual skills. It is dominant in spatial skills and visual skills such as recognising patterns, faces and melodies; putting together a puzzle; reading a map or interpreting a painting. It is also more dominant in detecting and expressing emotion (Borod et al., 1998; Christianson et al., 1995). Table 3.1 specifies the functions of each hemisphere.

hemispheric specialisation Refers to the functional differences between the left and right cerebral hemispheres

cerebral hemispheres The two halves of the cerebrum that cover the upper part of the brain

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TABLE 3.1 Specialised functions of the left and right hemispheres

LEFT HEMISPHERE	RIGHT HEMISPHERE
Motor functions	
» Controls movement in the right side of the body » Production of speech	» Controls movement in the left side of the body
Sensory functions	
» Receives sensations from the right side of the body	» Receives sensations from the left side of the body
Perceptual functions	
» Comprehension of language	» Recognition of faces » Recognition of patterns
Cognitive functions	
» Reading » Writing » Analytical thinking » Sequential processing » Logical reasoning » Mathematics	» Musical ability » Spatial ability – design, movement, dance » Emotional expression » Detection of emotion

Some tasks require the use of one hemisphere more than the other, but in most real-world activities the two hemispheres work together holistically. Each hemisphere has its particular strengths and shares information with the other hemisphere via the corpus callosum. A popular-psychology myth, stemming from the left-brain and right-brain functions, states that people are either 'right-brained' or 'left-brained'. It is incorrect to assume that a person's personality and strengths can only come from one side of the brain. A person can be logical and analytical as well as creative and artistic. It is also incorrect to assume the brain is not flexible or adaptable. Although certain abilities may be commonly associated with one hemisphere, for example language abilities residing in the left hemisphere, it does not necessarily mean that the right hemisphere cannot take over language functions if need be. We now know the human brain is a 'plastic' organ that has the ability to change, adapt and transform. Brain plasticity is a relatively new research area, and is described in more detail in Focus on research 3.1 and Chapter 4.

THE CORPUS CALLOSUM

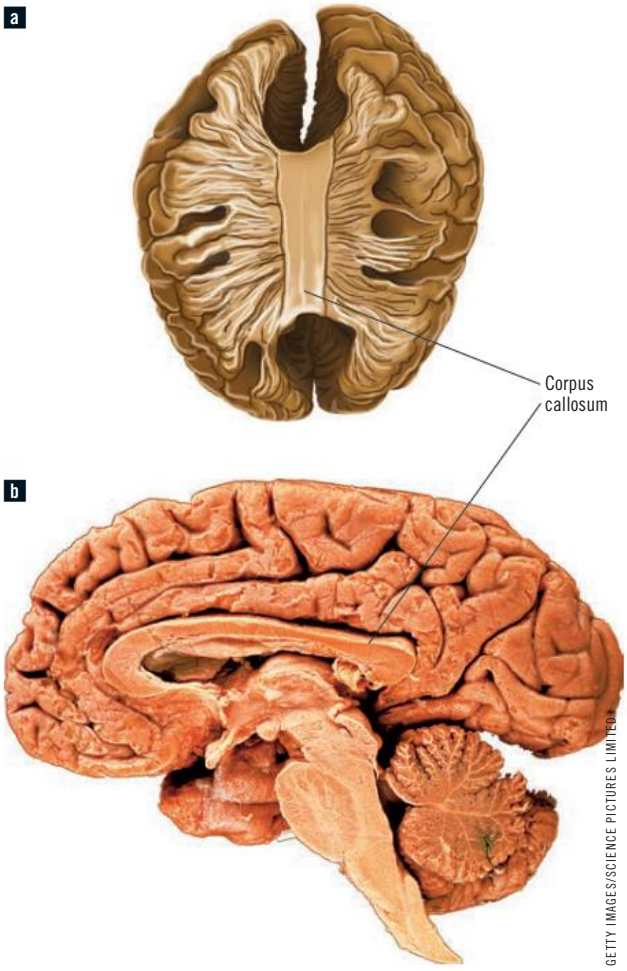
A superficial look at the outside of the brain reveals an obvious physical feature – the outer layer is made of two halves or hemispheres (the left hemisphere and the right hemisphere). These hemispheres are separated by a deep groove – a longitudinal fissure – but connected by a thick band of nerve fibres known as the corpus callosum (see Figure 3.9).

Located deep in the centre of the brain, the corpus callosum is approximately 10 centimetres long and 7.5 millimetres thick. It is a major physical connection between the hemispheres and its function is to transfer information registered in one hemisphere to the opposite hemisphere for processing.

The corpus callosum integrates the sensory, motor and cognitive functions of the brain's right and left hemispheres, so it plays an important role in everyday actions and behaviour. For instance, if you were playing tennis, you may be holding the ball in your left hand and the tennis racket in your right hand. When it is your turn to serve, you throw the ball in the air with your left hand and arm. The information about this movement travels from the left side of your body to your brain's right hemisphere for processing. The right hemisphere controls movement on the left side of your body so it relays a message to the left hemisphere that enables you to raise your right arm and hit the ball at the required moment. Without the corpus callosum, there would be no connection between the hemispheres and the information would not be transferred between them. As a result, you would not be able to successfully deliver your serve to your opponent.

Because the corpus callosum transfers information between hemispheres, it allows information from both hemispheres to be exchanged and integrated in a continuous way. Although we know that each hemisphere can perform specialised functions, most of our thoughts, feelings and behaviours involve both hemispheres working together.

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FIGURE 3.9 The corpus callosum connects the brain's left and right hemispheres. (a) The brain viewed from above with a section of each hemisphere cut out to expose the corpus callosum, (b) a cross-section of the brain

3.3 CHECK YOUR UNDERSTANDING

1 Describe the contralateral organisation of the cerebral hemispheres.

2 Who were the first researchers to identify the left hemisphere as specialising in language? When did they make this discovery?

3 The corpus callosum:
- A manages our understanding of speech and language.
- B cannot process messages sent from the left hand.
- C is a deep fissure in the cerebral cortex.
- D is a thick band of nerve fibres linking the two hemispheres of the brain.

4 _____ draws more on the left hemisphere functions, whereas _____ is more of a right hemisphere specialisation.
- A Reading a map; language ability
- B Working out an argument in a debate; reading a map
- C Doing a jigsaw puzzle; language ability
- D Rearranging the furniture in your bedroom; language ability

5 Which of the following statements is true?
- A Each hemisphere's functions are fixed and cannot be performed by the other hemisphere.
- B The right hemisphere mostly specialises in verbal functions, while the left hemisphere specialises in non-verbal functions.
- C Both hemispheres operate quite independently.
- D We usually draw on both hemispheres to perform most functions.

FOCUS ON RESEARCH 3.1

HOW ROBUST IS THE RIGHT- OR LEFT-BRAIN DOMINANCE THEORY?

Brain plasticity (also known as neuroplasticity) refers to the brain's ability to change due to growth and experience, or in response to a deficit. There is a large body of growing evidence to support the notion that the brain is malleable. Before the emergence of neuroplasticity research in the early 1980s, neuroscientists believed the brain was relatively unchangeable after a sensitive period during early childhood. It was thought that anatomical structures in the brain only carried out their specified functions. Neuroplasticity research does question the right- or left-brain dominance theory because now there are several cases highlighting the right hemisphere's ability to take over the specialised functions of the left hemisphere and vice versa. Patients who have undergone a rare and radical medical procedure known as a hemispherectomy are living examples of the brain's remarkable ability to transform. The procedure involves removing or disabling one of the cerebral hemispheres, which is sometimes used to treat severe epilepsy, Rasmussen syndrome or brain tumours.

corpus callosum A thick band of nerve fibres in the middle of the brain that connects the left and right hemispheres and transfers information registered in one hemisphere to the other hemisphere for processing

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In a study conducted by Laura Danelli (2013) and a team of researchers, a patient (known as EB) had his linguistic abilities studied years after having a left hemispherectomy. EB was born in Italy in 1992, and when he was approximately 2 years old he began to experience severe headaches and frequent vomiting. After an MRI scan it was found EB had a large expanding tumour in his left hemisphere. Because of the high risk of brain haemorrhage, EB underwent a left hemispherectomy. Before the procedure, EB's parents recognised his right-hand preference, consistent with his older brother and other immediate family members. It was assumed his language centres (Broca's and Wernicke's areas) were situated in his left hemisphere, which was now removed. This assumption was supported within the first 2 years of his recovery as he experienced aphasia; his language recovery was slow and effortful. Within the first 2 years after the operation, EB was involved in linguistic rehabilitation to help him overcome his deficits. By the time EB started school, his language abilities had remarkably improved. EB was studied at the age of 14 and it was found that his language abilities were near to normal when compared to other individuals his age. He showed results in the normal range for linguistic tasks such as accuracy and speed in both reading and writing. Interestingly, when EB's brain was scanned using fMRI technologies it was found that his right hemisphere closely resembled a left linguistic hemisphere. The conclusion was that EB had a 'left-like neural blueprint' in his lone right hemisphere. This case supported previous research into brain plasticity because it demonstrated that when one hemisphere is removed the remaining hemisphere takes on a compensatory role.

QUESTIONS

1 What is neuroplasticity?
2 What functions did EB's right hemisphere take over that it would not normally specialise in?
3 What are some disadvantages of research based on a single case study?
4 What can be concluded about the right- or left-brain dominance theory based on the results of this study?

3.1 TRY IT YOURSELF >>

HEMISPHERIC SPECIALISATION

Do each part of this activity twice, in pairs, swapping roles the second time.

PART 1

One person in the pair is to do the following:

- Stretch your arms out in front of you and then cross them, with the palms of your hands facing each other. Clasp your hands and interlock your fingers – your hands may feel upside down and back to front.
- Bring your arms down towards the floor and then move your clasped hands up towards your chest, bending your elbows. You may feel as if you're twisting your arms inside out. Your clasped hands should now be up near your chest or chin, and your elbows should be against your body.

The second person in the pair is to do the following:

- Point to one of your partner's fingers, but don't touch them. Ask them to move that finger. Repeat this with different fingers.

QUESTIONS

1 How long does it take you to move the correct finger?
2 How many errors did you make (moving the incorrect finger)?
3 How would you explain any difficulties you had?

PART 2

One person in the pair is to clasp their hands as explained in Part 1. The second person in the pair must now touch one of their partner's fingers, and ask them to move that finger. Repeat this with different fingers.

QUESTION

1 Is there any difference in the time it takes or in the level of difficulty?

PART 3

Repeat Part 1 of the activity but do not cross your arms before clasping your hands. Just clasp your hands in front of you as you would normally.

QUESTION

1 How would you explain the differences between the two conditions – crossed arms and uncrossed arms – in terms of the contralateral organisation of the motor and somatosensory cortices?

THE ROLE OF THE CEREBRAL CORTEX

Considering what it is capable of, we can see that the human brain is highly developed. There are approximately 100 billion neurons in the adult human brain, and an almost infinite number of synaptic connections between them. As we move from lower-order (for example, fish or snails) to higher-order animals (for example, chimpanzees or apes) (see Figure 3.10) we find that an ever-increasing proportion of the brain is devoted to the cerebrum – two large hemispheres (cerebral hemispheres) that cover the upper part of the brain.

The outer layer of the cerebrum is known as the cerebral cortex. Although this cortex is only three millimetres thick, it is the largest brain structure and contains approximately 70 per cent of the neurons in the central nervous system. Without the cerebral cortex, humans would not be any more intelligent than lower-order animals.

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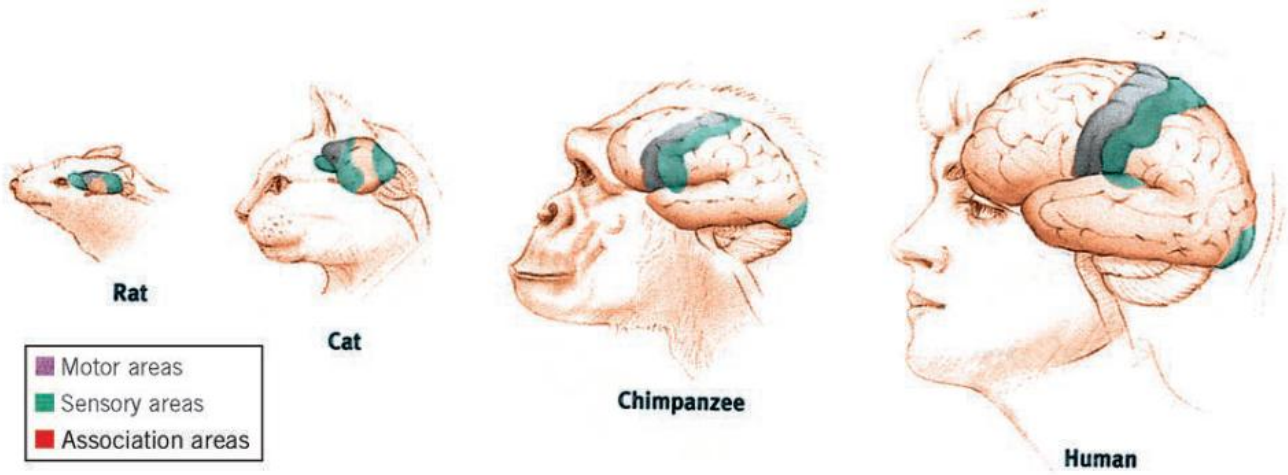


FIGURE 3.10 The human brain compared to that of lower-order animals. Animals higher up the evolutionary scale have larger areas of cerebrum and are able to perform more complex functions.

The cerebral cortex looks a little like a giant, wrinkled walnut. It covers most of the brain with an outer layer of grey matter (spongy tissue made up mostly of cell bodies). The cortex in lower-order animals is small and smooth. In humans, it is highly convoluted (folded) and is the largest brain structure. These folds increase the cortex's surface area and, naturally, the number of neurons and neural connections possible. In fact, if you spread the thin layer of cortex out flat, it would cover an area of more than half a square metre. The fact that humans are more intelligent than other animals is related to the large surface area of the human cortex.

There is a small variation in brain size among individuals and a small positive correlation exists between intelligence and brain size (Flashman et al., 1997; Rushton, 1995; Wickett, Vernon, & Lee, 1995). However, it is a mistake to think that size alone determines human intelligence. A person with an average-sized brain could be extremely intelligent, and someone with a very large brain could have average intelligence. Intelligent behaviour is based on what you know and how efficiently you use your mental capacities, not just the size of your brain.

The cerebral cortex is the most highly developed part of the brain and performs a variety of functions. Certain regions of the cerebral cortex have primary functions including motor, sensory, visual and auditory processing functions. Other cortical regions of the cerebral cortex perform other complex mental functions such as logic, reasoning, planning, initiating, language and symbolic thinking.

The overall role of the cerebral cortex is to integrate the brain's motor functions (coordinating voluntary movement), sensory functions (receiving information about the texture or temperature of an item we touch) and cognitive functions (symbolic thought processes). For example, when making a decision on whether or not you should buy a new blanket for your bed, the interaction of these processes is at play. Your brain may first coordinate the voluntary movement of your hands to touch the blanket in the store you are shopping in. Your brain will then receive and process the sensory information received by your hand about the texture of the blanket. Your brain may then use cognitive thought processes to visualise the blanket on your bed at home to determine whether or not the colour will match your bedroom décor as well as process the sensory information about the texture of the blanket to determine whether or not it will be warm enough.

The several functions of the cerebral cortex can be localised in different areas of the brain. These areas are often divided into four distinct lobes in each hemisphere: the frontal lobe, parietal lobe, temporal lobe and occipital lobe (see Figure 3.11). These lobes are bordered by major fissures (grooves) and defined by their functions. The lobes are named after the particular bones of the skull under which they lie.

cerebral cortex The thin layer of tissue that forms the outer layer and surface of the brain's cerebrum; responsible for basic sensory and motor functions, as well as higher mental processes

symbolic thinking A cognitive skill that enables us to use symbols, gestures or images to mentally represent people, objects and events that may not be present

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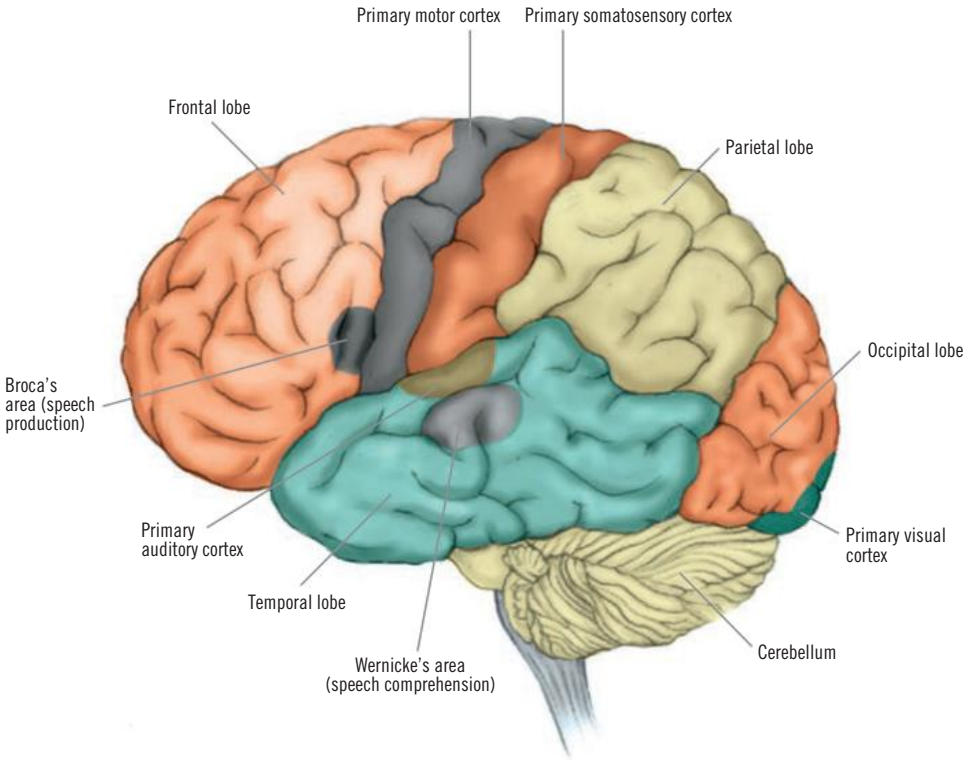


FIGURE 3.11 The brain, showing all four lobes, sensory and motor cortex areas and language centres

FOCUS ON RESEARCH

3.2

HOW DO BRAIN STRUCTURES IN OTHER ANIMALS COMPARE WITH THOSE IN HUMANS?

For years psychologists have been researching what makes the cognitive capabilities of humans superior to those of other animals. Is our ability to perform higher-order functions such as reasoning, problem solving and decision making the thing that separates us from other primates? One team of researchers at Oxford University compared the brain structures in the forward frontal lobes of humans and monkeys to localise a structure in the brain that makes us uniquely human.

In this study conducted by Neubert et al. (2014), an area in the frontal lobe known as the ventrolateral frontal cortex (VLFC) was compared in humans and monkeys. The VLFC, which is located in the forward part of the frontal lobes, plays a key role in humans' cognitive abilities, including complex thought processes and language acquisition. In this study it was hypothesised that there are areas in the human VLFC that do not exist in monkeys. It was further hypothesised that there would be differences in the brain regions of humans and monkeys in the interconnections and interactions between the VLFC and other brain regions.

To carry out this study, researchers used 25 human participants and 25 macaque monkeys. They used

→

neuroimaging technologies such as MRI to study the structure of the VLFC in monkeys and humans, and tested the connections between the VLFC and other brain regions. When comparing the scans of the monkeys and humans, they found many similarities in VLFC brain structure. In humans, 12 VLFC regions were identified; similarly, 11 of these 12 regions were also found in monkeys. However, they found one stark difference. In humans, there is a region in the VLFC known as the lateral frontal pole. There is no comparable area in the brains of monkeys. Researchers also found significant differences between the connections of the VLFC and auditory processing regions in the brains of humans. The same connections were not seen in the brains of monkeys. This could account for the difference between monkeys and humans in our ability to communicate through the use of language.

QUESTIONS

1. What was the aim of this research?
2. What did researchers hypothesise for this experiment?
3. What did the researchers conclude about the comparison of human brains and monkey brains?
4. What ethical principles were important to observe in this research?

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THE LOCALISATION OF FUNCTION WITHIN THE CEREBRAL CORTEX

THE FRONTAL LOBES

The frontal lobes, located on the upper front half of each hemisphere, are the largest of the four lobes. Cortical areas known as association areas cover the front of each lobe. Association areas are found throughout the cerebral cortex and they do not have a specific sensory or motor role. Their role is to integrate information received from other brain areas or structures. Association areas in the frontal lobe give meaning to the information they integrate, and determine an appropriate response. In doing so, they are the area of the frontal lobe responsible for our most complex mental behaviours, such as planning, problem-solving, memory, learning, analysing and symbolic thinking.

Symbolic thinking

Because symbolic thinking is a higher-order cognitive developmental skill, psychologists believe it is a function of the frontal lobe. Symbolic thinking refers to the ability to mentally represent people, objects and events – even those that are not present – by using abstract concepts such as words, gestures and numbers. For example, a person may describe to their friend a basketball game they watched on the weekend. This person will begin to describe a player's tactics when moving past their opponent to score a goal and how this was carried out on the court. In order to demonstrate this, they may use salt and pepper shakers on the table they are sitting at as 'symbols' to represent the player and the player's opponent. Although this event (the basketball match) is not happening at the time the person is retelling the story, they are able to think symbolically and use other objects and gestures to re-enact the play on the court. This cognitive skill enables the person to mentally visualise the play on the court to then reflect on and reconstruct this scene using unrelated objects (see Figure 3.12).

Symbolic thinking is most clearly demonstrated in language and mathematics, when we use words or symbols to express concepts. As our cerebral cortex develops, particularly our frontal lobe, so does our ability to transfer information in the cortex. As a result of this development, our ability to think symbolically also develops. Psychologists believe



FIGURE 3.12 A person using their symbolic thought processes to describe the details of a basketball match

that the ability to think symbolically is acquired as humans progress through the lifespan. According to Swiss developmental psychologist Jean Piaget (1896–1980), all children pass through a series of distinct age-based stages in their cognitive development. Piaget suggested that as the human brain develops, symbolic thinking becomes more prevalent though infancy and into early childhood. Piaget proposed that during the preoperational stage of cognitive development (aged 2 to 7 years) children begin to think symbolically. This is manifested through children's 'pretend play'. During this stage, children begin to engage in pretend play where they use objects, for example a 'stick' and a 'towel', to represent their internal thoughts of pretending to be a magician. The child may use the 'stick' to symbolise the magician's wand and the 'towel' to symbolise the magician's cape.

Motor function

The frontal lobes are also responsible for the control of voluntary movement. An arch of tissue at the rear of the frontal lobe that extends over the top of the brain, called the primary motor cortex, directs the body's skeletal muscles; therefore, it controls voluntary movement. If the primary motor cortex is stimulated with an electrical current, various parts of the body

frontal lobe The upper front half of each cerebral hemisphere; associated with complex mental abilities and the control of voluntary movement

association areas All the areas of the cerebral cortex that do not have a specialised sensory or motor function; they integrate information received from different brain areas and structures to enable complex mental behaviours

primary motor cortex An area at the rear of the frontal lobe that directs the body's skeletal muscles and controls voluntary movement

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twitch or move, depending on which cortical area was stimulated. The left frontal lobe's primary motor cortex controls voluntary movement for the right side of the body and the right frontal lobe's primary motor cortex controls voluntary movement for the left side of the body.

Different parts of the body are represented at various locations on the motor cortex, but the amount of motor cortex devoted to each body part corresponds to the importance of bodily areas and how often they are used, not to their size. Figure 3.13 shows a homunculus of the motor cortex – a pictorial representation of the portion of the brain responsible for different anatomical functions. In Figure 3.13, the hands, for example, are represented by more area than the feet. If you've ever wondered why your hands are more dexterous than your feet, it's partly because a larger area of motor cortex is devoted to the hands. You will also notice in Figure 3.13 that a large area of motor cortex is devoted to the lips, mouth and tongue. This is hardly surprising, since dozens of muscles are involved in the production of simple speech. Figure 3.13 also shows you that the parts of the body are represented on the cortex in the opposite position to where they are located on the body. For example, the face and mouth are located towards the bottom of the motor cortex, while the feet and legs are towards the top.

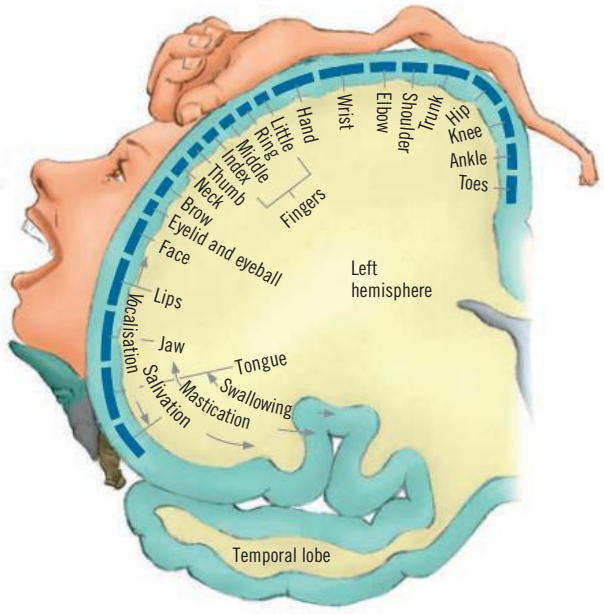


FIGURE 3.13 The location and size of various representations of body parts along the primary motor cortex are drawn in this motor homunculus so as to correspond to the number of muscles involved in the movement of that body part.

Psychologists also believe that the frontal lobes are heavily involved in emotional behaviour and personality. If the frontal lobes are damaged, an individual's personality and emotional life may change dramatically. Case studies of individuals suffering frontal lobe injury from accidents, brain tumours or accidental poisonings provide much valuable information about the structure and function of the human brain. You may remember the case of Phineas Gage (see page 42), who experienced a drastic personality change following traumatic injury to the brain. Gage's case was the first to support the theory of localisation of frontal lobe functions such as personality and social and moral judgment; however, more recent case studies also validate these functions. Another well-known case was that of a patient who became known as EVR. EVR was a 35-year-old family man, married with two children and working as a trustworthy accountant before he underwent surgery to remove a brain tumour from his frontal lobe. After his surgery, EVR's decision-making abilities and moral reasoning were severely impaired. As a result of this, his marriage broke down. He joined a partnership with an untrustworthy former colleague to start a new business, which subsequently failed and led him to bankruptcy. He then worked in many jobs but was fired from most of them because of his unreliability, lateness and disorganisation. EVR was tested on his intelligence and, interestingly, it had not deteriorated following the surgery. In fact, his measurable intelligence was superior. Nevertheless, EVR struggled to make simple, rapid decisions such as which brand of toothpaste to buy, what to wear in the morning or what to eat for dinner. EVR reportedly sometimes spent the entire day shaving and washing his hair (Eslinger & Damasio, 1985).

Other than voluntary movement, symbolic thinking and moral judgment, the left frontal lobe is also believed to play an important role in the production of language, as we have seen with Broca's area.

3.4 CHECK YOUR UNDERSTANDING

1 What is the overall role of the cerebral cortex?

2 What does it mean to think symbolically? Use an example to support your answer that is not mentioned in the text.

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3 The frontal lobe of the cerebral cortex is associated with:
   A helping us find our position in space.
   B receiving information from bodily sensations.
   C higher-order functions such as planning, reasoning and problem-solving.
   D processing auditory information.
4 Describe the role and location of the primary motor cortex.
5 Which of the following body parts will receive the least amount of neuronal devotion on the primary motor cortex?
   A Hands
   B Feet
   C Lips
   D Tongue

3.2 TRY IT YOURSELF >>

TESTING SYMBOLIC THINKING IN CHILDREN

For this activity you will need:

» one child participant aged 3 years
» one child participant aged 7 years
» a variety of random household objects; for example, a ruler, ball, pot, key and a pillow case.

One child should be placed in a room at a time and read the following story:

'A young girl is trapped at the top of a burning tower and can't get out. She yells from the top of the tower, "Someone please come and help me, I'm stuck and can't get out." A flying superhero hears the young girl's cry and flies to the top of the tower to rescue her. He puts her on his back and flies her safely to the ground away from the fire.'

The child should then be asked to retell the story using the objects presented to the child on a table to represent characters and objects from the story.

QUESTIONS

1 What were the differences observed (if any) between the younger and older child when retelling the story?
2 Were the children able to think symbolically? How do you know?
3 What can be concluded about symbolic thinking and frontal lobe development as a result of this activity?
4 What ethical issues need to be considered when carrying out an activity involving children such as this?

THE PARIETAL LOBES: SENSORY FUNCTION

The parietal lobes are areas of the cerebral hemispheres located at the top of the cerebral cortex behind the frontal lobes, mostly associated with processing bodily (somatic) sensations (see Figure 3.14).

Touch, temperature, pressure and other somatic sensations relating to muscle and joint movement and the body's position in space are registered in the parietal lobe's primary somatosensory cortex. The primary somatosensory cortex is a strip of neurons located at the front of the parietal lobe, adjacent to the primary motor cortex. Sensations detected in the sensory receptors located throughout the body and the skin are registered and processed in the primary somatosensory cortex. As a result, we feel a sensation and form a perception of what it is and where it came from. Sensory information from the left side of the body travels, in the first instance, to the primary somatosensory cortex of the right hemisphere's parietal lobe. Sensory information from the right side of the body travels first to the somatosensory cortex of the left hemisphere's parietal lobe.

As with the motor cortex, we find that the 'map' of bodily sensations on the somatosensory cortex is distorted. The homunculi in Figures 3.14 and 3.15 show that the cortex reflects the sensitivity of body areas rather than their size. Sensitivity is a measure of the number of sensory receptors found in that part of the body. For example, the lips are large in both Figures 3.14 and 3.15 because of their great sensitivity; the back and trunk, which are less sensitive, are much smaller. You will notice also that each body part is represented on the somatosensory cortex according to its position on the body (adjacent body parts are adjacent on the somatosensory cortex). As for the motor cortex, parts of the body are represented on the somatosensory cortex in the opposite order to their position on the body. For example, sensations from the face, mouth and lips register towards the bottom of the somatosensory cortex and sensations from the feet and legs register towards the top.

Other than its primary sensory function, the parietal lobe has a large area of association cortex that receives and integrates information from other brain structures and areas such as information from our visual and auditory cortices. This function of the parietal lobe enables us to determine where objects are located in space and where our body is positioned in space. Therefore, the parietal lobe is also involved in the coordination of senses and movement.

parietal lobe An area of each cerebral hemisphere located behind the frontal lobe; mostly associated with processing sensations but also involved in the coordination of senses and movement

primary somatosensory cortex A strip of neurons located at the front of the parietal lobe, adjacent to the primary motor cortex, which registers and processes sensory information from receptors in the body

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People with parietal lobe damage may lose sensation in a body area, they may become clumsy in their movements, and they may have difficulties with spatial skills. They may confuse left and right, or may suffer from a neurological disorder known as spatial neglect where they neglect one whole side of their world (usually the left), both inside their body and out.

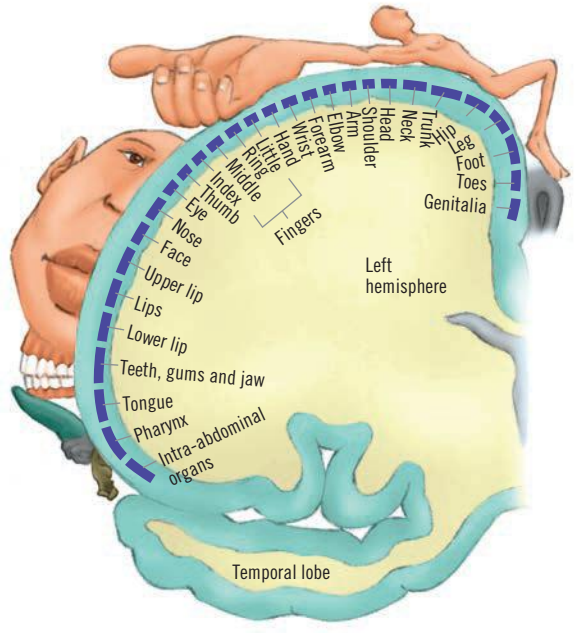
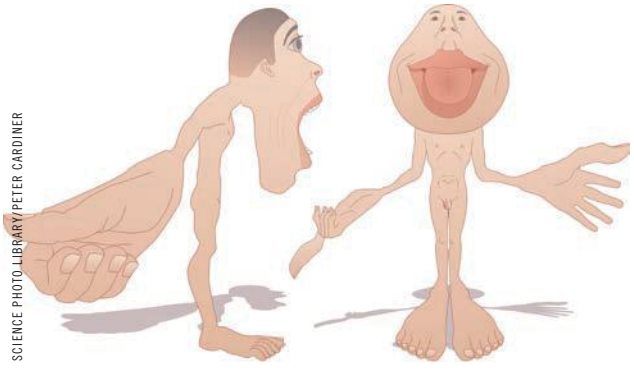


FIGURE 3.14 The somatosensory homunculus. Note the proportion of primary somatosensory cortex devoted to the hand, fingers, mouth and tongue.



SCIENCE PHOTO LIBRARY/PETER CARDINER

FIGURE 3.15 These misshapen homunculi represent motor (left) and somatosensory (right) cortex organisation. The parts of the body that are enlarged have more cortex devotion.

THE TEMPORAL LOBES: AUDITORY FUNCTION

The temporal lobes are located on each side of the brain (see Figure 3.11). Auditory (sound-based) information received by both ears is transmitted directly to each temporal lobe, making them the main site where sound is processed. The temporal lobes contain large amounts of primary auditory cortex. The primary auditory cortex is the area of the temporal lobe that registers and processes auditory information. If we were to stimulate the auditory area of a temporal lobe, our subject would 'hear' a series of sound sensations. Additionally, different parts of the auditory cortex respond to a different pitch. The primary auditory cortex in the right temporal lobe is specialised to process non-verbal sounds (for example, the sound of a siren or a door slamming), and the primary auditory cortex in the left temporal lobe is specialised to process verbal sounds that are associated with language.

Other than its primary auditory function, psychologists believe the association areas of the temporal lobe contribute to memory, particularly our ability to recognise faces and identify objects, and make appropriate emotional responses. People who experience temporal lobe damage may be unable to remember previously known facts or skills, may forget events that were personally significant and may demonstrate inappropriate emotional responses to people or situations. They may also be unable to recognise faces or objects even though they will still be able to describe them. The left temporal lobe is also believed to play an important role in language processing, more specifically language comprehension. This region is known as Wernicke's area and is discussed in more detail later in this chapter.

THE OCCIPITAL LOBES: VISUAL FUNCTION

At the back of the brain are the occipital lobes, the major visual area of the cortex. The occipital lobes contain large areas of primary visual cortex; an area at the base of the occipital lobe that registers and processes visual information transmitted from the retinas of both eyes. The optic nerves, which leave the back of the retina and connect with neurons in the primary visual cortex, provide the neural pathway along which this information travels.

When the retina in an eye receives an image, it is divided into a right visual field and a left visual field. Information from the right visual field of each eye is transmitted to the primary visual cortex in the left occipital lobe, and information from the left visual field of each eye goes to the primary visual cortex in the right occipital lobe. This arrangement ensures that information from both eyes goes to both cerebral hemispheres for processing (see Figure 3.16).

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The primary visual cortex contains a variety of neurons specialised to respond to specific features of visual information. For example, some feature detector cells contribute to vision by only responding to colour, some to shape and some to motion.

The specialised neurons in association areas of the occipital lobe select and integrate information from the primary visual cortex. In addition, they send visual information to other brain lobes. This helps the brain process a variety of different information at once, and form an integrated, meaningful understanding of it. For example, the association area might combine visual information about the shape, distance and speed of a ball being thrown at you with sound information from the auditory cortex – 'Catch!' – and input from the frontal lobe to help you judge whether you can catch the ball.

Visual information arrives in many 'bits' that must be reassembled into a complete image by the visual cortex. The function of the visual cortex is partly to reassemble the 'bits' of information that arrive there into a 'whole picture'.

Damage to the occipital lobe may result in visual impairment even if the eyes and the optic nerve are uninjured. For example, individuals who experience a tumour in one of their occipital lobes may experience blind spots in their vision.

3.5 Check your understanding

1. Where is the primary somatosensory cortex located? What is its main function?
2. How are different areas of the body represented on the primary somatosensory cortex? Use an example to support your answer.
3. Describe the location and role of the primary auditory cortex.
4. Which of the following is not a function of the temporal lobe?
   - A Language comprehension
   - B Memory
   - C Facial recognition
   - D Vision
5. Explain what change in behaviour might be experienced by someone who had sustained damage to their primary visual cortex.

3.3 FOCUS ON RESEARCH

HOW CAN BRAIN TRAUMA IN SPORTING INJURIES AFFECT COGNITIVE FUNCTION?

A traumatic brain injury (TBI) involves a blow, jolt or hit to the head that affects normal brain functioning. TBI can range from mild to severe depending on the severity of the trauma the head has sustained. Mild TBI can include symptoms such as temporary unconsciousness (concussion), nausea, headaches, confusion and memory problems. Severe TBI can include symptoms such as prolonged unconsciousness or coma, amnesia and language impairments. Although the human brain is protected by the skull and cerebrospinal fluid, there are many ways of sustaining TBI. Some common ways include a car crash, bike accident, playground injury, physical assault and sporting injury. A sports-related TBI can occur in a variety of ways. It can be caused by colliding with a team mate, tackling an opponent, falling head first on the ground or being hit with a piece of sporting equipment. There seems to be a growing number of sports-related TBIs recorded across Australia, occurring in both professional and non-professional sports. In one study published in the *Medical Journal of Australia*, researchers tracked hospitalisation rates in Victoria for sports-related concussions between the years 2002–03 and 2010–11. It was found that patients aged 15 years and older admitted to hospitals in Victoria with sports-related concussion increased by 61 per cent. Over the 9-year period, 28 718 people were hospitalised for concussion. Of these, 4745 (16.5 per cent) were sports-related (Finch, Clapperton, & McCroy, 2013). These statistics have caused public concern about safeguarding young Australians and making head injury prevention in sport a priority in Australia, particularly when sports-related TBI can cause subsequent cognitive impairments. The following research case study has validated this concern.

In 2012, Canadian neuropsychologist Dr Maryse Lassonde and a team of researchers set out to explore the effects of cognitive decline in athletes in late adulthood who had sustained head injuries in early adulthood (Tremblay et al., 2013). For this study, researchers recruited 30 participants between the ages of 51 and 75 who were all former university-level athletes. All participants played either American football (30 per cent) or ice hockey (70 per cent) and had not

→

temporal lobe An area located on either side of each cerebral hemisphere; associated with processing auditory information; also believed to be involved in memory, facial recognition, object identification and emotion

primary auditory cortex The area of the temporal lobes that registers and processes auditory (sound) information

occipital lobe An area located at the back of each cerebral hemisphere; associated with processing visual information

primary visual cortex The area at the base of the occipital lobe that registers, processes and interprets visual information sent from each eye

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played at a competitive level for the past 30 years. The participants were separated into two groups, 15 who had sustained sports-related concussions 30 years earlier and 15 who had not experienced a TBI. Participants underwent a number of tests such as a general medical questionnaire, a concussion history questionnaire and a neuropsychological test aiming to measure age-related cognitive changes. Brain neuroimaging technologies were also used to study the brains of the two groups of former athletes. Results showed differences in the structure of brains of concussed former athletes as well as cognitive decline compared to non-concussed former athletes. It was found that concussed former athletes displayed cortical thinning in regions of the brain that are normally associated with Alzheimer's disease. Cognitive deficits were also found and included declining of participants' episodic memory, attention and verbal fluency.

It was concluded that the brain anomalies and cognitive deficits experienced by concussed participants was an abnormal pattern of ageing and was more likely due to the long-term effects of sports-related TBI.

QUESTIONS

1. What is traumatic brain injury and what are some of the ways it can be caused?
2. Describe the Victorian statistics regarding sports-related concussion hospitalisation rates.
3. Evaluate the research conducted by Lassonde and her colleagues (Tremblay et al., 2013). Include the following in your evaluation:
   - aim
   - hypothesis
   - independent variable
   - dependent variable
   - control and experimental groups
   - participants
   - results
   - conclusion.

3.3 TRY IT YOURSELF >>

MAKE A BRAIN MODEL

Work in groups to make a model of the brain showing each of the four lobes. Each group will need:

- one quantity of playdough (see recipe below)
- four different food colourings
- 12 toothpicks
- light cardboard, A4 size
- scissors, glue and a stapler.

1. Make up the playdough according to the recipe below.
2. Divide it into four equal quantities. Colour each amount with a few drops of different-coloured food dyes (red, blue, yellow and green are best).
3. Place the playdough in airtight containers.
4. Make up a number of small 'flags' to be used to identify various regions and structures of your brain model. Cut the card into strips of 6 × 2 cm. Fold them in half and write the following labels on one side of the flags:
   - Cerebellum
   - Frontal lobe
   - Parietal lobe
   - Temporal lobe
   - Occipital lobe
   - Motor cortex
   - Somatosensory cortex
   - Auditory cortex
   - Visual cortex

   Form each card strip into a 'flag' by attaching it to a toothpick, using a stapler and glue or tape.
5. Make up your brain model, using the four different colours of playdough to indicate the four different lobes. Try to ensure your model is similar in size to an adult brain – about the size of a small cauliflower. You might also include the brain stem.
6. Label the features of the brain using your toothpick flags. Your teacher might award a prize for the most accurate representation – as long as you can explain the function of each of the key features!

PLAYDOUGH RECIPE

1 cup flour

1 cup warm water

2 teaspoons cream of tartar

1 teaspoon oil

¼ cup salt

Mix all ingredients and place them in a saucepan. Stir over medium heat until smooth. Remove from pan and knead until blended and smooth. Allow to cool. The mixture will last for a long time if you place it in an airtight container or plastic bag.

THE BRAIN REGIONS RESPONSIBLE FOR THE PRODUCTION OF COMPLEX FUNCTIONS

So far we have explored brain regions and noted the specialised functions located in them. We need to understand these localised functions to fully appreciate how the brain works. However, it is also important to realise that these various regions do not work in isolation. At any given moment, vast areas of the brain are constantly interacting and it is this interaction that enables us to perform the range of complex functions we are capable of. Some of these functions, such as processing language, coordinating voluntary movement and regulating emotions, require communication between and collaboration of multiple regions of the brain. These complex mental functions and brain areas are discussed next.

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LANGUAGE PROCESSING: BROCA'S AREA, WERNICKE'S AREA AND GESCHWIND'S TERRITORY

Humans have the innate capacity to communicate through written and spoken language. The complexities of communicating through language involve not only speech production and articulation, but also speech comprehension and understanding. This complex ability is most likely due to the uniqueness of the human brain; it has specific structures dedicated to language processing not seen in any other species. Since the mid to late 1800s, neuroscientists have been aware of two main language centres in the brain – Broca's area and Wernicke's area. However, more recent research suggests the existence of a third language area, known as Geschwind's territory.

As we discovered earlier, the left frontal lobe contains an important language centre known as Broca's area. In most people, Broca's area is located in the left frontal lobe close to the primary motor cortex (see Figure 3.16). Broca's area directs the area of the primary motor cortex that controls the muscles of the throat, mouth, jaw, tongue and face. By controlling the movement of these muscles, Broca's area is primarily responsible for the production of articulate (clear and fluent) speech. It is also involved in the structure of sentences and analysing the grammar of sentences. If Broca's area is damaged, a person may be unable to produce clear and articulate speech.

For most people, the left temporal lobe, apart from containing the primary auditory cortex, also contains a second important language centre known as Wernicke's area. For 5 per cent of people, this area is in the right temporal lobe. Wernicke's area is located near the primary auditory cortex and is connected to Broca's area by a bunch of nerve fibres known as the arcuate fasciculus (see Figure 3.14). Wernicke's area is the cortical area believed to be responsible for accessing words stored in memory; therefore, it is believed to be responsible for the comprehension of speech and the formulation of meaningful sentences (Gardner & Gardner, 1978). The sounds associated with speech initially register in the primary auditory cortex of both hemispheres. However, the information must then be transferred to association areas in the left temporal lobe and processed by Wernicke's area if they are to be identified as words and their meaning understood.

In the 1960s, American neurologist Norman Geschwind discovered a third region in the brain that is believed to be one of the last language structures to mature in humans. This region became known as Geschwind's territory (also called the inferior parietal lobule) and it is located above Wernicke's area in the lower part of the parietal lobe, adjacent to the occipital lobe (see Figure 3.16). Geschwind's territory is thought to have a multimodal function, which means it has the ability to process different kinds of stimuli simultaneously. For example, auditory, visual and sensory stimuli can all be processed by Geschwind's territory at the same time. Its location assists this function because it is close to the primary auditory, visual and somatosensory cortices. In terms of language processing, Geschwind's territory assists Wernicke's area to comprehend spoken or written language by using its multimodal function to integrate the different components of a word. For example, sound, sight and meaning are integrated so we are able to understand the full meaning of a word (Carter, 2014).

You may previously have thought that having a conversation with someone was a 'simple' process. Now that you have investigated the number of brain regions associated with language processing, it should be apparent that it is not. When you are preparing to speak, Wernicke's area and Geschwind's territory are both activated. They locate the correct words stored in your memory that are required for you to express your thoughts in a way that is comprehensible to others. The selected words will then be transmitted to Broca's area through the arcuate fasciculus. Once they have reached Broca's area, this region will activate the movements required in the throat, tongue, jaw and larynx to pronounce the words.

The importance of the interaction between multiple areas of the brain to produce and understand language is highlighted when brain damage occurs. Language deficits can be seen when brain regions connecting and surrounding the language centres are damaged. When brain damage through disease or injury results in language loss or impaired language ability, the person

Broca's area An area in the left frontal lobe of the brain that controls the muscles responsible for the production of articulate speech

Wernicke's area An area of the left temporal lobe of the brain responsible for the comprehension of language and the formulation of meaningful sentences

Geschwind's territory (inferior parietal lobule) Assists Wernicke's area to comprehend spoken or written language by integrating the different properties of a word

arcuate fasciculus The bundle of nerve fibres connecting Broca's and Wernicke's areas

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is said to suffer from aphasia. Some aphasia sufferers can speak fluently but they cannot read; others may understand what they read but cannot speak; some can write but not read; some can read but not write; some can read numbers but not letters; and others can sing but not speak. The wide range of symptoms experienced by aphasia sufferers will depend on the severity and localisation of brain damage.

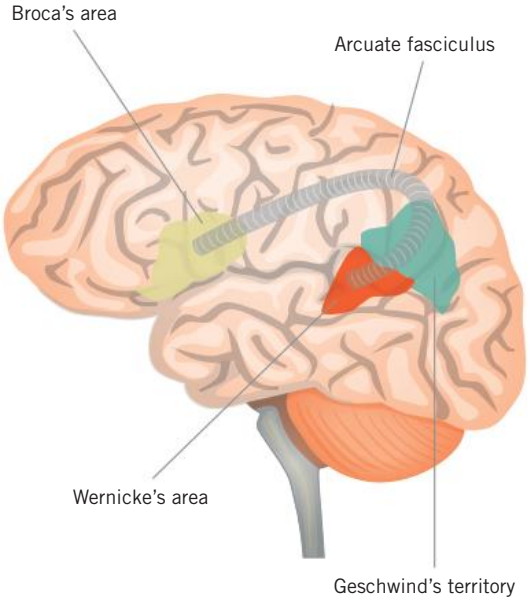


FIGURE 3.16 The left hemisphere of the brain showing the location of Broca's area, Wernicke's area, Geschwind's territory and the arcuate fasciculus connecting these brain regions.

3.6 CHECK YOUR UNDERSTANDING >>

1. When were the first two main language centres of the brain discovered? What did this discovery reveal about language processing in the brain?
2. What is the name of the most recently discovered language area in the brain believed to be able to process various information simultaneously? How does this area assist language processing?
3. Which of the following statements is true about language processing in the brain?
   - A Broca's area in the left frontal lobe is involved in the production of articulate speech.
   - B The right hemisphere is where all major language functions are located.
   - C The comprehension of speech is a function of Wernicke's area in the left frontal lobe.
   - D Damage to Wernicke's area does not cause any speech difficulties.
4. Wernicke's area is said to be responsible for speech _____, whereas Broca's area is involved in speech _____.
   - A production; comprehension
   - B syntax; production
   - C comprehension; syntax
   - D comprehension; production
5. If a person has sustained damage to one of the language areas in the brain and is experiencing difficulties speaking, what are they said to suffer from?
   - A A speaking disorder
   - B Ataxia
   - C Aphasia
   - D A speech impairment

VOLUNTARY MOVEMENT: PRIMARY MOTOR CORTEX, CEREBELLUM AND BASAL GANGLIA

Moving your fingers to tie your shoelace, writing a text message, riding a bike – all of these complex functions are only possible because of the interaction of multiple regions of the brain. Although we may take for granted the brain's immense capabilities to coordinate these conscious movements, we must always remember that even the simplest movement requires multifaceted communication between different brain regions. For example, if you want to pick up the remote control and change the television channel you are watching, your brain needs to simultaneously process a variety of sensory and motor messages. It must register and process the visual information it received after looking at the remote so it can determine where the channel button is. It must also identify your body's position in space so it can accurately judge the distance between your body and the remote control. Once this happens, your brain can send motor commands to your arms to enable them to accurately reach for the remote control, and to your fingers to press the channel button 'up' or 'down'. Your brain must also determine the strength needed to press the button.

Neuroscientists are still learning about the connections between brain regions that enable us to carry out voluntary movements. One brain region we know plays an important role is the primary motor cortex. As discussed earlier, the primary motor cortex is an area of the cerebral cortex located in the frontal lobe. Areas of the primary motor cortex play an important role in coordinating voluntary

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movement, although this brain region does not work independently. Researchers have found that other areas of the cerebral cortex play a role in voluntary movement, such as association areas in the frontal and parietal lobes as well as other brain structures such as the cerebellum and basal ganglia.

We also know that the hindbrain structure, the cerebellum, plays a vital role in coordinated movement, particularly maintaining posture and balance. For example, an elite gymnast who is performing an elaborate routine on the balance beam is relying on her cerebellum in order to maintain equilibrium and accomplish her acrobatic skills (see Figure 3.17a). Similarly, various yoga poses rely on the ability to balance; for example, the tree pose (*vrikshasana*) requires individuals to stand on their right foot with their left foot placed high on their right thigh or vice versa (see Figure 3.17b). This challenging pose requiring posture and balance is possible because of the workings of the cerebellum. The cerebellum also plays an important role in communicating motor information to and from the cerebral cortex to coordinate these functions.

Much like the cerebellum, the basal ganglia play an important role in communicating motor messages to and from the cerebral cortex. The basal ganglia are clusters of nerve cells located in the forebrain, deep within the cerebral hemispheres (see Figure 3.18), whose major function is to regulate motor control. The basal ganglia work with the cerebellum to plan and manage smooth coordinated movement. Dysfunctions of the basal ganglia can cause movement problems linked to serious disorders such as cerebral palsy, Huntington's disease and Parkinson's disease.

The brain structure that enables this communication between different brain areas to coordinate voluntary movement is the thalamus. As previously discussed, the thalamus is a forebrain structure that acts as a relay system for incoming sensory information. In this instance, the thalamus enables motor messages to be transmitted between the cerebral cortex, cerebellum and basal ganglia in order to execute movements.





FIGURE 3.17 Examples of the cerebellum's function to maintain posture, balance and coordinate movement: (a) a gymnast using the balance beam to perform an acrobatic routine, (b) a person practising the yoga tree pose

basal ganglia Clusters of nerve cells located in the forebrain whose function is to regulate motor control

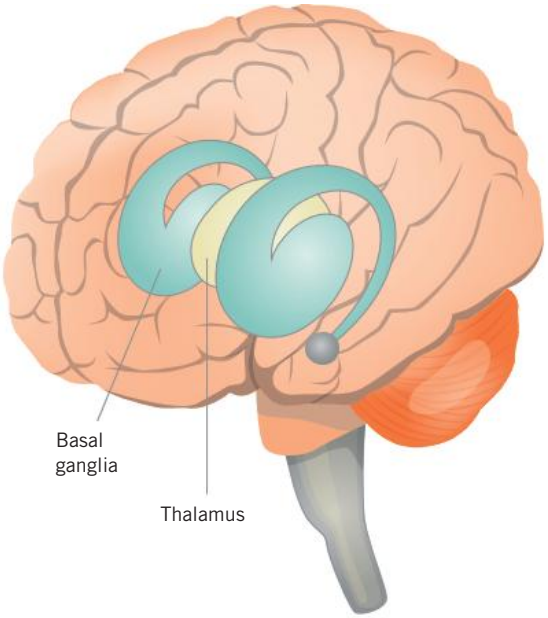


FIGURE 3.18 The inner brain structures: basal ganglia and thalamus

3.7 CHECK YOUR UNDERSTANDING >>

1 Which of the following brain regions are associated with coordinating voluntary movement?
   - A The hypothalamus, primary motor cortex and basal ganglia
   - B The cerebellum, hypothalamus and primary motor cortex
   - C The cerebellum, primary somatosensory cortex and basal ganglia
   - D The primary motor cortex, cerebellum and basal ganglia

2 Which brain area is responsible for the ability of a gymnast to perform a routine of acrobatic exercises on a balance beam? Explain.

3 Describe the location of the basal ganglia.

4 Dysfunctions of which area of the brain can cause serious motor disorders such as Parkinson's and Huntinton's disease?
   - A The basal ganglia
   - B The cerebellum
   - C The primary motor cortex
   - D The thalamus

5 Select the most appropriate ending for this sentence: 'Performing complex mental functions such as voluntary movement ...'
   - A requires activation of isolated brain regions.
   - B is not possible if you have sustained brain damage.
   - C requires communication and interaction among multiple brain regions.
   - D is not possible until the brain has fully matured into adulthood.

REGULATION OF EMOTION: LIMBIC SYSTEM, AMYGDALA AND PREFRONTAL CORTEX

Emotions exert a large influence on our daily lives. Feeling happy, sad, angry, fearful or frustrated can influence our overall mood. Psychologists consider mood to be longer lasting than emotions, which are typically short-lived. Emotions are often thought to be conscious experiences; however, they do have a physiological basis. Emotions can be described as complex, intense physiological and psychological reactions to a particular event.

Generally, psychologists recognise three components to emotions: expressive behaviour, physiological responses and subjective feelings.

Expressive behaviour

Expressive behaviour refers to the way in which individuals respond to the emotions they are experiencing. For example, a new father may faint while watching his wife give birth to express the emotion of feeling anxious or overwhelmed. Facial expressions are also expressive behaviours to emotions. One psychologist who has extensively studied emotions and facial expressions is Paul Ekman. His research revealed that facial expressions are universal; that is, the way in which emotions are displayed through facial expressions is almost identical across different cultures. Ekman initially proposed that there are six basic emotions: happiness, sadness, fear, disgust, surprise and anger. He later added a seventh emotion to the list – contempt (see Table 3.2).

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TABLE 3.2 Paul Ekman's list of seven basic emotions

EMOTION	DESCRIPTION	EXAMPLE OF ONSET OF EMOTION	FACIAL EXPRESSION DISPLAYING EMOTION
Happiness	A feeling of gladness and delight brought on by a pleasurable experience	Watching a funny movie or receiving a gift	
Fear	A distressing emotion brought on by a threat or potential threat, pain or danger	Seeing a snake in your backyard	
Anger	A strong feeling of displeasure and hostility brought on by wrongdoings	Being ignored by a friend	
Disgust	A feeling of repulsion or strong disapproval brought on by something unpleasant or offensive	Seeing someone vomit	
Sadness	A feeling of sorrow usually brought on by a distressing experience	Experiencing the loss of a loved one	
Surprise	A feeling of wonder or astonishment brought on by something unexpected	Your partner cooks you a romantic dinner on your anniversary after he told you he did not want to celebrate the occasion.	
Contempt	A feeling of utter worthlessness or disregard towards a person or situation	If your house has been burgled, you may feel contempt for the burglar.	

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emotions Complex and intense physiological and psychological reactions to a particular event

Physiological responses

Physiological responses to emotions originate deep within the brain. They are the unconscious, biological experiences that occur in response to a particular event. Emotions are generated in an area of the human brain known as the limbic system. The limbic system is a cluster of structures that lies on both sides of the thalamus, just under the cerebrum, and includes brain structures such as the hypothalamus and amygdala (see Figure 3.19). The limbic system is involved in physiological emotional responses. These physiological responses exhibited by the limbic system are designed to either push us away from danger, where we experience the unpleasant emotion of fear, or push us towards reward, where we experience the pleasurable emotion of happiness. One structure in the limbic system, the amygdala, is almost exclusively concerned with emotion, especially the emotion of fear. This almond-shaped mass of neurons found deep within each of the two temporal lobes (see Figure 3.19) assesses the environment for potential threats and determines the emotional significance of a situation. If the situation is deemed to be potentially threatening to our survival, the amygdala activates autonomic responses controlled by the sympathetic nervous system that stimulate the emotional reaction of fear. Some of these reactions include the dilation of our pupils, an increased heart rate, and deeper and more rapid breathing. The amygdala may also signal other brain regions to experience appropriate emotional responses. For example, the feeling of pleasure is usually brought on by the release of a mood-lifting hormone known as dopamine. This hormone is released by the activation of the hypothalamus. When pleasure is experienced, the activity of the amygdala will be dampened. The nuclei in the amygdala are also affected by different sex hormones, which explains why gender differences exist in emotional responses.

Subjective feelings

The third component of an emotion, subjective feelings, relates to how each individual experiences reactions to emotions. For example, the event of having a baby for the first time may induce emotions such as joy and excitement in one new mother; for a second new mother it may provoke emotions such as

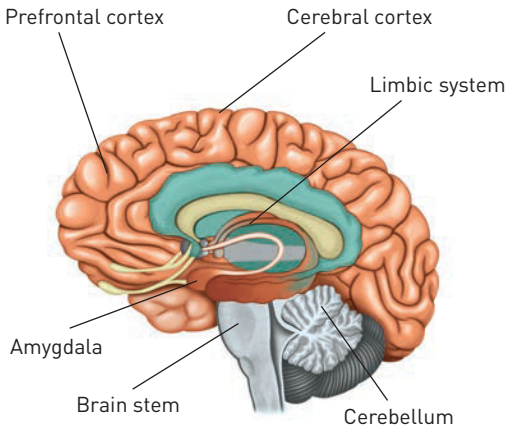


FIGURE 3.19 The limbic system and amygdala

apprehension and anxiety; a third new mother may experience a combination of these emotions. The intensity of the emotions experienced by each mother will also vary. This subjective evaluation of the physiological response leads to an emotional response in the brain. This is when we consciously experience the emotion. The forward part of the frontal lobe known as the prefrontal cortex (see Figure 3.19) is responsible for evaluating this subjective feeling in response to the physiological reaction our body has made, thus regulating our emotions. Nerve tracts in our brain connect the limbic system to the prefrontal cortex to enable two-way communication between these brain regions. This allows our thought processes (generated by the prefrontal cortex) to regulate our physiological emotional reactions (generated by the limbic system) and vice versa. For example, an individual who is afraid of flying is invited to a friend's wedding in Sydney. She needs to face her fears so she can join in the celebrations. When the plane is getting ready for take-off, her amygdala will be activated, registering the situation as fearful. This will then generate increased levels of arousal and activate physiological responses such as increased heart rate and respiration rate. This arousal may be exacerbated if her prefrontal cortex assesses the situation as fearful – she may start to think about the plane crashing and bursting into flames or the wheels falling off during take-off. On the other hand, if her prefrontal cortex evaluates the situation as positive and she starts thinking about the plane landing safely in Sydney, the physiological responses associated with fear may begin to alleviate (see Figure 3.20). In this instance her emotions have been regulated by the activity of the prefrontal cortex.

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FIGURE 3.20 A person's emotional reaction to fear is regulated by and based on the evaluation made by their prefrontal cortex.

Research evidence supports the role of the prefrontal cortex in emotional regulation. Studies have been carried out where participants are confronted with an emotional stimulus. They have then been asked to use a cognitive strategy, such as reappraisal (re-evaluation of a situation, usually in a more positive light), to change the impact of an emotional response. Brain-imaging technologies reveal that when participants use these strategies, there is increased activity in the prefrontal cortex. Therefore, researchers argue the prefrontal cortex should be examined further to help explain why people who suffer from certain mental illnesses are unable to successfully regulate their emotions (Nauert, 2008). The inability to regulate emotions is seen in several mood disorders, such as depression. People who suffer from such mood disorders are believed to have weakened pathways between nerve fibres connecting the prefrontal cortex and limbic system in the brain. A relatively new therapeutic technique in psychology is known as mindfulness. It is used to help regulate emotions and involves paying specific attention to sensory experiences in a non-judgmental way. Mindfulness can be an effective technique for people who suffer from mood disorders. Because they are unable to control their cognition to regulate their emotions, their cognitive efforts are directed instead towards focusing on changes in their present experience (Farb, Anderson, & Segal, 2012). Mindfulness can be a helpful technique for all to use, not just for people with a mood disorder. It can help to relieve stress, slow down your nervous system, clear your head and help you concentrate.

3.8 CHECK YOUR UNDERSTANDING

1 Describe the three components of an emotion.

2 What are the seven universal emotions? Provide an example that relates to your personal experience of each emotion. (Your examples must be different from those provided in the text.)

3 The amygdala is responsible for the physiological experiences of emotions, especially the emotion of:

A surprise.
B fear.
C happiness.
D disgust.

4 The limbic system includes which of the following brain structures?

A The hippocampus and cerebellum
B The medulla and amygdala
C The medulla and hypothalamus
D The hypothalamus and amygdala

5 How do we know the prefrontal cortex is involved in emotional regulation?

limbic system A cluster of brain structures, including the hypothalamus and amygdala, that is located on both sides of the thalamus, just under the cerebrum; involved in physiological emotional responses

amygdala An almond-shaped cluster of neurons found deep within each temporal lobe; responsible for the physiological experience of emotions, especially the emotional response of fear

prefrontal cortex An area in the forward part of the frontal lobe responsible for the regulation of emotions

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CHAPTER SUMMARY

Hindbrain

- The hindbrain is often referred to as the 'brain stem' because it is located at the base of the brain near the back of the skull. It has two important structures: the cerebellum and medulla.
- The cerebellum helps coordinate voluntary movement and balance. It receives information from the spinal cord, sensory systems and other parts of the brain to regulate posture, muscle tone and muscular coordination.
- The medulla plays an essential role to regulate all of our organs vital for life function. These include involuntary functions such as breathing, heart rate and digestion. The medulla communicates with the autonomic nervous system (ANS) and directs various bodily systems to change according to the needs of the body.

Midbrain

- The midbrain is the area of the brain between the hindbrain and the forebrain. Its systems help to keep us alert, awake and vigilant. The reticular formation is located in the midbrain.
- The reticular formation is a network of neurons extending from the top of the spinal cord up through the brain stem to the midbrain. Its functions include helping us to selectively focus our attention and alertness, and controls our physiological arousal.

Forebrain

- The forebrain is located above the midbrain and is divided into two hemispheres, it is the largest and most highly developed part of the brain. It contains three distinct areas: the hypothalamus, the thalamus and the cerebrum.
- The hypothalamus plays a significant role in controlling body temperature, our sleep–wake cycle, sex drive, and our thirst and hunger needs. The cluster of neurons (nuclei) in the hypothalamus work by connecting the nervous system and endocrine system.
- The thalamus acts as a relay system for sensory messages on their way to the cerebral cortex. Information from all senses passes through the thalamus, except smell. The thalamus analyses the information and directs it to appropriate sensory areas of the cerebral cortex.
- The cerebrum is located at the top of the forebrain. The outer layer of the cerebrum is known as the cerebral cortex. The cerebrum can be divided into two hemispheres, the left and the right hemispheres. The two hemispheres are separated by a deep groove (a fissure), but connected by a thick band of nerve fibres, the corpus callosum.
- Hemispheric specialisation refers to the left and right hemispheres' specialised functions. The left hemisphere specialises in verbal and analytical functions. It receives sensory information from and sends motor information to the right side of the body. The right hemisphere specialises in non-verbal functions, especially visual and spatial skills. It receives sensory information from and sends motor information to the left side of the body.

Roles of the cerebral cortex

- The cerebral cortex is responsible for complex cognitive processes such as thinking, knowing and mentally manipulating information.
- The cerebral cortex is the most highly developed part of the brain and performs a variety of functions. Its overall role is to integrate motor functions (coordinating voluntary movement), sensory functions (receiving information about the texture or temperature of an item we touch) and cognitive functions (symbolic thought processes).

Localisation of function within the cerebral cortex

- The brain is physically covered by an outer layer of cortex and organised into two hemispheres. It is made up of four lobes in each hemisphere: the frontal, parietal, temporal and occipital lobes.
- Each lobe contains an area of cortex that specialises in a particular motor or sensory function. The frontal lobe contains the primary motor cortex, involved in producing movement; the parietal lobe contains the primary somatosensory cortex, which registers and processes sensory information from the skin and muscles; the temporal lobe contains the primary auditory cortex, which receives and processes sound-based information; the occipital lobe contains the primary visual cortex, which receives and processes visual information. All lobes contain areas of association cortex that integrate information between all lobes.
- Symbolic thinking is a cognitive skill arising from the frontal lobe in the cerebral cortex that enables us to use symbols, gestures or images to mentally represent people, objects and events that may not be present.

The brain's ability to interact and produce complex functions

- Complex functions such as language processing, voluntary movement and the regulation of emotions require activation and integrating of multiple brain regions.
- Language processing requires communication between various brain structures. The two main language areas are Broca's area and Wernicke's area. Broca's area is involved with language production. Wernicke's area is involved with language comprehension. The arcuate fasciculus is the bundle of nerve fibres that connects the two regions. A third region has recently been

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discovered, Geschwind's territory. Its role is to integrate information from other brain regions (e.g. auditory, somatosensory and visual cortices) to support language comprehension.

- The body's ability to carry out fine-tuned, coordinated voluntary movements is primarily controlled by the primary motor cortex located in the frontal lobe. The cerebellum assists in this by ensuring that movement is balanced and coordinated. The cerebellum communicates with the primary motor cortex via the thalamus. The basal ganglia regulate motor control and also communicate with the primary motor cortex via the thalamus.
- Physiological responses to emotions are generated in an area of the human brain known as the limbic system. The limbic system includes brain structures such as the hypothalamus and amygdala. The amygdala is almost exclusively concerned with emotion, especially the emotion of fear. The prefrontal cortex is responsible for evaluating the physiological reactions our body has made in response to an emotion, thus regulating our emotions.
- Nerve tracts in our brain connect the limbic system to the prefrontal cortex. This allows our thought processes (generated by the prefrontal cortex) to regulate our physiological emotional reactions (generated by the limbic system).

APPLY YOUR KNOWLEDGE AND SKILLS

SECTION A: MULTIPLE-CHOICE QUESTIONS

Answer the following questions by writing the correct letter in your workbook. Only one answer is correct for each question.

1 The thalamus and hypothalamus are _____ structures, whereas the medulla and cerebellum are _____ structures
- **A** midbrain; forebrain
- **B** forebrain; midbrain
- **C** forebrain; hindbrain
- **D** hindbrain; forebrain

2 What brain structure is located at the top of the forebrain and can be divided into two hemispheres?
- **A** The reticular formation
- **B** The cerebrum
- **C** The thalamus
- **D** The hypothalamus

3 The thalamus filters most sensory information and sends it to the appropriate areas of the cerebral cortex. Which sense is excluded from this process?
- **A** Sight
- **B** Touch
- **C** Smell
- **D** Taste

4 Lilly is a nurse who has just come off a period of night shift. She now needs to reset her body clock in order to sleep at night and remain awake and alert during the day. Which part of Lilly's brain will assist her in regulating her circadian rhythm?
- **A** The hypothalamus
- **B** The medulla
- **C** The thalamus
- **D** The cerebellum

5 Which brain structure is responsible for selectively focusing attention on important sensory stimuli?
- **A** The hypothalamus
- **B** The cerebrum
- **C** The reticular formation
- **D** The medulla

6 Between what ages should a child have developed the cognitive skill of symbolic thinking?
- **A** 1–2 years
- **B** 2–7 years
- **C** 6–18 months
- **D** 7–10 years

7 Rachel hears her alarm ring in the morning, and she gets out of bed. Which areas of Rachel's brain are primarily responsible for her response?
- **A** The primary somatosensory cortex; the primary auditory cortex
- **B** The primary motor cortex; the primary visual cortex
- **C** The association cortex; the primary somatosensory cortex
- **D** The primary auditory cortex; the primary motor cortex

8 What is the name of the bundle of nerve fibres connecting Broca's area and Wernicke's area?
- **A** The primary somatosensory cortex
- **B** The primary auditory cortex
- **C** The corpus callosum
- **D** The arcuate fasciculus

9 The role of the cerebellum is to:
- **A** detect emotions.
- **B** coordinate posture and balance.
- **C** process visual information.
- **D** think symbolically.

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10 Which of the following statements is most true about hemispheric specialisation?

- **A** The left hemisphere specialises in visuospatial skills while the right specialises in analytical skills.
- **B** The left hemisphere specialises in problem-solving while the right specialises in art.
- **C** The left hemisphere specialises in mathematics while the right specialises in musical abilities.
- **D** The left hemisphere specialises in verbal functions while the right specialises in non-verbal functions.

11 Gillian has suffered brain trauma as a result of an accident. She has difficulty understanding language and forming sentences that make logical sense. She has most likely damaged:

- **A** Broca's area.
- **B** Wernicke's area.
- **C** the occipital lobe.
- **D** the parietal lobe.

12 The parietal lobes are mostly associated with processing:

- **A** bodily sensations.
- **B** auditory information.
- **C** visual information.
- **D** emotions.

13 If you were comparing the brains of a grasshopper and a human you would expect that:

- **A** the association area in both animals would be equal.
- **B** the grasshopper would have a larger association area than the human.
- **C** the grasshopper would not have any association area.
- **D** the human would have a larger association area than the grasshopper.

14 Which area of the brain is largely responsible for the regulation of emotions?

- **A** The prefrontal cortex
- **B** The medulla
- **C** The hypothalamus
- **D** The occipital lobe

15 What is the primary area of the temporal lobe?

- **A** The primary auditory cortex
- **B** The primary visual cortex
- **C** The primary motor cortex
- **D** The primary somatosensory cortex

SECTION B: SHORT-ANSWER QUESTIONS

1 Which hindbrain structure is most important for our survival? Explain.

2 Other than its connection with the endocrine system, describe the other specialised functions of the hypothalamus.

3 Describe three important functions of the frontal lobes of the brain.

4 Explain the importance of Paul Broca and Carl Wernicke's brain discoveries.

5 Describe the brain regions activated when coordinating a voluntary movement such as throwing a ball.

6 Describe the roles of the association and primary cortices in the temporal lobe.

7 When visual information is received from the eye, explain how it is sent to the brain and where in the brain it is processed.

8 Explain the brain processes involved in the physiological arousal experienced through emotions and how our brain regulates emotions.

9 Explain why the somatosensory cortex devotes more neurons to your hands and lips compared to your trunk and hip.

10 Describe the specialised functions of the right and left hemispheres.

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SECTION C: EXTENDED-RESPONSE QUESTION

A team of neuroscientists is interested in investigating whether a new drug treating cerebellar ataxia is effective at improving an individual's equilibrium after they have sustained damage to their cerebellum. In order to carry out this experiment, the neuroscientists need to recruit participants who have sustained damage to their cerebellum because of a stroke. They need enough patients to create an experimental group and a control group. The participants should have sustained the damage no more than 3 months ago and should be experiencing difficulty coordinating simple movements, such as walking and maintaining posture and balance. Each participant's symptoms should be relatively similar in terms of their severity. Neuroscientists also need to obtain consent from participants before the experiment is conducted.

You are now required to design this investigation and write an introduction and methodology section of a scientific investigation report for this research scenario.

In your answer be sure to include:

- an introduction
  - a description of the key terms relating to the background of this research
  - identification of the independent and dependent variables
  - an aim and testable hypothesis
- the method
  - participants
  - apparatus
  - procedure.

This question is worth 10 marks.

SECTION D: ASSESSMENT TASK

VISUAL PRESENTATION

This activity will draw together your understanding of the relationship between brain structure and cognitive processes in a visual presentation.

AIM

Create and present a visual presentation of the brain demonstrating the roles of the forebrain, midbrain and hindbrain; and the functions of the lobes, primary cortices and hemispheres. Include illustrations. Your presentation should stand alone as an explanation of the relationship between brain structures and functions.

AUDIENCE

VCE students

MATERIALS

Either a large sheet of poster paper and coloured pens, or a multimedia software program

METHOD

Your presentation can be either a poster or a multimedia presentation.

Your presentation should clearly show each structure or brain area listed below. It must also explain the function of each structure of the brain area.

- Whole brain
- Forebrain
- Midbrain
- Hindbrain
- Corpus callosum
- Four lobes – frontal, parietal, temporal and occipital
- Primary cortex in each lobe – motor, somatosensory, auditory, visual, association areas

Provide one illustration of each function. If using a multimedia format, this could be a still or a moving image. For example, you might show a pair of walking legs to illustrate the function of the primary motor cortex.

CHAPTER 04

BRAIN PLASTICITY AND BRAIN DAMAGE

KEY KNOWLEDGE INCLUDES:

- infancy and adolescence as periods of rapid development and changes in brain structure and function, including development of myelin, synaptic pruning and frontal lobe development
- the impact of injury to the cerebral cortex on a person's biological, psychological and social functioning and the ability of the brain to undergo adaptive plasticity, illustrated by rehabilitation of people with brain injuries
- the use of animal studies and neuroimaging techniques to develop understanding of human neurological disorders including Parkinson's disease.

Psychology Area of Study Key knowledge points derived from *VCE Psychology Study Design 2016*, p. 15; © The Victorian Curriculum and Assessment Authority (VCAA). Used with permission.



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THE DEVELOPING BRAIN

As we move through our lifespan stages, our body and brain change in a number of ways that allow the relatively limited, simple behaviours we are born with to develop into a range of complex behaviours. As many of these changes are linked to maturation, their timing and order are predictable. When our body and brain change, so too does our thinking and behaviour.

Initially, infants are incapable of many behaviours, such as communicating via language or sitting unaided. As we move through childhood, adolescence and adulthood, our body changes and our behaviours become more varied and complex. Chronologically, infancy extends from birth to approximately 2 years of age. During this period our brain will grow so rapidly that by approximately 3 years of age it will be three-quarters the size of an adult brain. Childhood occurs from 2 to 12 years of age, and then adolescence begins. Adolescence is generally marked by the beginning of puberty, and ends at 18 years of age when adulthood begins. While all stages of the lifespan are marked by physical and psychological change, infancy and adolescence are particularly notable for the changes we experience in brain structure and function.

Beginning in infancy and continuing through adolescence into early adulthood, brain development occurs as a result of innate and dynamic processes. These processes enable the brain to refine itself, and specialise and sharpen its functions for the specific demands of its environment. So, by the time an individual reaches adulthood, their brain is composed of more than 100 billion neurons (Drachman, 2005). And, since each neuron can connect with more than a thousand other neurons, the adult brain is thought to have more than 60 trillion neuronal connections (Stiles, 2008).

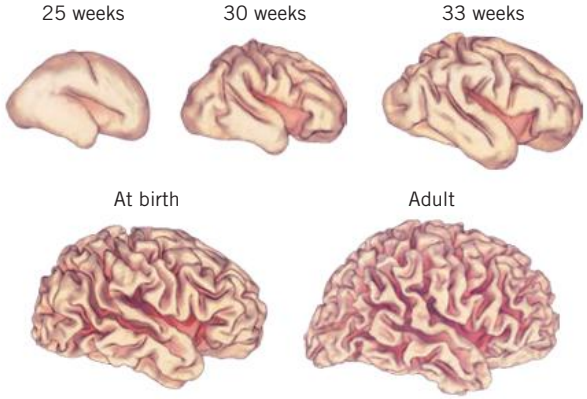


FIGURE 4.1 Stages in brain development over the lifespan

Brain development is a lengthy process that does not occur at an even pace. It tends to develop in waves, with different parts developing at different times. However, this development takes place in a predictable, age-related sequence for most people.

BUILDING THE BRAIN: THE BEGINNING

The brain starts to develop during the third week of gestation (Stiles, 2008). At this stage, the central nervous system is merely a long, hollow tube on the back of the embryo. As the embryo develops and the neurons start to form and gather to create what will become the brain, the tube shape changes into the three major brain parts – the hindbrain, midbrain and forebrain (Santrock, 1997).

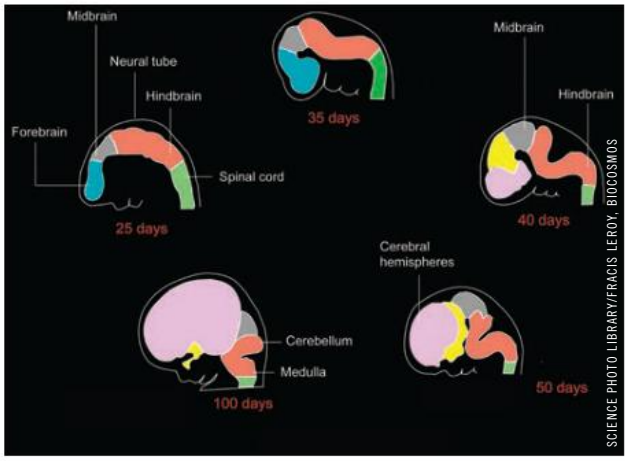


FIGURE 4.2 Development of the human brain during gestation

Brain formation is the result of three major processes: cell production, cell migration and cell elaboration. During cell production, cells divide and multiply (proliferate) and this creates the neurons required to receive, process and transmit information (see Figure 4.3). Most brain neurons will be produced in the first 10 to 26 weeks of gestation, which means that the rate of production is about 250 000 per minute. Cell migration involves the newly formed

maturation The physical growth and development of the body, brain and nervous system at fairly predictable stages in the lifespan

infancy The period in the lifespan that begins at birth and ends at approximately 2 years of age

childhood The period in the lifespan that begins from 2 years of age and ends at 12 years of age

adolescence The period in the lifespan that begins at 12 years of age and ends at 18 years of age

gestation The period of development in the uterus from conception until birth

cell production A process by which cells divide and multiply to create neurons

cell migration The process by which newly formed neurons determine what their function will by by travelling to their final location within the nervous system

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neurons travelling to their final location within the nervous system, and the location will determine what their function will be. Cell elaboration then takes place, whereby neurons connect with other neurons to form synapses so the transmission of information can take place.

While cell production and cell migration only occur during gestation, cell elaboration continues for many years after birth. The most extensive cell elaboration occurs during infancy. However, the developing brain continues to change over time in response to exposure to a variety of changing environmental stimuli. A number of automatic internal processes, such as myelination of axons and pruning of unwanted synaptic connections, also impact on the brain's development.

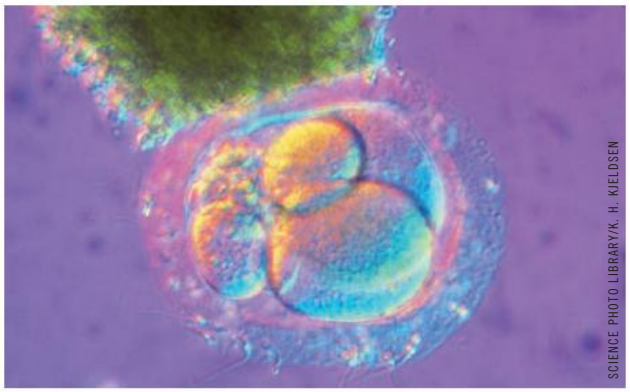


FIGURE 4.3 As basic cells divide and multiply, new cells are formed.

MYELINATION: MAKING COMMUNICATION BETTER

Myelin is a white, fatty substance that coats the axons of a neuron. Myelin not only protects the axon, it increases the speed at which the electrical impulse travels, so it makes the process of transmission between neurons more effective.

When we look at the brain, we notice that the outside layer, the cerebral cortex, is 'greyish' in colour. This is because axons of neurons in the cortex are mostly unmyelinated, so the cortex is often referred to as grey matter. These neurons are mostly unmyelinated because their role is generally to process information that occurs in the localised area. In other words, they are not involved in transmitting information to other brain areas, so they do not require the assistance of myelin.

The parts of the brain that contain myelinated neurons are referred to as white matter due to the 'whitish' colour of the myelin. Myelinated neurons transmit messages between different brain regions. Myelinated neurons act like a networking grid that connects the brain's grey matter and other processing centres with one another. Therefore they have a direct impact on behaviour that is dependent on the integration of information from a number of brain areas.

The greater the number of myelinated neurons, the greater the potential for behaviour. For example, the increased development of white matter in children has been shown to correlate with increased development of motor skills, reading ability and cognitive function (Paus et al., 1999).

Research into brain development suggests that between the stages of infancy and adolescence, grey matter and white matter develop at different rates.

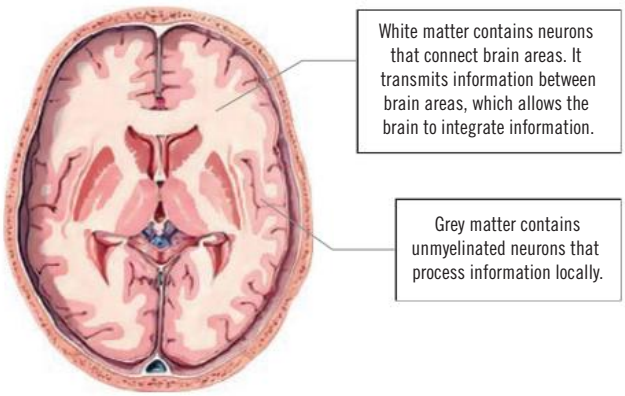


FIGURE 4.4 Areas of white and grey matter in the human brain

4.1 CHECK YOUR UNDERSTANDING >>

1 Puberty generally marks the end of:
   - A infancy.
   - B childhood.
   - C adolescence.
   - D adulthood.

2 The human brain starts to develop:
   - A at conception.
   - B at birth.
   - C during the third week of gestation.
   - D during the third trimester of gestation.

3 Cell elaboration occurs:
   - A only during gestation.
   - B only during infancy.
   - C most extensively during adolescence.
   - D throughout the lifespan.

4 Explain the difference between cell production, cell migration and cell elaboration.

5 Explain the difference between the brain's grey matter and white matter in terms of location, structure and function.

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INFANCY (BIRTH TO 2 YEARS OF AGE)

Myelination

Myelination of neurons in the human brain begins during foetal development, and research suggests that it continues throughout adolescence and into early adulthood. Although neurons in all brain areas do not become myelinated at the same time, there does appear to be a pattern or sequence of when the myelination occurs for most people. For instance, neuroimaging shows that myelination begins in the brain stem and cerebellum before birth. Neurons in the visual pathways become myelinated by about 6 months of age, whereas neurons in the auditory pathways begin myelination earlier. The process is complete by about 4 to 5 years of age (Santrock, 1997). It is also well established that the primary sensory and motor areas myelinate before association areas, including those in the prefrontal cortex (Yakovlev & Lecours, 1967).

As the brain becomes more myelinated, information is transmitted more efficiently between areas. This means that as the infant brain develops, it is increasingly able to integrate a variety of information, so the behaviours it is capable of become more varied and complex.

Creating and strengthening synapses: Stimulation is the key

Infancy is characterised by enormous change in all aspects of development, particularly the development of sensory and motor functions. During the first two years of life, individuals develop the capacity for independent and purposeful movement. For example, most infants will progress from only being able to randomly grasp objects to deliberately picking up a spoon or fork and coordinating their movements so they can feed themselves.

Cognitive skills also increase rapidly during infancy. Infants gradually acquire language, and by the end of infancy most will have a vocabulary of 24 to 200 words or more. Infants will also begin developing a concept of self. They will be able to express and understand a wider range of emotions, and show a preference for people, food and activities.

During infancy, if an infant is to develop the range of sensory, motor and cognitive skills necessary for them to effectively process and learn from their environment, their brain and nervous system must develop at a very rapid pace. To assist this development, the infant brain has excess neurons during the first 3 years of life. This excess occurs in order to increase the likelihood that they will absorb all the environmental stimuli required to develop their skills. So, during infancy, the brain is more 'plastic' or changeable; it can 'capture' experience more efficiently as there are more neurons available for the task than later in life. This is why learning new things is easier in infancy compared to other lifespan stages. Assuming the infant is exposed to a variety of stimuli, under normal circumstances it should be able to achieve optimal brain development during this period.

Infants are exposed to an enormous array of environmental stimuli (for example, different sounds, sights, tastes and smells), which they take in through their senses. Their senses relay information about the stimuli to their brain and this input triggers neural activity in specific brain areas. Speech sounds, for example, activate neurons in the left temporal lobe's auditory cortex. If the amount of sensory input increases or if there is repeated exposure to a stimulus (for example, if more speech is heard), then synapses between brain neurons processing the input will form and strengthen (see Figures 4.5 and 4.14). So, when

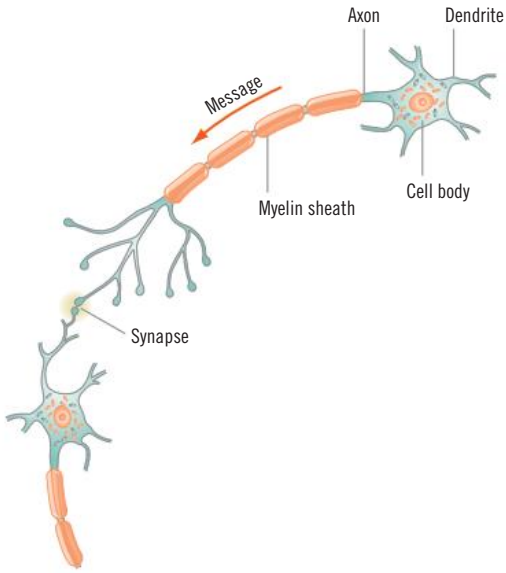


FIGURE 4.5 Repeated exposure to stimuli activates neurons and strengthens their synaptic connections so information can be transmitted more efficiently.

cell elaboration The process by which neurons form synapses with other neurons to enable the transmission of information

grey matter The darker nerve tissue of the brain and spinal cord, consisting mainly of nerve cell bodies, branching dendrites and unmyelinated axons

white matter The whitish nerve tissue of the brain and spinal cord, consisting mainly of myelinated axons

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an infant is exposed to environmental stimuli, such as sounds (for example, language or music), a neural pathway to a specific cortical area (such as the auditory cortex) and other areas of the brain involved in processing that information will form. With repeated use, this pathway strengthens and becomes more efficient at transmitting information.

Clearly, early childhood experiences have a physical impact on how the brain is 'wired'. An infant's experiences not only determine what information enters the brain, they also influence how the brain develops and processes information.

Synaptic pruning

As we noted earlier, repeated activation of brain neurons increases the number of synapses – and they are formed at a faster rate during infancy than at any other stage. However, because of the oversupply of neurons in the infant brain, not all neurons will be activated, so the strength of synapses throughout their brain will vary. Neurons and synapses that are repetitively activated strengthen, but those that are rarely used remain weak and are more likely to be eliminated by natural brain processes. Neurons that do not receive or transmit information die through apoptosis. Lack of use weakens them, so they are easily damaged and eventually die. Synaptic pruning is a process by which unwanted or weak synaptic connections are removed so that neuronal transmission is as efficient as possible.

Synaptic pruning removes unnecessary neuronal structures from the brain, ensuring that there is enough brain capacity for the neuron connections most frequently used to operate as efficiently as possible. By pruning weak connections, more brain area and resources (such as nutrients) can be devoted to the most important networks, allowing them to expand and strengthen. This allows the brain to progressively develop more in-depth, efficient and complex functions because there are fewer connections and changes taking place. As a result of synaptic pruning, the brain becomes more flexible for future learning.

Experience has a huge impact on brain development. The types and variety of stimuli an infant is exposed to influence the creation and pruning of brain synapses, and the strength of these synapses contributes to how connected and efficient their neural networks will be. In turn, these networks influence how efficiently their brain transmits information and what behaviours they are capable of. For example, the infant's neural networks will affect their learning ability and memory, and their ability to coordinate and control their movement. Clearly, experience not only determines what information enters the infant's brain, it also influences how the brain processes the information and the response the infant will make.

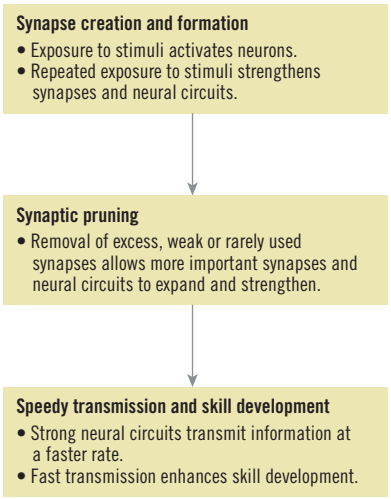


FIGURE 4.6 Synapse formation and pruning results in stronger neural circuits so information is quickly and efficiently transmitted around the brain.

Frontal lobe development

The frontal lobes are one of the last brain areas to become myelinated. They receive information from other brain areas, integrate it so that it can be given meaning and decide on an appropriate response. The frontal lobes regulate our emotions; are responsible for our higher, more complex cognitive behaviours; and control voluntary movement.

Myelination of the frontal lobes is a lengthy process. Neuroimaging shows that the frontal lobes are the last to be myelinated. Frontal lobe myelination begins at approximately 8 to 12 months of age and it is now generally accepted that the process is not completed until early adulthood.

Research suggests that some portions of the frontal lobes, specifically the prefrontal cortex, do not appear to develop equally at the same time. Some studies also indicate that the prefrontal cortex's white and grey matter may mature at different times. Prefrontal grey matter seems to increase in volume after birth, reaching its maximum sometime between 4 and 12 years of age and then decreasing gradually (Pfefferbaum et al., 1994). As the brain becomes more myelinated, the amount of white matter increases. This increasing myelination

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enables more efficient transmission of neural signals; therefore, the ability of brain areas to communicate with each other increases. The result of myelination is that the brain is able to process information at a faster rate and perform higher cognitive functions that rely on the integration of information from a number of brain areas. So, any differences in brain maturation because of differences in the rate and extent of myelination are likely to have an effect on behavioural performance even within the normal range (Shaw et al., 2006). This means that infants who have more myelinated brain neurons in their frontal lobe will probably demonstrate greater cognitive development than others at their age and vice versa.

ADOLESCENCE (12 TO 18 YEARS OF AGE)

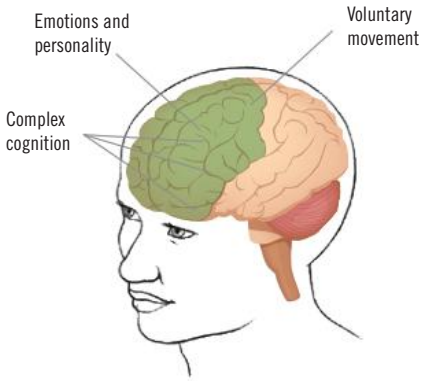
Adolescence is the culturally defined period between childhood and adulthood when an individual undergoes a number of significant physiological and psychological changes. In Australian culture, adolescence is considered to occur between 12 and 18 years of age.

During adolescence, a person experiences a number of physiological and psychological changes. With the onset of puberty, the adolescent body develops into an adult body capable of reproduction. Puberty also brings a number of psychological changes. The person generally seeks more independence from family and caregivers, and changes in their hormonal level may also contribute to mood changes. They may experience more mood volatility, which may lead to an increase in risky behaviour such as the use of alcohol and drugs, dangerous driving and violent responses to threatening situations.

In the past, information about how the brain develops during adolescence was generally limited to inference based on recording changes in observable behaviour. Today, modern structural and functional imaging techniques such as fMRI and PET provide images that show how the brain changes over the lifespan. Because these structural changes affect brain function and behaviour, these images help us to understand adolescent behaviour far more than was possible in the past.

Myelination and synapse creation: Moving towards maturity

The laying down of myelin sheaths to protect axons continues throughout adolescence. This increases the connectivity of neurons and allows different parts of the brain to communicate with each other with more coordination and speed. Neuroimaging has shown that the more developed – or myelinated – our brain becomes, the more we are able to integrate information from multiple brain areas. The adolescent is therefore able to perform more complex behaviours than an infant or child. However, because myelination appears to continue into early adulthood, the adolescent brain is not as developed as the adult brain. It is not equipped to integrate information at the same rate or level as the adult brain, so it is not as capable of the same thinking processes as an adult.



The frontal lobe

FIGURE 4.7 The frontal lobes are responsible for higher cognitive functions, regulate our emotions, control voluntary behaviour and are considered to be the seat of our personality. Because they are the last cortical area to be myelinated, the brain does not fully mature until early adulthood.

Creating and strengthening synapses

During adolescence, the adolescent has an increasing number of new experiences and the developing adolescent brain responds to these experiences by forming new synapses. Repeated experiences continue to activate specific groups of neurons so that complex networks or neural circuits are created and strengthened. This increases the brain's connectivity because there is an increase in the number of different brain areas activating together and 'connecting' to perform tasks, which did not occur before this stage in the lifespan. This allows the adolescent to perform cognitive tasks in a more advanced way than they could during childhood; however, because their brain is still developing, their cognitive ability will not be as great as

apoptosis Programmed cell death to remove extra, weak or unused neurons so that neuronal transmission is as efficient as possible

synaptic pruning The process of removing extra, weak or unused synaptic connections so that neuronal transmission is as efficient as possible

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it will be in adulthood. Continued social and emotional development in adolescence is also linked to ongoing growth and development in the brain.

Selective specialisation: Refining the brain

Before adolescence, between the approximate ages of 7 and 11, the brain experiences a synaptic growth spurt, mostly in the temporal and parietal lobes. One of the major changes that occurs during adolescent brain development is the amount of selective pruning of non-essential synapses and excess neurons. This reduction in synaptic density, which possibly reduces the number of synapses by approximately 40 per cent (Huttenlocher, 1997), is thought to be the result of selective specialisation. During selective specialisation, excess synapses are pruned to allow the remaining cognitive networks to become specialised. It also promotes more efficient brain function because it provides space for networks of essential connections to expand.

Which synapses will be pruned is determined by the strength of the synapse. Synaptic strength relies on neurons being repeatedly activated. Clearly, the type of stimulation we provide to our neurons and how regularly we activate them affect how our brain becomes 'hardwired'. For example, if you play a musical instrument or spend a lot of time reading, the neurons and synapses activated by these activities will strengthen. Likewise, if you spend a lot of time watching television or playing computer games but little time playing sport or reading, then the neurons and synapses involved in watching television and playing computer games will strengthen. Those neurons, synapses and neural circuits involved in playing a sport or reading become weak because of a lack of activation, so they are more likely to be pruned.

As myelination and pruning continue during adolescence, most adolescents show signs that they are developing the ability to think in a progressively more complex, logical and abstract way. However, the experiences a person has during adolescence impact on their brain development during this period because they influence which neural circuits will or will not survive pruning. Furthermore, this impact may extend beyond adolescence because the circuits that survive pruning provide the foundation for adult brain development and behaviour.


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FIGURE 4.8 The type of activity you engage in impacts on which neural circuits will strengthen (and survive synaptic pruning) or weaken (and be pruned).

FOCUS ON RESEARCH 4.1

LEARNING EARLY IN LIFE MAY HELP KEEP BRAIN CELLS ALIVE: BRAIN CELLS SURVIVE IN YOUNG WHO MASTER A TASK

How you use your brain, particularly during adolescence, may help brain cells survive and could impact on how the brain functions after puberty. Scientists at Rutgers University have found that the newborn brain cells in young rats that were successful at learning survived while the same brain cells in rats that didn't learn a task died quickly. In those that didn't learn, three weeks after the new brain cells were made, nearly one-half of them were no longer there. But in those that learned, it was hard to count. There were so many that were still alive. The researchers believe the study is important because it suggests that the massive proliferation of new brain cells helps young animals leave the protectiveness of their mothers and face dangers, challenges and opportunities of adulthood.

Scientists have known for years that the neurons in adult rats, which are significant but fewer in numbers than during puberty, could be saved with learning, but they did not know if this would be the case for young rats that produce two to four times more neurons than adult animals. By examining the hippocampus – a portion of the brain associated with the process of learning and memory – after the rats learned to associate a sound

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with a motor response, the researchers found that the new brain cells injected with dye a few weeks earlier were still alive in those that had learned the task while the cells in those who had failed did not survive.

'It's not that learning makes more cells,' one member of the research team reported. 'It's that the process of learning keeps new cells alive that are already present at the time of the learning experience. Since the process of producing new brain cells on a cellular level is similar in humans, ensuring that adolescents learn at optimal levels is critical. You don't want the material to be too easy to learn or to be so difficult that the student gives up and doesn't learn.'

So, what does this mean for the adolescent boy or girl? While scientists can't measure individual brain cells in humans, this study, on the cellular level, provides a look at what is happening in the adolescent brain and provides a window into the amazing ability the brain has to reorganise itself and form new neural connections at such a transformational time in our lives.

Source: Adapted from Rutgers University (2014, May 27). Learning early in life may help keep brain cells alive: Brain cells survive in young who master a task. *ScienceDaily*. Reproduced with permission.

QUESTIONS

1 What was the aim of this study?
2 Identify the population of research interest.
3 Create a hypothesis for this study.
4 Identify the independent and dependent variables in this study. State how each could be operationalised.
5 Can the results be generalised to the human population? Explain.

Frontal lobe development

Research has shown that the development of both the axons and dendrites of frontal areas, particularly the prefrontal cortex, is slower than that of other areas of the brain.

The prefrontal cortex is the cortical area responsible for a range of complex cognitive functions such as attention, planning, organising, reasoning, judgment, risk assessment, decision-making, empathy and impulse control. Because the frontal lobes are not fully developed until early adulthood, the adolescent does not have the ability to think in the same complex, logical or abstract way an adult is capable of. However, an adolescent is more capable of mature thought than a child.

Adolescent behaviour often wavers between being childish or mature. Because their frontal lobes are still not fully connected, adolescents are still developing the ability to integrate information from a variety of brain areas. This impacts on their thinking skills, and some scientists believe delayed frontal lobe development explains why some adolescents make poor decisions, show poor emotional and impulse control, and engage in risky behaviours.



FIGURE 4.9 At times adolescents do not consider the long-term implications of their behaviour. This can lead to poor decision-making and increased risk-taking behaviour.

4.2 CHECK YOUR UNDERSTANDING >>

1 The process by which the brain disposes of excess neurons is called:
   A apoptosis.
   B homeostasis.
   C synaptic pruning.
   D maturation.
2 During adolescence the brain gradually matures. This is the result of:
   A increased myelination.
   B axon growth.
   C synaptic pruning.
   D All of the above
3 During adolescence:
   A the brain produces excess neurons so the adolescent can experience maximum brain stimulation.
   B the brain removes neurons so the brain can become more efficient and specialised.
   C brain development slows because of an increased rate of growth in the body that is triggered by increased hormone production.
   D brain development is completed first in the frontal lobe, followed by the parietal lobe, the temporal lobe and finally the occipital lobe.
4 Explain why an infant's brain has an excess of neurons.
5 Explain how pruning synapses and reducing the amount of neurons in the brain enhances adolescent brain capacity.

selective specialisation The process of pruning excess synapses to allow the remaining cognitive networks to become specialised and efficient in their function

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INJURY AND THE CEREBRAL CORTEX

Much of what we know about the cerebral cortex and its functions comes from studies of people who have sustained brain damage. Early brain studies were usually based on individual case studies or autopsies that compared normal, intact brains to damaged brains. These studies provided useful information on brain structure, but because they did not allow scientists to view the brain in action, they revealed little about brain function. Modern imaging techniques, however, allow neuroscientists to view a healthy functioning brain as well as the impaired functioning of a damaged brain. This has enabled them to establish links between specific brain structures and functions. As a result, we now have a better understanding of the impact the brain has on our biological, psychological and social functioning.

Biological functioning refers to the way our body and its various components operate. It refers to all the voluntary and involuntary physical behaviours that we engage in, such as combing our hair, walking and breathing. Psychological functioning involves our cognitive, perceptual and emotional ability, and these two areas of behaviour underpin our ability to communicate our thoughts as well as understand others. Humans are social beings, and the ability to communicate appropriately through language (written and spoken) and action influences our level of social functioning. Because we live in groups and interact with others on a daily basis, it is important that we are socially functional.

THE EFFECT OF DAMAGE TO THE CEREBRAL CORTEX

The upper part of the brain consists of two large cerebral hemispheres, each containing four lobes. These two hemispheres are united by a thick band of myelinated nerve fibres, the corpus callosum, which transfers information registered in one hemisphere to the other for processing. Thus, it allows the hemispheres to communicate. Together, the left and right hemispheres form the cerebrum (Latin for brain), which is the largest and most highly developed part of the human brain. In an evolutionary sense, the cerebrum is also the most recent part of the brain to develop.

The outer layer of the cerebrum, the cerebral cortex, is approximately 3 millimetres thick and it is the largest brain structure. The cerebral cortex contains approximately 70 per cent of the neurons in the central nervous system as well as the major association areas of the brain. Association areas integrate sensory and motor information and relate it to information that has already been processed and stored in memory. These association areas are therefore believed to be responsible for higher, more complex mental abilities such as intelligence, problem-solving, language, planning and organisation, judgment, movement, sensations, learning, memory, emotion and consciousness.

When the cerebral cortex is damaged, the result is some form of dysfunction. The degree of dysfunction will vary according to which area of the brain was damaged and the level of severity of the damage.

Acquired brain injury (ABI)

If a person sustains brain damage as a result of injury, and the result of this damage is some form of dysfunction, the person is said to have an acquired brain injury (ABI). To be considered dysfunctional, a person must demonstrate a pattern of abnormal behaviour that negatively impacts on their ability to carry out normal daily activities. According to Brain Injury Australia, over 700 000 Australians have an ABI. Three out of every four of them are aged under 65. Most acquire their brain injury before the age of 25, and three out of every four people with an ABI are men (Brain Injury Australia, n.d.).

Acquired brain injuries have a number of causes, including stroke, trauma, substance abuse, infection



FIGURE 4.10 Acquired brain injuries can lead to various forms of dysfunction, including psychological, emotional and behavioural dysfunction as well as loss of muscle control or coordination.

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and degenerative neurological diseases such as Parkinson's disease, multiple sclerosis and Alzheimer's disease. Acquired brain injuries cause cognitive, physical, emotional or motor functions to deteriorate. They can be temporary or permanent and they can cause partial or total dysfunction.

Common symptoms of ABI include behavioural or mood changes, impaired memory and executive thinking skills, fatigue and muscle weakness or loss of muscle control or coordination. If an ABI results in psychological and/or social dysfunction, it may also lead to mental health problems. Mental health problems encompass a broad range of emotional and behavioural difficulties that alter mood, thinking, communication or behaviour (or a combination of these) to the degree that a person cannot effectively cope with the demands of day-to-day living. Compared with the general population, people with an ABI are more likely to suffer mental health problems, such as adjustment disorders, depression and anxiety, and drug and alcohol addiction.

Acquired brain injuries can significantly affect a person's ability to function socially. A person with an ABI may have impaired impulse control, self-awareness and social skills. As a result of their injury they may become agitated, difficult, disruptive, inappropriate or aggressive. They may also lack motivation and become physically and socially inactive (Victoria. Department of Human Services, 2004).

4.3 CHECK YOUR UNDERSTANDING >>

1 Problems with attention and memory, disruptions in higher-order social cognition tasks and disruptions in executive functioning are characteristics of changes in:
   - A motor skills.
   - B perceptual ability.
   - C cognitive ability.
   - D emotional ability.

2 Brain injury can affect a person cognitively, physically and emotionally. Cognitive consequences do not include:
   - A slower processing of information.
   - B organisational problems and impaired judgment.
   - C inability to multi-task.
   - D depression and inability to regulate emotions.

3 Which of the following statements is true about acquired brain injury (ABI)?
   - A Women have more ABIs than men.
   - B Men have more ABIs than women.
   - C People over 65 are more likely to acquire a brain injury.
   - D ABIs are not caused by neurological diseases.

4 What is meant by the term 'acquired brain injury'? How is it different from a head injury?

5 Explain what psychologists mean by the term 'dysfunction'.

Frontal lobe damage

PREFRONTAL CORTEX

The frontal lobes are the largest and most advanced part of the cerebral cortex. Situated at the front of the brain, the frontal lobes are especially vulnerable to damage from traumatic injury. MRI studies have shown that the frontal area is the most common region of injury following mild to moderate traumatic brain injury (Levin, Amparo, & Eisenberg, 1987). If a person suffers damage to their prefrontal lobes (the large area at the front of the frontal lobe), they may experience a range of cognitive and perceptual difficulties as well as changes to their emotional behaviour and personality.

Frontal lobe damage is not always the result of external events such as accident or injury. It may also be caused by disease or degeneration of the nervous system. Excessive and prolonged alcohol abuse can also lead to brain damage in the form of Korsakoff's syndrome.

COGNITION

Because the prefrontal cortex mainly consists of association areas, it receives information from other brain lobes and structures. It merges this with previously learned information stored in memory. As a result of this integration, we are able to perform a range of complex cognitive functions, often referred to as 'executive' functions. For example, we can quickly identify information and formulate an appropriate response. However, if the prefrontal cortex is damaged, we will not be able to perform at our normal cognitive level. We may not be able to concentrate, plan, problem-solve, think logically, form new memories or

acquired brain injury Brain damage that occurs as a result of injury or physical trauma to the brain and results in some form of dysfunction

Korsakoff's syndrome An organic brain disorder (usually associated with chronic alcoholism) caused by extensive and prolonged lack of thiamine (vitamin B1)

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access old ones, make decisions, analyse information or communicate effectively; so our ability to deal with our environment and adapt to changing circumstances will be diminished.

A reduced concentration span is very common after frontal lobe injury, as is a reduced ability to pay attention to more than one task at the same time. If a person with ABI has difficulty paying attention, their working memory (the part of short-term memory that briefly holds and manipulates information when completing a cognitive task) may be compromised. For example, if someone with frontal lobe damage were told a telephone number, they may not be able to remember the digits for long enough to key them into the telephone touch screen.

When there are problems with concentration, other skills related to processing information and learning can also be affected. For example, the person may find it difficult to follow instructions, follow fast speech and formulate a quick reply to a question, plan ahead, be organised and so on. The person may lose the ability to think and reason in a rational and logical way, and they may find simple problem-solving impossible. For instance, they may have difficulty following simple step-by-step instructions and become easily confused.

EMOTIONAL CONTROL AND PERSONALITY

Emotions affect a range of behaviours, such as motivation, decision-making, memory and planning. Emotions play an important role in our social interactions. The frontal lobes are believed to be responsible for emotions and personality. So, if they are damaged, a person's personality and emotional life may change so dramatically that they become socially dysfunctional. A clear example of this is the case of Phineas Gage, the railroad foreman whose personality changed dramatically following his brain injury (see Chapter 2).

Following frontal lobe damage, noticeable changes may occur in the way the person feels emotions, expresses emotion or detects emotion in others. They may experience uncharacteristic changes in mood, such as sudden episodes of laughing or crying. This can occur in the absence of a specific trigger, and their response may not relate to the way they feel. For example, they may cry when they feel happy, or laugh while feeling sad.

After frontal lobe damage, the person may be unable to effectively filter information from the environment and this may cause a dramatic change in their social behaviour. If they cannot regulate their emotions and match them to a situation, they may behave inappropriately. They may not follow social rules because they cannot identify the social cues that guide behaviour. For example, they may interrupt other people's conversations by interjecting random comments or laugh at inappropriate points in the conversation. They may also display abnormal sexual behaviour or they may experience a reduced sexual interest.



FIGURE 4.11 People with intact brains are generally able to regulate their emotions and behave in an appropriate social manner. A person with frontal lobe damage may lose the ability to regulate their emotions and begin to exhibit inappropriate or unusual social behaviours, such as crying throughout a comedy performance when everyone else is laughing.

Frontal lobe damage may also result in apathy, causing the person to have no interest in others or events. Alternatively, the person might become uncharacteristically uninhibited and show no regard for the consequences of their actions. They may become impulsive and engage in risky behaviour. This effect may manifest as argumentative, vulgar or euphoric behaviour. The person may also lose the ability to interpret another person's emotional state and to empathise with them.

CONTROL OF VOLUNTARY MOVEMENT

The person's ability to plan and execute a voluntary movement may also be affected if their frontal lobe is damaged. This is because the prefrontal cortex

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receives information about the person's current position in space from several other brain areas and merges it with other information, such as the goal to be attained and memories of past movement strategies. When this information is combined and interpreted, a command response is formulated and sent to the primary motor cortex. Motor neurons in the primary motor cortex relay the command to motor neurons in the spinal cord. The spinal cord then relays the command to motor neurons in the somatic nervous system that connect to specific skeletal muscles. By commanding this chain of motor neurons, the primary motor cortex directs the movement of skeletal muscles and controls voluntary, goal-directed movement.

If damage occurs to the prefrontal cortex, these commands may not be able to be issued, or if the damage was in the primary motor cortex, the commands may not be able to be received and transmitted to skeletal muscles. As a result, the person may experience movement difficulties ranging from involuntary muscle spasms to total paralysis of a body area. They may also have difficulty expressing spontaneous emotions through facial expressions (Kolb & Milner, 1981). For example, someone who is feeling happy may not be able to smile.

If a person sustains damage to Broca's area, the section in the lower section of their left frontal lobe close to the motor cortex, they may not be able to produce speech. This is because neurons in Broca's area direct the motor neurons that control speech. If Broca's area is damaged, messages about which muscles need to be moved in order to speak fluently will be compromised, so speech ability will be impaired.

Occipital lobe damage

Problems with visual sensation and perception can result from brain damage to the occipital lobe. If the occipital lobe's primary visual cortex is damaged, the person may experience some loss of vision because they may not be able to register visual information sent from the eyes. Alternatively, if association areas on this cortex are damaged, they may have difficulty recognising visual material such as shapes or objects even though the information has been registered in their occipital lobe. Or, they may have no problem seeing the information, but they may have problems paying attention to it or making sense of it.

Some individuals may also not be able to judge the distance between themselves and objects. This can lead to all kinds of problems in daily life, such as trying to put a mug on the table but missing the table, banging into pieces of furniture, not being able to judge when it is safe to cross the road, or confusion with left and right.

Temporal lobe damage

Damage to the temporal lobe can lead to problems processing auditory information. The primary auditory cortex of each temporal lobe registers sound, so if this area is damaged we may have difficulty hearing. The temporal lobes are involved in a number of language- and memory-related functions, so any damage may result in language or memory loss. For example, the left temporal lobe contains Wernicke's area, the cluster of neurons responsible for understanding written and spoken language. If Wernicke's area is damaged, we may suffer from Wernicke's aphasia, which causes difficulty recognising words. Although we may speak clearly, what we say will make little sense and we will have difficulty understanding language.

The temporal lobes also contribute to memory function, so any damage to this area can result in short-term or long-term memory loss. For example, we may not be able to recognise familiar faces or objects. Because memory and language are closely related, individuals with temporal lobe damage may have difficulty categorising words or pictures.

A person with temporal lobe damage may also have difficulty paying attention to what they see or hear. In addition, because the temporal lobes contribute to emotional control, damage may result in emotional disturbance. For example, the person may lose their sense of humour.

Parietal lobe damage

The parietal lobe has many functions that are determined by where specific groups of specialised neurons are located in the lobe. The forward section of the parietal lobe (next to the primary motor cortex) contains neurons that constitute the somatosensory cortex. This is the cortical area that receives and analyses sensory information sent from the body

working memory A subsystem of short-term memory that briefly holds and manipulates information when completing a cognitive task

relating to touch, pressure, temperature and some aspects of pain. Therefore, the somatosensory cortex plays a vital role in the sensation and perception of sensory information.

Damage to the somatosensory cortex may result in loss of sensation because the person may not be able to register sensations sent from their sense organs. For example, they may not be able to recognise the taste of food, feel that they are injured, or appreciate the difference between hot and cold. This can also affect their perception of their environment because vital sensory information necessary for a correct perception, and formulation of an appropriate response, may be missing when perceptions are formed.

The parietal lobe also integrates sensory input from a number of brain areas, primarily the visual system, so we have an understanding of our spatial environment. For example, the parietal lobe enables us to understand where we are in relation to our surroundings, where our body parts are in relation to each other, and what the spatial relationship is between the objects in our environment. If a person damages their parietal lobe, they may have problems with their perception of their body image as well as with spatial awareness (Kandel, Schwartz, & Jessel, 1991).

The parietal lobe's ability to integrate information also affects our ability to read, recognise people and objects, distinguish left from right and multi-task.

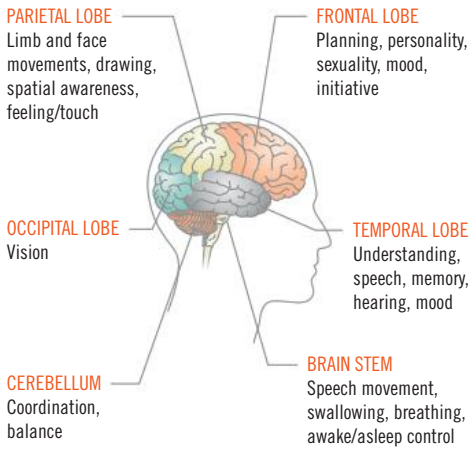


FIGURE 4.12 Damage to any part of the brain, particularly the cerebral cortex, can result in the loss of function in psychological, emotional and behavioural areas.

Hemispheric damage

Each hemisphere registers sensory information from the opposite side of the body and controls voluntary movement in the opposite side of the body. If the areas of the cortex involved in these functions are damaged, the person may not be able to register sensations or control their movement. In addition, each hemisphere has a range of specific functions, so damage to either the right or left hemisphere can result in a range of dysfunction.

The ability to think creatively is dominated by the right hemisphere, so if it is damaged these abilities would be compromised. The person may also not be able to process information simultaneously or holistically. For example, they may have difficulty with completing a jigsaw puzzle because they cannot work out how to put the pieces together.

If the right cerebral hemisphere sustains damage, a person's specialised skills relating to non-verbal thinking and communication may be reduced. For instance, their ability to detect emotion in others may decline. They may have difficulty with non-verbal aspects of communication because they can no longer identify emotional cues given through facial expressions or tone of voice. Their spatial skills and pattern recognition ability may also be compromised. For example, damage to the right parietal lobe is the most common cause of spatial neglect, which is a tendency to ignore the left or right side of visual space after a brain-damaging event (see Figure 4.13). Often sufferers of spatial neglect will not eat food on the left side of a plate and some even refuse to acknowledge a paralysed left arm as their own (Springer & Deutsch, 1998).

Because the left hemisphere contains the language centres, damage to Broca's area (left frontal lobe) or Wernicke's area (left temporal lobe) can result in aphasia, or language impairment.

The ability to analyse information and think logically and sequentially are also dominated by the left hemisphere, so any damage to this hemisphere may also result in a decline in these abilities. In addition, the person may experience difficulty with mathematics and organising information, so their ability to problem-solve may be compromised.

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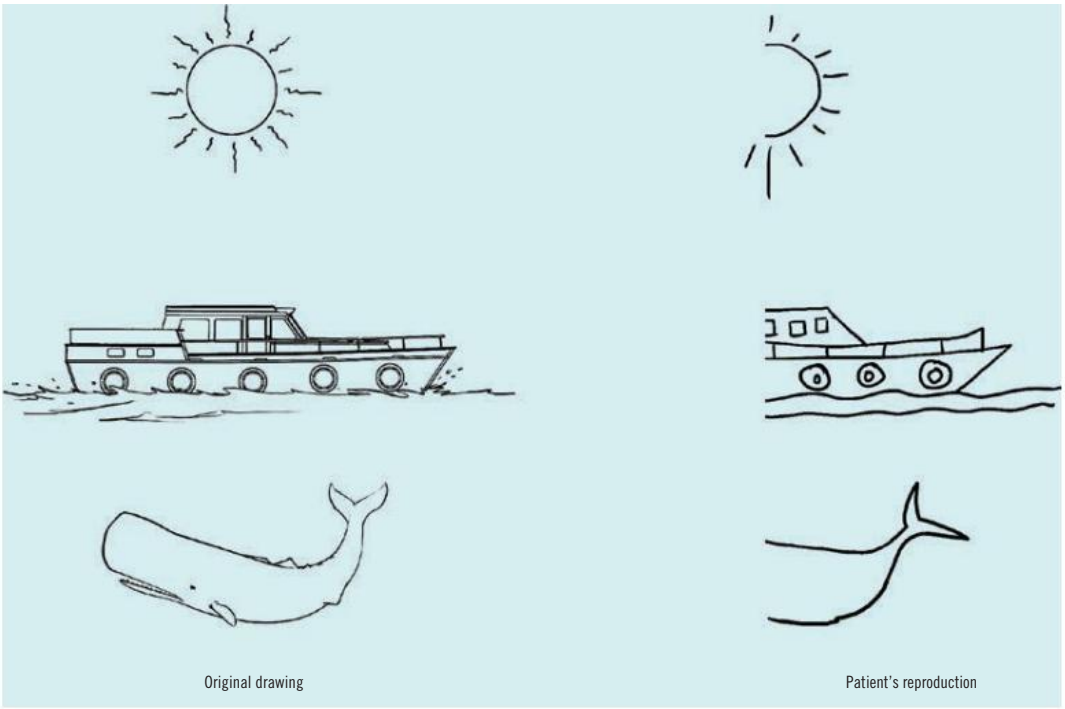


FIGURE 4.13 A person with spatial neglect tends to ignore one side of their visual space.

4.4 CHECK YOUR UNDERSTANDING >>

1 Which area of the cerebral cortex combines sensory and motor information with information stored in memory?
   - A The primary motor cortex
   - B The primary somatosensory cortex
   - C The cerebrum
   - D Prefrontal association areas

2 The prefrontal cortex is responsible for:
   - A planning movements.
   - B organising movement sequences.
   - C producing specific movements.
   - D inhibiting spontaneous movements.

3 A person with spatial neglect will most likely:
   - A have difficulty coordinating movements as a result of frontal lobe damage.
   - B have difficulty recognising faces because of temporal lobe damage.
   - C only recognise one side of visual space because of parietal lobe damage.
   - D not pay attention to stimuli in the environment because of frontal lobe damage.

4 Describe two physical changes you might see in a person who had sustained damage to their right cerebral hemisphere.

5 Explain how damage to the prefrontal cortex can result in an inability to move your arms or legs at will.

RECOVERING FROM BRAIN DAMAGE: PLASTICITY

PLASTICITY: REWIRING THE BRAIN

If something is plastic, it means that it can be moulded and changed. For example, a lump of plasticine (synthetic plastic) can be transformed into whatever shape we want; it does not have a fixed shape. In terms of the human brain's capacity to learn, research studies indicate that the human brain can also be moulded and changed throughout the lifespan. When one brain area is damaged, other areas may, in time, reorganise and take over some of its functions. If neurons are destroyed, nearby neurons may partly compensate for the damage by making new connections that replace the lost ones. In other words, the brain has the ability to change its structure and relocate functions to different areas and neuronal networks. This is known as plasticity. These studies also indicate that the environment in which a person lives, as well as the actions of that person, play a role in plasticity.

spatial neglect A tendency to ignore the left or right side of one's body or the left or right side of visual space resulting from damage to one of the cerebral hemispheres (usually the right parietal lobe)

plasticity The ability of the brain to change its structure and relocate functions to different areas and neuronal networks

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Brain plasticity is the result of many different, complex processes that occur in our brains throughout our lifetime. There are three circumstances under which brain plasticity can occur:

- at the beginning of life, when the immature brain organises itself
- in case of brain injury, to compensate for lost functions or maximise remaining functions
- throughout life, whenever something new is learned and memorised.

Developmental plasticity

Developmental plasticity is a term referring to changes in neural connections during development, which result from environmental interactions and learning experiences. Developmental plasticity is specific to changes in neurons and synaptic connections as a consequence of developmental processes.

When the brain is in its developmental stages, dramatic changes occur in neuron numbers. During development of the nervous system, cells divide, differentiate, extend axons and dendrites, and form synapses (see Figure 4.14). During brain development and also during other periods of change (such as maturation), synaptic connectivity can also change, and the post-synaptic response to the release of neurotransmitters is not necessarily always the same (it can be made stronger or weaker).

Adaptive plasticity

The brain is still capable of plasticity throughout adult life. The major structures in the human brain are basically the same for everyone, but subtle differences between the brains of different individuals result from the fact that it is adaptable and able to modify its circuits in various ways throughout life. This is what makes our behaviour flexible and efficient.

The brain automatically makes new synapses and reorganises neural pathways in response to changing environmental conditions and during learning, and this response continues throughout adulthood. Remarkably, the brain can also 'rewire' (or reorganise) itself after some types of damage, and this can happen at any stage during the lifespan. We call this adaptive plasticity, and it occurs when the connections between the synapses are altered to best suit the environmental conditions when learning something new or when relearning something after brain injury or surgery.

The surprising discovery that the brain can actually change its shape within weeks in response to certain mental and physical stimuli differs from the traditional concept that brain shape must remain unchanged except as a result of neurologic disorders. Investigations into the brain's adaptive plasticity have been undertaken in the past, but it was not until recently that the effect of learning on larger structural changes in the brain was observed. Today, researchers can not only demonstrate that certain parts of the brain are function-specific but that they grow when we learn and alter in shape. And it is this ability that allows us to change our behaviour and adapt to changes in our environment.

A new skill, such as playing the piano, requires many changes in the brain. Some dendrites grow longer and sprout new branches; others are 'pruned' away. New synapses form, while others disappear. Activity levels change in groups of neurons. Through such processes, parts of the cortex are 'rewired' and 'tuned' to carry out tasks more efficiently. For example, as a result of cortical tuning, distinct areas of your brain are especially good at recognising faces, animals, furniture and other specific types of objects. Likewise, the brain of an adult violinist will be different if they began practising as a child, rather than later in life. Over the course of a lifetime, our experiences literally shape, mould and remodel details of the brain.

In his 2007 book, *The Brain That Changes Itself: Stories of Personal Triumph from the Frontiers of Brain Science*, Norman Doidge describes numerous

TABLE 4.1 A comparison of developmental and adaptive plasticity

	DEVELOPMENTAL PLASTICITY	ADAPTIVE PLASTICITY
Definition	Changes in brain neurons and synaptic connections that occur as a specific consequence of developmental processes	Changes in brain neurons and synaptic connections to best suit a person's environmental conditions
When it occurs	» During specific periods of development as a result of normal maturation » Throughout the lifespan, but is greatest during infancy and childhood	» In response to learning something new or relearning following brain injury » Throughout the lifespan, but is greatest during infancy and childhood
Impact on behaviour	Provides the potential to develop new behaviours following environmental interactions and learning experiences	Allows the brain to adapt to changing environmental circumstances or to loss of function following brain injury

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examples of individuals who experienced shifts in their functional ability following brain injury. One story features a surgeon who suffered a stroke that left him with paralysis in his left arm. Part of his rehabilitation was not to use his good arm; to instead make himself use his left arm. When the patient was asked to clean tables, at first the task was not possible because he was not allowed to use his right arm and his left arm was paralysed. Then, bit by bit, he began to remember how to move his left arm. Eventually, he learned to write and play tennis again (Doidge, 2007). In this case it would appear that the functions damaged by the stroke transferred themselves to regions of the brain that were unaffected by the stroke. The brain compensated for the lost ability caused by the brain damage by reorganising and forming new connections between intact neurons and, in order to reconnect, the neurons had to be stimulated through activity.

Plasticity allows the brain to learn new skills and remember information, to reorganise neuronal networks in response to environmental stimulation, and to recover from brain injury.

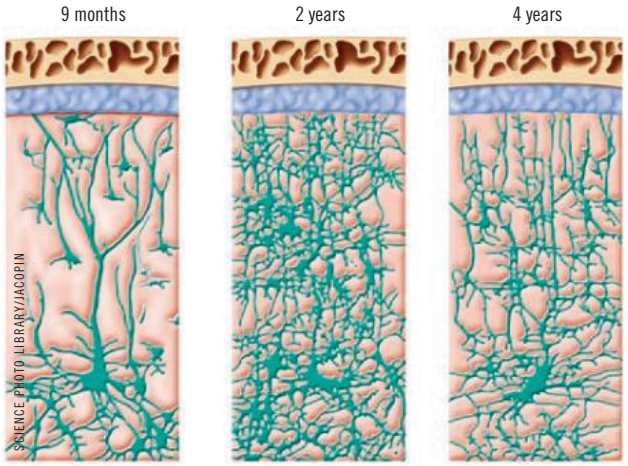


FIGURE 4.14 The increase in axons and dendrites is greatest during the first two years of life. During infancy, the brain develops an excess of neurons to maximise the likelihood of absorbing environmental stimuli. Neurons and synapses that are repetitively activated strengthen. Rarely used or weak neurons are eliminated to ensure maximum efficiency of neural transmission for future learning during childhood.

4.1 TRY IT YOURSELF >>

PRACTICE MAKES PERFECT: HOW TO STRENGTHEN SYNAPSES

Ask a friend to silently read through the list of 15 words below.

peg	sailor	shoe	rabbit	sun
apple	pig	cloud	lolly	hat
car	spoon	dog	coin	hair

Allow them 20 seconds to do this. Then ask them to write down as many words as they can remember from the list, but do not let them continue for more than 20 seconds. Then score how many they remembered correctly.

After an hour, ask them to repeat the exercise and score them again. After a further hour, repeat the exercise.

Did their score increase with each attempt? How would you explain this in terms of brain plasticity?

Rehabilitating the damaged brain

When the cerebral cortex is damaged, structural and functional changes take place. However, because of adaptive plasticity, the undamaged parts of the brain can 'take over' the function of the injured brain part. For example, if someone lost control of movement in their left arm after damage to their right motor cortex, their brain may adapt to this situation by moving the location for motor information about the left arm elsewhere on the motor cortex. If this happens, the person should regain control of their left arm. Adaptive plasticity allows the brain to reorganise itself to compensate for the loss of ability following brain injury. So, if a brain-injured person undergoes rehabilitation, they can retrain their brain and reorganise their cortex.

Rehabilitation refers to a therapy or treatment aimed at helping a person recover from injury and return to the normal or near-normal level of physical, psychological and social function they experienced before they were injured. Brain-injury rehabilitation usually consists of a hospital-based program over a period of time. The type of rehabilitation required is determined by which parts of the brain have been injured and the extent of the functional loss. Some people may require rehabilitation for the rest of their life; others may only require it for a few weeks. Specific interventions would focus on stimulating new neural connections, enhancing cortical reorganisation, and promoting lasting neural networks for improved responses. Depending on the damage sustained and the degree of functional loss, a person's individual

developmental plasticity Changes in brain neurons and their synaptic connections that occur as a specific consequence of developmental processes

adaptive plasticity The ability of brain neurons to alter the connections between the synapses to best suit the environmental conditions when learning something new or when relearning something after brain injury

rehabilitation A therapy or treatment aimed at helping a person recover from injury and return to the normal or near-normal level of physical, psychological and social function they experienced before they were injured

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FIGURE 4.15 Rehabilitation after brain injury is usually undertaken for a prolonged period of time. It relies on the processes of adaptive plasticity to reorganise brain circuits to compensate for loss of function caused by brain injury.

rehabilitation program may focus on improving cognitive, motor or emotional and behavioural skills, or a combination of these.

Rehabilitation after brain injury focuses on neural restructuring, so it relies on the processes involved in adaptive plasticity. During rehabilitation, specific brain areas are repetitively stimulated. This allows damaged neural pathways to be rerouted or new neural pathways to be created around the damaged or blocked pathway. This cortical reorganisation of the synaptic networks responsible for a specific behaviour allows the signals sent by remaining healthy neurons to be transmitted to neurons in other brain areas and results in the creation or reorganisation of neural circuits. As a result, the person may regain their lost ability or improve their level of post-injury ability. Research into the effect of practice on recovery from brain injury suggests that intense practice with enough repetition encourages adaptive changes in the brain and results in improved skills (Kleim & Jones, 2008). Research also suggests that stimulating the recovering brain over a period of time by increasing the person's physical activity and social interactions, and providing them with interesting sensory stimuli (such as novel objects or problem-solving opportunities) encourages the processes involved in adaptive plasticity and enhances their recovery (Lee et al., 2013; Yang et al., 2012).

Studies of neural plasticity suggest the concept of 'use it or lose it' also applies to the brain. These studies show that using your brain in novel or stimulating ways actually increases its size and the number of dendritic branches it contains (Kempermann & Gage, 1999). Neuroimaging technologies have shown that during rehabilitation, when the person is learning a new skill or relearning a lost skill, the cortical regions involved in processing the sensory information and motor commands associated with the skill eventually come to occupy more space on the primary sensory and motor cortex. This shows that the experiences involved in rehabilitation reorganise the structure and function of the undamaged parts of the brain. So, the more you challenge and engage your brain – especially by learning new skills – the healthier it will be and the better it will function.

4.5 CHECK YOUR UNDERSTANDING >>

1 Plasticity of the brain refers to:
   - A the brain's ability to remain stable over time.
   - B the brain's ability to set like 'plastic' when learning occurs.
   - C the brain's ability to adapt and change when required.
   - D the brain's inability to adapt and change when required.

2 Adults who acquire a brain injury are often able to recover any functional loss because of their brain's:
   - A adaptive plasticity.
   - B developmental plasticity.
   - C synaptic pruning of damaged neurons.
   - D ability to remove excess grey matter.

3 Which of the following statements is true about brain plasticity?
   - A The brain is equally plastic during all stages of the lifespan.
   - B The brain of an elderly person has very little plasticity because, as we age, brain neurons die so the person has fewer functional neurons.
   - C The brain of an elderly person has very little plasticity because their white and grey matter loses its flexibility.
   - D The brain is most plastic in early life but remains plastic throughout one's life.

4 Explain the difference between adaptive plasticity and developmental plasticity.

5 Outline the relationship between adaptive plasticity and rehabilitation of people with acquired brain injuries.

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4.2

FOCUS ON RESEARCH

REMAPPING THE DAMAGED BRAIN

Scientists at the RIKEN Center for Life Science Technologies and the AIST Human Technology Research Institute in Japan, have identified a time-dependent relationship between two brain regions that contributes to the recovery of motor function after brain damage. The research team investigated how rehabilitation aimed at recovering motor function after brain damage affects the structure and function of brain neurons.

The team studied the rehabilitation process in monkeys that had suffered injury to the region of their cerebral cortex that controls hand movements, especially fine movements required for gripping and manipulating small objects. The researchers taught monkeys to quickly and repeatedly grab a piece of potato through a small opening using their thumbs and index fingers. The team found that performing this task 30 minutes a day for several weeks after injury resulted in greatly improved motor function. To estimate changes in brain activity associated with the recovery, they used a PET scan to image the regional brain activity before injury and at the early and late stages of recovery while monkeys performed the task. They found that activity in the ventral premotor cortex – a brain region distant from the injury – was higher during the early stage of recovery than before the injury. They also found that when monkeys performed the task in the later stages of recovery, connections between the lesion site and regions of primary motor cortex immediately surrounding it became stronger.

To verify whether the changes in these regions were necessary for the recovery, they temporarily inactivated them before injury and at the recovery stages. They found that inactivation of a brain region (the ventral premotor region) on the same side of the brain as the lesion weakened precision grip during the early stages of recovery. They also found that the area surrounding the injury became devoted to movements related to precision grip. During the later stage of recovery, inactivating this area only affected precision grips, but not other types of grips impaired by inactivation before the lesion.

These results may contribute to the development of new rehabilitation techniques and drugs, as well as new ways to evaluate rehabilitative training for humans who experience motor dysfunction as a result of brain injury.

Sources: Adapted from RIKEN. (2015, January 6). Remapping the damaged brain. http://www.riken.jp/en/pr/press/2015/20150107_1/

Murata, Y. et al. (2014). Temporal Plasticity Involved in Recovery from Manual Dexterity Deficit after Motor Cortex Lesion in Macaque Monkeys. *The Journal of Neuroscience, 35*(1): 84-95; doi: 10.1523/jneurosci.1737-14.2015.

QUESTIONS

1. What was the aim of this research?
2. Create a hypothesis for this research.
3. What were the results?
4. What conclusion can be drawn from the results?
5. Can the results be generalised to humans? Explain.

RESEARCHING NEUROLOGICAL DISORDERS

Scientists engaged in research aimed at discovering the causes of neurological disorders that affect the brain, and developing treatments for them, have found this task very challenging. This is due to the complex and diverse nature of these disorders and ethical concerns associated with carrying out experimental research on human beings. Although there are also ethical concerns relating to the use of animals in research, strict ethical guidelines exist to protect the welfare of non-human animal research participants. Even though many neurological disorders are still not yet fully understood, research using animal models has provided much valuable information about the causes, progress and treatment of these disorders in humans. A range of neuroimaging techniques have allowed scientists to clearly view the physiological impacts of these diseases, including destruction of the central nervous system, particularly the brain.

RESEARCH INVOLVING ANIMAL MODELS

Research into the pathology and molecular mechanisms of human neurological disorders, as well as the contributions of genetics, has traditionally relied on investigations using non-human animal participants. Researchers have produced an abundance of information relating to the cause of these disorders and they have provided scientists with the opportunity to test the effects of a range of possible treatments before they are given to humans.

Historically, animal models have been instrumental in the discovery of therapeutics for a range of mental disorders including anxiety, depression, schizophrenia and neurological disorders such as Parkinson's disease, Huntington's disease and multiple sclerosis.

Significant progress has been made in the development of gene therapy strategies using small animals, including rats and mice and small organisms, but gene therapy outcomes using these models do not always translate to a more complex human setting. The use of animal models has been increasingly criticised

neurological disorder A disorder of the nervous system that affects cognitive and motor functions

Parkinson's disease A progressively degenerative neurological disorder that affects the control of body movements and forms part of a group of conditions known as motor system disorders

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because clinical trials that followed them have failed for a number of reasons, including inherent limitations of the models and ethical concerns for the animal subjects used. Scientists using animals as their research subjects must always follow the strict ethical standards set out for such research. If it is known before the experiment that the animal will experience distress, discomfort or pain, or if this occurs during the experiment, the researcher must decide if the gains for human welfare outweigh the concerns for the animal's welfare. If they decide that the concerns outweigh the gains, then the research is not ethical and should not be carried out or continued.

Some of these models may be in vitro; that is, they are conducted in a test tube or controlled environment, rather than on a living organism. In-vitro testing allows scientists to isolate specific cells and enzymes and focus their observations on specific mechanisms or processes. When using this method, they are not bound by the same ethical constraints they would be if living, animal (human and non-human) participants were used. While in-vitro models have been useful in enhancing our understanding of neurological disorders, they also have their limitations. For example, viruses grow differently in test tubes than in humans. And they do not replicate the precise cellular conditions of a whole living body. Also, humans have an immune system, but test tubes do not. Viruses do not have the same physiological structure as humans, so viruses growing in a test tube are not ideal models for human diseases.

As information is gathered and scientists want to learn more, they eventually need to test their ideas in vivo, or on a living animal. Animal studies are a form of in-vivo research and they are often used because they allow researchers to observe the overall effects of an experiment on a living subject. Animal models, while not a perfect substitute for human models, provide a closer approximation of human responses because of the many biological similarities shared by humans and animals. Many animals, for example mice and monkeys, have the same organs and organic systems that perform in much the same way as they do in humans.

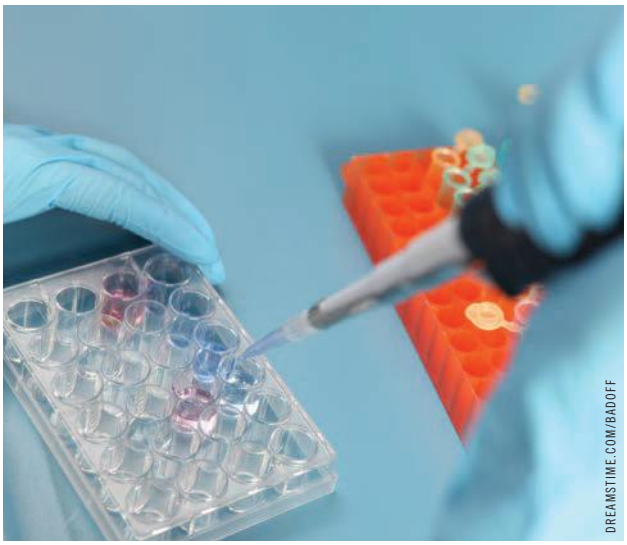


FIGURE 4.16 In-vitro studies have provided much valuable information about how human neurological disorders develop.

When using animal models to research human neurological disorders, researchers must take care to select the relevant animal model to achieve their research goals. Researchers can choose from three different models: homologous models, isomorphic models or predictive models. A homologous model uses animals that duplicate the same origin, symptoms and outcome of the human disorder in every major aspect. This model provides the researcher with a basis for studying all aspects of a disorder, including its causes. An isomorphic model resembles the human disorder, but the disorder is artificially produced in the laboratory in a way that does not reflect normal human origins. It allows the researcher to make predictions and to study the underlying mechanisms of the disorder. A predictive model does not necessarily resemble the human disorder, but is valuable in terms of predicting some aspect of the disorder such as the response to various drugs. Once the purpose of the experiment is defined, the type of model to be selected becomes apparent.

These models do not fully replicate the cognitive deterioration and behavioural problems associated with these disorders, and they cannot be used to study all the changes that occur in different tissues as the disorder slowly progresses.

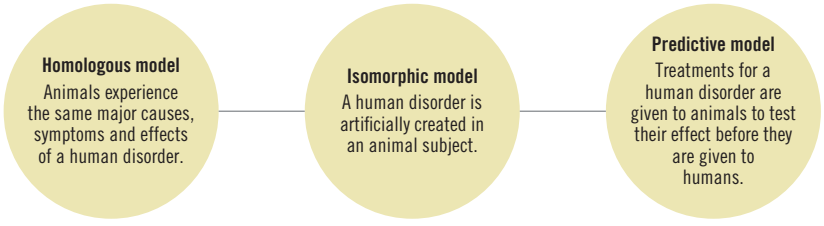


FIGURE 4.17 A comparison of three different animal models used in research

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4.6 CHECK YOUR UNDERSTANDING >>

1 The main reason scientists may choose animal models over human models in their research is because:
   - A they can generalise the results to a human population.
   - B animals do not require compensation, so they make the experiment cheaper to run.
   - C often the experiments are too dangerous to carry out on human participants.
   - D they are not bound by any ethical principles when using animals as participants.

2 If a scientist was conducting an in-vitro experiment, they would be:
   - A growing micro-organisms in a test tube.
   - B experimenting on a living animal.
   - C bound by the same ethical principles that apply to human and non-human animals who participate in experiments.
   - D dissecting a dead animal.

3 When conducting research, scientists often use models that are 'in vitro' and 'in vivo'. What do these terms mean?

4 Identify one advantage and one limitation of using an in-vivo model in scientific research.

5 Drug companies conduct extensive research into the possible effects of their drugs before they become available to the public. Identify which research model would be most suitable for this purpose: a homologous, isomorphic or predictive model. Provide a reason or reasons for your answer.

RESEARCH INVOLVING NEUROIMAGING: A WINDOW TO THE BRAIN

The cerebral cortex has many specialised areas that work together to produce the range of behaviours humans are capable of. Brain scans, such as PET and fMRI, typically show that several widely separated areas of the cortex are active simultaneously when a mental task is performed. Often there is a characteristic pattern. For example, the same five or six different areas may light up each time a person perceives pain.

Recent innovations in neuroimaging have allowed neuroscientists to investigate the structure and function of the human nervous system, in particular the brain and the role it plays in neurological disorders, in a way previously not possible. Now, it is possible to locate structural damage and assess functional changes in the brain that occur as a disorder progresses.

Both functional and structural imaging have contributed dramatically to our understanding of the causes of various neurological disorders and their diagnosis and management. Magnetic resonance imaging (MRI) and computerised tomography (CT) provide images of the structural changes associated with various neurological disorders. Functional imaging techniques, such a positron emission tomography (PET), provide active images of the brain. These techniques have improved our understanding of the changes in blood flow, metabolism and neurotransmitter activity that occur as a result of a range of neurological disorders.

Neuroimaging and research using animal models have been particularly helpful in providing information about Parkinson's disease, the most common movement disorder and the second most common neurodegenerative disorder after Alzheimer's disease.

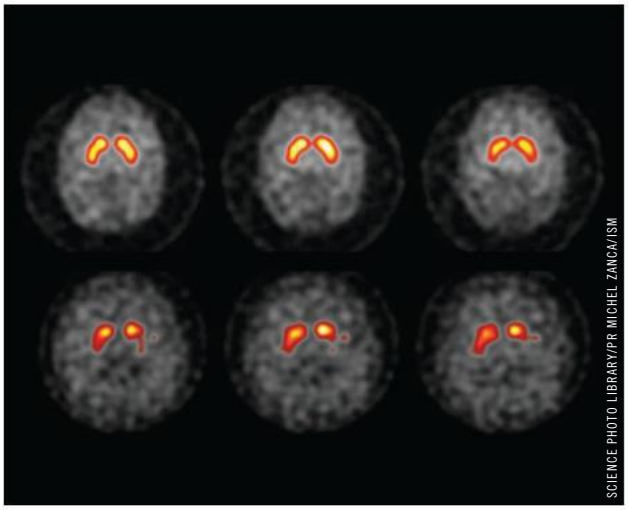


FIGURE 4.18 Neuroimaging techniques such as these single-photon emission computed tomography (SPECT) images provide information about brain structure and function that allow neurologists to more accurately diagnose and treat neurological disorders such as Parkinson's disease. These images compare the number of functional nerve cells (coloured areas) in the presynaptic dopaminergic pathway of a normal subject's brain (top), with that of a patient with Parkinson's disease (bottom). There is less activity in the brain of the Parkinson's patient.

in vitro Relates to a medical test, experiment or procedure that is carried out in an artificial environment, such as a laboratory test tube

in vivo A medical test, experiment or procedure that is carried out on a living organism, such as a laboratory animal or human

homologous model An experimental model that uses animal participants that duplicate the same origin, symptoms and outcome of a human disorder

isomorphic model An experimental model that uses animal participants who have had a disorder artificially created in them

predictive model An experimental model that uses animal participants who have a disorder that does not necessarily resemble a human disorder but assists in making predictions about aspects of the disorder

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PARKINSON'S DISEASE

Parkinson's disease is a progressively degenerative neurological disorder that affects the control of body movements and forms part of a group of conditions known as motor system disorders. Parkinson's disease was named after British physician James Parkinson (1755–1824), who first described the symptoms of the disease.

Genetic or hereditary Parkinson's disease is very rare. Current research suggests that about 10 per cent of people with Parkinson's disease will have a relative who is also affected (Parkinson's Australia, 2015a). Parkinson's disease affects people in different ways and the presentation of symptoms varies. The illness progresses at a very slow rate and lifespan is not shortened, but no two people are affected in the same way. The average age of diagnosis is 65 years; however, younger people can be diagnosed with Parkinson's (Parkinson's Australia, 2015b).



FIGURE 4.19 In 2013, actor and comedian Billy Connolly was diagnosed with Parkinson's disease.

CAUSES

At present there is no known cause for Parkinson's disease, but it begins with progressive loss of a specific set of nerve cells in the basal ganglia, a complex network of structures in the base of the forebrain that are an important component of the brain's motor control systems. Basal ganglia structures contribute to a number of behaviours including posture, movement, learning, memory, emotions, motivation and speech.

One component of the basal ganglia, the substantia nigra, is heavily involved in movement control. Nerve cells in a healthy, fully functioning substantia nigra send out messages to the next 'relay station' of the brain, the corpus striatum, to produce smooth, purposeful muscle activity. The substantia nigra and corpus striatum also produce a chemical neurotransmitter, dopamine. When neurons in these structure are damaged, their ability to produce dopamine is impaired. Unfortunately this damage will have been going on for a long time before symptoms become apparent. Autopsies of patients who had Parkinson's disease found dopamine levels to be one-tenth of normal (Lefrançois, 1980).

Facts about Parkinson's disease

- It is a chronic, progressive and incurable neurological disease.
- It is the second most common neurological condition, second only to dementia.
- There is no known cause for the disease, but it begins with a loss of dopamine-producing cells in the brain.
- It usually occurs in middle or later life (after age 50).
- According to Parkinson's Australia (2015c), more than 80 000 Australians are currently living with Parkinson's disease.
- Common symptoms:
  - trembling hands, arms, legs, jaw or face
  - bradykinesia (sudden slowness or loss of spontaneous movement)
  - problems with posture and balance
  - uncoordinated movement
  - muscle stiffness
  - fatigue.

Physical symptoms can lead to depression and anxiety.

FIGURE 4.20 Facts about Parkinson's disease

Neurotransmitters function as chemical messengers in the brain. When neurotransmitters are released from a pre-synaptic neuron's axon terminals, they enter the synapse that separates it from other neurons. The neurotransmitter travels across the synapse until it is taken up by the dendrites of a post-synaptic neuron. At this point it attaches to a specialised receptor on the post-synaptic neuron. If the neurotransmitter activates the neuron, it is referred to as excitatory. If it slows the activity of the receiving neuron, it is referred to as inhibitory.

Effects of dopamine loss

Dopamine is an excitatory neurotransmitter, so it activates neighbouring neurons. Damaged dopamine-producing neurons generate less dopamine, causing the nerve cells of the corpus striatum to fire out of control. When this happens, the symptoms of Parkinson's disease appear. The person will have difficulty controlling their movements in the normal manner, and movement will progressively become delayed and uncoordinated.

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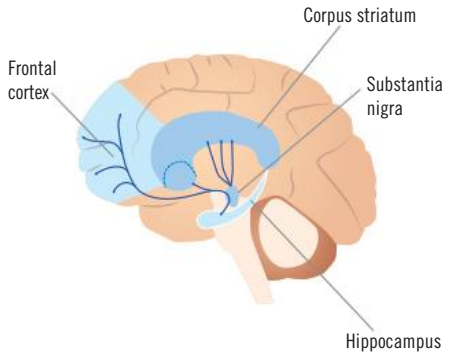


FIGURE 4.21 When neurons in the dopamine pathways in the brain are damaged, the person will exhibit the symptoms of Parkinson's disease.

As well as contributing to movement, muscle control and balance, dopamine also helps to regulate mood and motivation levels, and it is involved in the brain's reward cycle. Dopamine has also been linked to addiction. When dopamine is released, we experience pleasure. So, when we learn that a behaviour will be rewarded with a pleasure sensation, we tend to repeat that behaviour.

SYMPTOMS OF PARKINSON'S DISEASE

Parkinson's disease is characterised by tremors, muscular rigidity and reduced control over voluntary movement that gradually affect how a person moves, including how they speak and write.

Generally, three main physical symptoms are used for diagnostic purposes. Unpredictable tremor, or shaking, is the most common symptom. Tremor usually begins in one hand and spreads to the leg, before crossing to the other side. Some suffers also report feeling tremor internally. Typically, tremor is most noticeable when the person is resting or when stressed or tired, but usually disappears during movement and when asleep. Another symptom involves rigidity, or stiffness of the muscles, which seem unable to relax, even when the person is resting. Finally, bradykinesia, or slowness of movement and gradual loss of spontaneous movement, occurs as a result of the brain's inability to control smooth and delicate movements. Bradykinesia inhibits spontaneous movement, for example swinging of the arms, and reduces fine motor coordination, for example handwriting may become difficult. Bradykinesia may also lead to muscle freezing or periods of involuntary immobility. Apart from tremor and slow movements, the person may also have a fixed, inexpressive face because of reduced control over their facial muscles.

Other physical symptoms may include pain and discomfort in an arm or leg. Constipation and bladder problems are common, and speech and swallowing problems tend to worsen as the disease progresses. The general slowing of muscle activity can also lead to problems with temperature regulation, digestion and sexual function.

These physical symptoms, and the unpredictable nature of their occurrence, may result in psychological problems that lead to social dysfunction. Difficulties with communication tend to limit the person's ability to socialise. They may feel embarrassed by their physical behaviour and their increasing dependence on others and worried about their uncertain future. As a result, they may experience anxiety and depression, and isolate themselves.

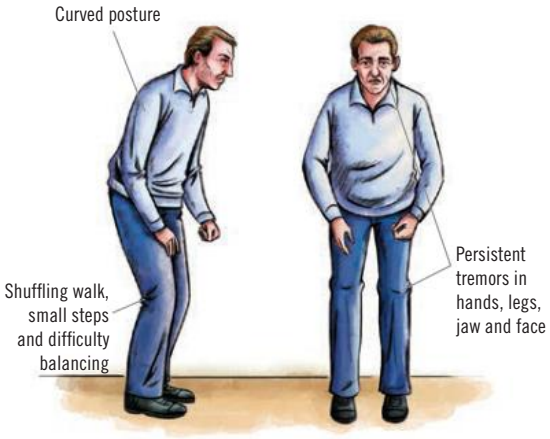


FIGURE 4.22 People living with Parkinson's disease progressively lose control of movement.

Parkinson's disease also has cognitive side effects. Because brain and nervous system functioning is negatively affected by the degenerative processes of the disease, the person ultimately experiences slowness of thinking and memory problems. During the advanced stages, some people are affected by dementia. Although most people retain their normal intellectual functioning, they may have difficulty with tasks involving sequential steps, or activities that depend on short-term memory.

basal ganglia Clusters of nerve cells located in the forebrain whose function is to regulate motor control

substantia nigra A midbrain structure composed of nerve cells that produce dopamine; associated with movement control

corpus striatum A midbrain structure composed of white and grey matter that contributes to the production of smooth, purposeful muscle movement

dopamine An excitatory chemical neurotransmitter produced in the brain; has a number of roles including producing feelings of pleasure and is associated with smooth, coordinated movement

bradykinesia Slowness of movement and gradual loss of spontaneous and voluntary movement

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4.7 CHECK YOUR UNDERSTANDING >>

1 Which of the following brain structures shows marked degeneration in Parkinson's disease?
   - A The hippocampus
   - B The amygdala
   - C The substantia nigra
   - D Dopamine

2 Which of the following statements about dopamine is correct?
   - A Dopamine inhibits the firing rate of neurons.
   - B Dopamine increases the firing rate of neurons.
   - C Dopamine is carried to the brain in the bloodstream.
   - D Dopamine is essential for involuntary muscle movement.

3 Which of the following brain structures produces dopamine?
   - A The corpus striatum
   - B The hippocampus
   - C The amygdala
   - D The cerebellum

4 Outline the role of dopamine in the development of Parkinson's disease.

5 Identify three major symptoms of Parkinson's disease.

RESEARCH APPROACHES TO PARKINSON'S DISEASE: ANIMAL STUDIES AND NEUROIMAGING TECHNIQUES

Neuroimaging studies have provided invaluable insights into the mechanisms underlying Parkinson's disease. At present, Parkinson's disease is incurable. It is always chronic and progressive. Fortunately, scientists have recently been able to apply a range of neuroimaging techniques to identify people with Parkinson's disease before they show marked symptoms of the disease. These techniques also allow neuroscientists to track the progression of the disease and to see the impact of treatments used.

DIAGNOSIS AND TREATMENT OF PARKINSON'S DISEASE

MRI imaging

One investigation reported in 2014 carried out by a research team at Oxford University described the development of a simple and quick MRI technique that offers promise for early diagnosis of Parkinson's disease. The team demonstrated that a new MRI approach can detect people who have early-stage Parkinson's disease with 85 per cent accuracy.

The Oxford researchers used an MRI technique called resting-state fMRI, in which people were required to stay still in the scanner. They used the data collected to look at the strength of brain networks in the basal ganglia. The team used the resting-state fMRI to study levels of brain activity that may suggest that Parkinson's disease is present. They compared one group of subjects with early-stage Parkinson's disease but not taking medication with a group of healthy people of similar age and gender. They found that the Parkinson's patients had much lower connectivity in the basal ganglia, a significant component of the brain's motor control systems.

In the future, this test may enable scientists to identify people at risk before symptoms take hold and develop treatments that can slow or halt the progression of the disease before it affects people significantly (University of Oxford, 2014).

4.2 TRY IT YOURSELF >>

FAMOUS PEOPLE

Many famous people have been diagnosed with Parkinson's disease, including Michael J. Fox (actor), Billy Connolly (actor and comedian), Muhammad Ali (world champion boxer), Johnny Cash (musician) and Pope John Paul II.

Choose one of these people (or research others) and conduct an Internet search to find out:

1 how old they were when diagnosed.
2 what symptoms they experienced.
3 how they are or were affected by Parkinson's disease.

PET imaging

Positron emission tomography (PET) is widely used in the diagnosis and treatment of Parkinson's disease. By providing an active three-dimensional image of the brain, PET imaging of the dopamine-producing areas in the brain makes it possible to assess changes in the activity and function of brain structures that produce dopamine, and therefore affect movement. PET imaging also allows neuroscientists to track the changes in cognitive structures of people with Parkinson's disease. This allows medical practitioners to fine-tune treatment to suit the specific needs of the individual.

One way PET imaging can be used to diagnose Parkinson's disease involves injecting a patient with an imaging drug, 18F-DOPA, which is chemically similar to dopamine. When the drug is fully absorbed in the patient's body, changes in their brain's

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dopamine-producing structures can be examined, specifically deterioration of the metabolic pathways in the substantia nigra, the area of the brain responsible for dopamine production. This information is particularly helpful in diagnosing whether a patient is suffering from Parkinson's disease or some other type of movement disorder that has similar symptoms. Early detection of the disease is important, as it allows the patient to receive treatment that may slow the progress of the disease.

4.8 CHECK YOUR UNDERSTANDING >>

1. In reference to Parkinson's disease, what do PET images of the brain allow neuroscientists to assess?
2. Parkinson's disease is described as a chronic, progressive neurodegenerative disease. What does this mean?
3. Explain how a PET procedure could be used to diagnose Parkinson's disease.
4. Why is it important to detect Parkinson's disease early?

RESEARCH USING ANIMAL MODELS AND PARKINSON'S DISEASE

As we have seen, neuroscientists use imaging techniques such as CT, MRI and PET scans to track the progress of many diseases. The images produced allow them to identify the nervous system structures that have been damaged, how the damage progresses, and what the physiological effect of treatment has been. The use of animal models in research has also allowed researchers to test the effectiveness and safety of medicines and treatments that target a specific disease before they are tried on humans.

There are usually two kinds of drugs involved in treatment for Parkinson's disease, and they are aimed at restoring the dopamine deficiency in the brain. One type of drug is able to cross the blood–brain barrier and be converted into dopamine by the brain; an example is levodopa (L-Dopa). The other type of drug is a group known as dopamine agonists; these stimulate the dopamine receptors of the brain, thereby mimicking the effect of dopamine. These medications can help to manage or alleviate symptoms, but they do not halt or slow the progression of the disease.

Existing treatments for Parkinson's disease are usually very effective initially. As the disease progresses, however, long-term use of drugs such as levodopa and dopamine agonists produce side effects that are sometimes even worse than the initial symptoms of the condition. One of these side effects is dyskinesia, a condition characterised by abnormal involuntary movements.

FOCUS ON RESEARCH 4.3

DOPAMINE AND PARKINSON'S DISEASE

In 2005, the *Archive of Neurology* reported the cases of 11 people with Parkinson's disease who had begun to show signs of pathological gambling after taking dopamine agonist medication. In seven patients, pathological gambling developed within 3 months of starting to take or escalating the dose of the agonist. The other four patients also reported compulsive gambling, but not until 12 to 30 months after beginning dopamine agonist therapy (Dodd et al., 2005). Of the seven patients who developed pathological gambling behaviour within 3 months, four had never gambled before taking the medication.

In one case, a 63-year-old man who had previously gambled about 4 times a year, and never to excess, began to gamble 2 or 3 times a week even when he logically knew he should not be doing so. In another case, a 50-year-old man who had never gambled in his life felt consumed by the need to gamble and spent days at a time at casinos.

Recent studies of people with Parkinson's suggest that newer and more powerful dopamine 'agonists', which bind to dopamine receptors on brain cells, are more likely to produce this 'ventral overdose' effect. A review in *Movement Disorders* in 2007 found that pathological gambling behaviour has been diagnosed two to eight times more frequently among Parkinson's patients who take these agonists than among the general population. Yet it is not easy to reconcile such an effect with current models of dopamine signalling.

Source: Schnabel, J. (2009, September 21). Gambling among Parkinson's patients raise questions about dopamine. *The Dana Foundation online*.

QUESTIONS

1. Write a possible hypothesis that may be tested in investigating the effects of dopamine of gambling behaviours in Parkinson's sufferers.
2. Identify one reason why the dopamine-agonist medication may increase the urge to gamble in people with Parkinson's disease.
3. Explain one extraneous variable that may account for the increase in gambling behaviours of people with Parkinson's disease.

blood-brain barrier A layer of tightly packed cells that make up the walls of brain capillaries and prevent potentially harmful substances in the blood from diffusing freely into the brain

levodopa (L-Dopa) A drug that the brain converts to dopamine; used to treat Parkinson's disease

dopamine agonists Drugs that mimic the effect of dopamine by activating dopamine receptors in the brain that would normally be stimulated by dopamine

dyskinesia A condition characterised by abnormal involuntary muscle movements

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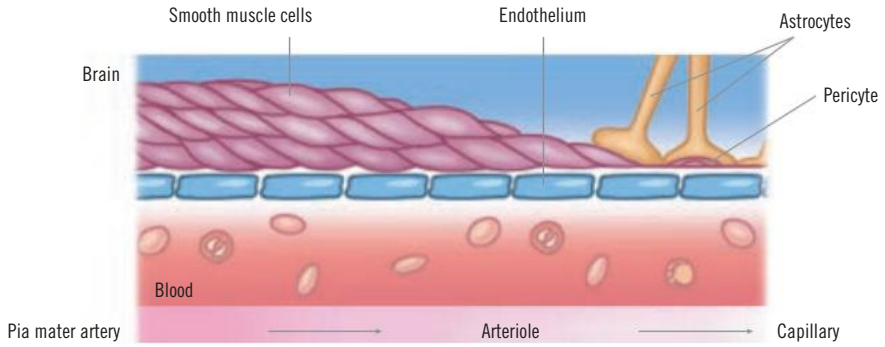


FIGURE 4.23 The blood–brain barrier is a brain structure made of capillaries whose walls are so tightly packed that they prevent harmful materials in the blood from entering the brain, but allow materials essential for brain function to enter the brain.

The blood–brain barrier and treatment of Parkinson's disease

The blood–brain barrier is a biological structure that alters the permeability of brain capillaries. It acts as a protective barrier for the brain because it prevents or slows the passage of potentially harmful materials (for example, viruses or elevated hormone levels) from the blood entering the brain, but allows others to cross and be absorbed by the brain's neurons.

The brain's neurons are fed by billions of blood vessels or capillaries. The blood–brain barrier is found in the capillaries on the brain's surface. Capillaries are minute blood vessels that distribute oxygenated blood from arteries to body tissue and feed deoxygenated blood from the tissues back into the veins. Normally, capillary walls are highly permeable to allow for a variety of substances in the blood to pass through into the body. In the brain, however, the capillary walls are lined on the inside with a compact, dense layer of specialised endothelial cells. This wall of tightly sealed cells prevents large molecules – that may threaten brain health because they are potentially toxic (such as bacteria, inflammatory cells and some chemical compounds) – from passing into or out of the bloodstream. Smaller molecules, such as those found in glucose (the brain cells' main fuel source), oxygen, hormones and amino acids easily cross the barrier.

By filtering what enters the brain from the blood, the blood–brain barrier helps to keep the environment in the brain as stable as possible. However, while the blood–brain barrier may prevent harmful substances from entering the brain, it also prevents them from leaving if they have managed to get in. This makes brain infections extremely difficult to treat.

Neuroscientists involved in researching treatments for Parkinson's disease are particularly interested in the blood–brain barrier because it affects the type of medications that can be given to those with Parkinson's disease. Researchers continue to develop drugs such as levodopa that can cross this barrier and help repair the brain.

4.9 CHECK YOUR UNDERSTANDING >>

1 What drug, first discovered in the early 1960s, is commonly used to treat Parkinson's disease?
   - A Chlorpromazine
   - B Levodopa
   - C Dopa-L
   - D Dopamine

2 If a neuroscientist took a PET scan of a person with Parkinson's disease, it would most likely show:
   - A a high level of activity in the substantia nigra.
   - B a low level of activity in the substantia nigra.
   - C a normal level of activity in the primary motor cortex.
   - D a high level of activity in the primary motor cortex.

3 The blood–brain barrier consists of:
   - A a layer of capillaries on the brain's surface.
   - B a layer of capillaries covering the substantia nigra.
   - C a layer of highly permeable capillaries.
   - D a layer of loosely packed capillaries.

4 What is the blood–brain barrier and how is it related to Parkinson's disease?

Using animals in treatment research

In 2000, Swedish pharmacologist Arvid Carlsson was awarded the Nobel Prize in Physiology or Medicine for his work on dopamine and its effects in Parkinson's disease. Before Carlsson's research findings, it was thought that dopamine affected the brain indirectly by stimulating brain cells to form another neurotransmitter, noradrenaline. In 1957, Carlsson demonstrated that dopamine was itself

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a brain neurotransmitter and that a shortage of dopamine leads to impaired movement and motor control. This finding led to the development of levodopa, a drug instrumental in the treatment of Parkinson's disease.

To research the role of dopamine in the brain's control of movement, Carlsson studied rabbits that had been given a drug that removed dopamine from their brain. The result was that the rabbits went into a complete physical trance and did not respond to stimuli. However, when he injected them with levodopa, a drug that the brain converts to dopamine, the rabbits' movement was restored (AnimalResearch.info, 2014). Carlsson's rabbit model showed that it was possible to influence brain function by using medicines that mimic the effects of dopamine (known as dopamine agonists) and change the way neurons transmit information .



FIGURE 4.24 Research models using rabbits as participants have proved valuable in establishing the role of dopamine in voluntary movement and the effects of levodopa on voluntary movement control.

Today, levodopa is widely used to control the symptoms of Parkinson's disease. Levodopa does not slow the progress of Parkinson's disease but it does help to reduce tremor, stiffness and slowness because it affects the way brain neurons communicate with each other. Levodopa also helps improve muscle control, balance and walking, but it does not affect muscle freezing, dementia or problems with involuntary functions, such as constipation and urinary problems. Unfortunately, the majority of people taking levodopa long-term develop complications from Parkinson's within 5 to 10 years, particularly movement problems. Fortunately, an alternative to levodopa as a treatment option for Parkinson's disease has been discovered, using monkeys as a research model. This treatment, which involves electrically stimulating brain areas that have become inactive in Parkinsons' sufferers, is discussed in the next section.

In other research into the role of dopamine, the brain and motor control, scientists examined the brains of pigeons. They discovered that dopamine was highly concentrated in the basal ganglia of the pigeon's brain. While it was already known that the basal ganglia are involved in motor functions, findings from the pigeon research led to the realisation that the cells of the basal ganglia die in people with Parkinson's disease, and this cell death causes a reduction in the production of dopamine.

If Parkinson's disease is related to insufficient levels of dopamine in the brain, why don't doctors introduce dopamine into the brains of Parkinson's sufferers? This is because dopamine is produced in the brain; it is not carried to the brain by the bloodstream. If a substance is injected into the bloodstream, in order for it to cross the blood–brain barrier, it has to be attached to a special protein transporter. Dopamine does not have a transporter so, even if it was absorbed into the bloodstream, it couldn't reach the brain. Levodopa, however, is a type of amino acid that does have a transporter so it can cross the blood–brain barrier. When levodopa enters the brain it is absorbed by the brain's nerve cells and converted into dopamine. When dopamine levels are raised, symptoms of Parkinson's disease (such as tremors, stiffness, spasms and poor muscle control) are relieved.

Levodopa does not slow the progress of Parkinson's disease, but it does improve muscle movement. However, many people who take levodopa for long periods suffer debilitating side effects, such as 'freezing' (a sudden but brief inability to start or continue a voluntary movement), when the drug's effects wear off (Abbott, 2010). Many medications used to treat Parkinson's disease are also suspected of

causing serious impulse control disorders including pathological gambling, hypersexuality, compulsive shopping, poriomania (wandering away from home), binge eating and kleptomania (Moon, 2014).

Monkeys: Deep brain stimulation (DBS)

Once scientists understood the role cell death in the basal ganglia (particularly in the substantia nigra) played in Parkinson's disease, they were able to replicate the disease in monkeys. After giving monkeys drugs that would cause cells in their basal ganglia to die so their dopamine levels dropped, scientists found that other regions of the brain became overactive in response to lowered signals from dopamine. Scientists realised that by stimulating these areas of the brain they could reduce the overactivity of these regions and relieve the symptoms of Parkinson's disease.

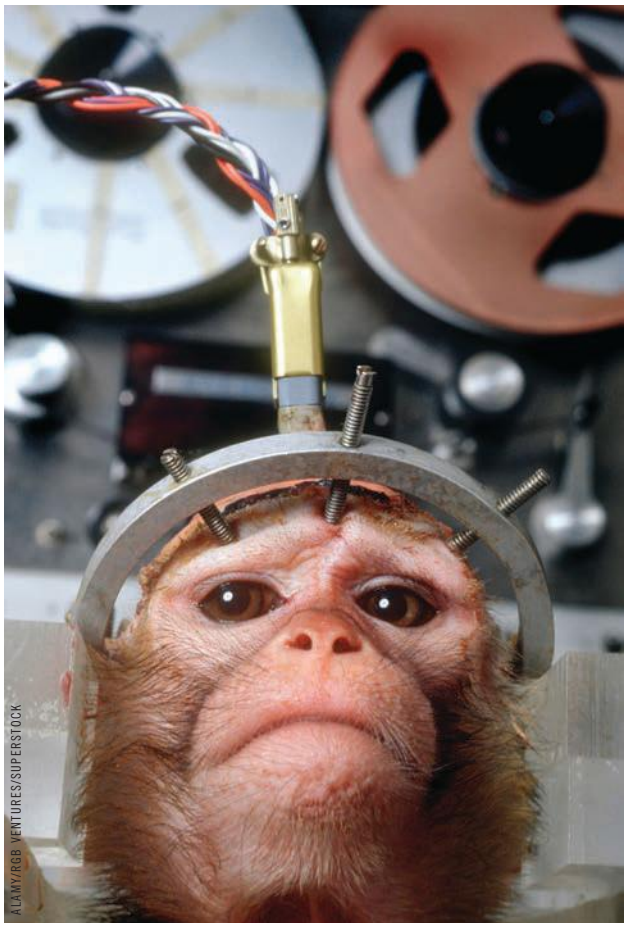


FIGURE 4.25 Monkeys are often used in research into causes and treatment for neurological diseases such as Parkinson's disease.

In order to stimulate these areas of the brain, researchers stimulated the monkeys' brains using a surgical treatment called **deep brain stimulation (DBS)**. Deep brain stimulation involves implanting a **neurostimulator** into the brain that is connected to a battery-operated device that sends electrical impulses to the targeted brain areas. When the neurons that controlled movement in the monkeys' brains were stimulated, the nerve signals that caused their tremor were blocked, alleviating this and other symptoms of Parkinson's disease.

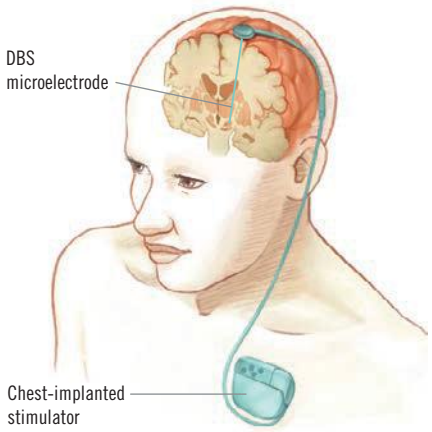


FIGURE 4.26 Deep brain stimulation involves implanting a battery-operated neurotransmitter deep in the brain to artificially stimulate basal ganglia neurons damaged by Parkinson's disease.

The development of deep brain stimulation was a major breakthrough in controlling and managing the symptoms of Parkinson's disease. Although most patients still require medication (usually levodopa) to help control Parkinson's disease after DBS, their symptoms are usually reduced and they are also usually able to reduce their intake of medications. Deep brain stimulation has the added benefit of being reversible and adjustable to the needs of the individual. Levodopa, dopamine agonists and DBS help manage the symptoms of Parkinson's disease; however, they do not stop the progression of the disease (Society for Neuroscience, 2012).

Animals and genetic modification

Research using a range of genetically modified transgenic organisms (including flies, nematode worms and mice) has helped advance our

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understanding of neurodegenerative diseases. Much of what we know about Parkinson's disease comes from models of the disease in animals; mostly models using mice and rats.

In one ground-breaking study, researchers at Mount Sinai School of Medicine used a mouse model to demonstrate how mutations in the LRRK2 gene may cause inherited Parkinson's disease. LRRK2 regulates dopamine transmission and controls motor performance. When it mutates, it loses this ability and results in Parkinson's disease. Previously, researchers knew that LRRK2 played a role in causing Parkinson's disease, but they did not have a suitable animal model with abnormal forms of the gene that would allow them to pursue the role of LRRK2 in the disease. By using the new mouse model, researchers were able to demonstrate that these mice also had a reduced production of dopamine as they aged. Thus, this model allowed them to study the potential root cause of the disease because it replicated the earliest stage of Parkinson's disease and gave an insight into how biochemical and molecular events contribute to the disease (Mount Sinai School of Medicine, 2010).


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FIGURE 4.27 The genetically engineered mouse on the right is two to three times more muscular than the normal mouse on the left. The more muscular mouse was created during research into gene manipulation, and researchers hope its creation will assist them to find more effective treatments for a range of movement disorders such as Parkinson's disease and muscular dystrophy.

In recent years, neuroscientists have also increasingly used pigs in research that models human brain disorders due to damaged brain tissue caused by diseases such as Parkinson's. Pigs are a suitable animal model because their brain resembles the human brain in anatomy, growth and development more than some small laboratory animals. The size of the pig brain also allows researchers to use neuroimaging techniques to locate and study cortical and subcortical structures.

Stem cell research

Stem cell research has been a hot topic in the science and political world for several years now. While the ethics around it are being debated, research, although limited, continues in some laboratories. Stem cells are immature cells that are undifferentiated, which means they have not yet acquired a special structure and function. Because stem cells do have the ability to differentiate, or transform, into other cells that have a specialised structure and function, they are of particular interest to neuroscientists, particularly those interested in neurodegenerative diseases such as Parkinson's disease.

Stem cell research has led to some success in reducing the symptoms of Parkinson's disease in rats. Many researchers now believe that transplanting embryonic stem cells into target cells in human Parkinson's disease patients may promote the regeneration of dopamine-producing cells (Parkinsons.org, 2012). PET scans have also allowed scientists to investigate the structures in the brain where dopamine is produced, helping them to further understand how Parkinson's disease affects the brain.

deep brain stimulation (DBS) A surgical procedure involving the implantation of a neurostimulator into the brain so electrical impulses can be delivered to specific parts of the brain to activate them

neurostimulator A small battery-powered device that delivers mild electrical currents to specific areas of the brain to stimulate targeted neurons

stem cells Immature cells that are undifferentiated and have not yet acquired a special structure and function

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4.3 TRY IT YOURSELF >>

INVESTIGATING STEM CELL RESEARCH

Stem cell research continues to cause controversy throughout the scientific community. Those who oppose it are particularly concerned about the ethical issues involved. Conduct an Internet search on stem cell research to find out:

1 what stem cell research involves
2 the possible advantages of stem cell research
3 the ethical concerns associated with stem cell research.

Then organise a class debate on whether stem cell research should continue.

4.10 CHECK YOUR UNDERSTANDING >>

1 Levodopa:
   - **A** is converted into dopamine by brain cells.
   - **B** allows dopamine to cross the blood–brain barrier.
   - **C** stops dopamine from destroying brain cells that control voluntary movement.
   - **D** reduces the deterioration rate of dopamine-producing cells in the brain.

2 Which of the following statements about levodopa is true?
   - **A** Levodopa slows the progress of Parkinson's disease.
   - **B** Levodopa helps to control the symptoms of Parkinson's disease.
   - **C** Levodopa is a brain neurotransmitter.
   - **D** Levodopa does not have long-term side effects.

3 Why are neuroscientists interested in investigating implanting stem cells in people with Parkinson's disease?

4 What is deep brain stimulation (DBS)?

5 How does DBS help patients with Parkinson's disease?

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CHAPTER SUMMARY

Brain development during infancy and adolescence

- The human brain begins development in the first few weeks of gestation and reaches maturity during early adulthood. The greatest period of brain development occurs during infancy when the brain creates more neurons than it needs to maximise the infant's learning potential.
- The development of myelin and the number and strength of synapses affects how efficiently and quickly information is transmitted.
- The brain automatically removes excess neurons so synaptic networks can expand to enable new learning to occur. This happens as a result of synaptic pruning, a process that occurs throughout the lifespan but is greatest during adolescence.
- Development does not occur evenly throughout the brain. The frontal lobes are the last to mature. This happens in early adulthood.

Brain injury, loss of function and recovery due to plasticity

- If the brain's cerebral cortex is injured, loss of function may follow. The functional loss depends on which area is damaged and how severe the damage is. Damage to the frontal lobe can cause a range of psychological, emotional and behavioural problems.
- Because of its plastic nature, the brain has the ability to change its structure and relocate functions to different areas and neuronal networks following brain injury.
- Developmental plasticity refers to changes in neural connections during development as a result of environmental interactions as well as neural changes due to learning. Developmental plasticity is specific to the change in neurons and synaptic connections as a consequence of developmental processes.
- Adaptive plasticity refers to changes in neural connections in response to changing environmental conditions (such as brain injury) as well as neural changes induced by learning. Rehabilitation programs rely on the processes of adaptive plasticity to restore function lost as a result of brain injury.

Research based on animal studies and neuroimaging techniques

- Animal models are used in brain research when the research is too dangerous to use human participants. Animal models also allow researchers to test any new medications or therapies before they are tried on human participants. All studies using non-human animal participants must follow strict ethical guidelines designed to protect participants.
- Neuroscientists also use a range of neuroimaging techniques when they diagnose and treat neurological disorders. These techniques provide images of the brain structures that are damaged and the level of damage sustained at a point in time. They also provide images of the level of functioning of these brain structures and this is very useful in determining the effect of a therapy or medication.

Parkinson's disease

- Parkinson's disease is a progressive, degenerative neurological disorder that affects the control of muscles. It is caused when brain cells responsible for the production of dopamine deteriorate. Dopamine is a neurotransmitter produced in the brain that influences movement control.
- The major physical effects of Parkinson's disease include tremor, muscle stiffness, slowness of movement and gradual loss of spontaneous movement.
- Parkinson's disease is incurable but deep brain stimulation (DBS) and medications such as levodopa and dopamine agonists help to control its effects.
- Animal research using rabbits, monkeys and mice has aided scientific knowledge about Parkinson's disease, as has neuroimaging.
- Research into the use of stem cells to treat Parkinson's disease continues.

APPLY YOUR KNOWLEDGE AND SKILLS

SECTION A: MULTIPLE-CHOICE QUESTIONS

Answer the following questions by writing the correct letter in your workbook. Only one answer is correct for each question.

1 Behaviours dependent on maturation:
- **A** are unique to the individual.
- **B** can be strengthened through practice.
- **C** are predictable.
- **D** are accelerated by puberty.

2 Which of the following processes results in the encasing of axons in a protective, fatty substance?
- **A** Insulation
- **B** Gestation
- **C** Axonisation
- **D** Myelination

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3 Synapse formation can occur:
- **A** at any time in a healthy person's life.
- **B** only during infancy.
- **C** only during adolescence.
- **D** only after brain damage.

4 Apoptosis is a natural brain process that enhances brain development by:
- **A** reducing the number of synapses so information can be transmitted more efficiently.
- **B** increasing the number of synapses so information can be transmitted more efficiently.
- **C** reducing the number of neurons so information can be transmitted more efficiently.
- **D** increasing the number of neurons so information can be transmitted more efficiently.

5 What is the principal role of the frontal lobes?
- **A** Planning
- **B** Regulating emotional and social behaviour
- **C** Initiating voluntary movement
- **D** All of the above

6 Where in the brain is Wernicke's area located?
- **A** The left frontal lobe
- **B** The left temporal lobe
- **C** The right frontal lobe
- **D** The left frontal lobe

7 In reference to the brain, pruning refers to:
- **A** the reduction of neurons during brain development.
- **B** the reduction of synaptic connections during brain development.
- **C** the frontal lobe being the last area of cortical development.
- **D** the loss of synaptic connections due to brain injury.

8 Following brain damage, _____ allows the brain to reroute neural circuits so a different brain area can take over a function that was lost.
- **A** developmental plasticity
- **B** synaptic pruning
- **C** adaptive plasticity
- **D** selective pruning

9 An infant's brain is:
- **A** smaller and more plastic than an adult's brain.
- **B** smaller and less plastic than an adult's brain.
- **C** smaller than an adult's brain but it has the same amount of plasticity.
- **D** smaller than an adolescent's brain but it has the same amount of plasticity.

10 When we learn something new, the neural pathways in our brain are changed. This change is represented by:
- **A** a decrease in the number of neurons.
- **B** an increase in the number of neurons.
- **C** an increase in the strength of synapses.
- **D** a decrease in the strength of synapses.

11 Parkinson's disease results from the death of neurons that produce:
- **A** serotonin.
- **B** thiamine.
- **C** amino acids.
- **D** dopamine.

12 Which of the following is not a symptom of Parkinson's disease?
- **A** Early memory loss
- **B** Tremors
- **C** Muscle rigidity
- **D** Spatial neglect

13 Which of the following brain imaging technologies would not provide useful information about the activity of brain neurons damaged by Parkinson's disease?
- **A** PET
- **B** fMRI
- **C** CT scan
- **D** All of the above

14 Bradykinesia is an indicator of Parkinson's disease. If a person had bradykinesia, they:
- **A** would invent information to fill in gaps in memory.
- **B** gradually lose their ability to produce spontaneous movement.
- **C** have very low thiamine levels.
- **D** have reduced impulse control levels.

15 Deep brain stimulation has proved useful in the treatment of Parkinson's disease because it:
- **A** stimulates the dopamine-producing cells in the brain.
- **B** stimulates the thiamine-producing cells in the brain.
- **C** reduces the activity of brain areas that become overactive when dopamine levels drop.
- **D** reduces the activity of brain areas that are underactive because dopamine levels have dropped.

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SECTION B: SHORT-ANSWER QUESTIONS

1 Describe the three major processes that contribute to brain formation.

2 Identify two problems a person might experience if they damaged their right somatosensory cortex.

3 Identify two psychological and two physiological changes you might observe in someone who had frontal lobe damage.

4 Jerome suffered a stroke that damaged his left frontal lobe, specifically his Broca's area. Describe how Jerome will be affected by this damage.

5 In terms of brain development, why is it easier for a child to learn a language or a musical instrument than an adult?

6 Identify two reasons why neuroscientists researching new treatments for neurological disorders might prefer to use animals as participants in their investigations.

7 Explain how the blood–brain barrier protects the brain.

8 Explain how dopamine agonists (drugs that mimic the effect of dopamine) help to reduce the effects of Parkinson's disease.

9 Identify one advantage and one limitation of using an MRI during diagnosis and treatment of Parkinson's disease.

10 A neurosurgeon wants to carry out experimental brain surgery on one of their patients who suffers from Parkinson's disease. The neurosurgeon wants to use deep brain stimulation to control the effects of the disease. Identify and explain two ethical principles the neurosurgeon must follow. Explain what they would have to do to follow these principles.

SECTION C: EXTENDED-RESPONSE QUESTION

A group of neuroscientists were interested in the effect that early alcohol use has on the effect of decision-making in later life. They wanted to determine whether the younger a person was when they first experienced alcohol was related to the development of problems with alcohol-related risk-taking and decision-making in adulthood.

In a study to test the effect of alcohol on brain chemistry, researchers used two groups of rats 30 to 50 days of age, the equivalent of the teen years in humans. One group was given alcohol-laced jelly cubes, the other group was given jelly cubes that had no alcohol. During the experiment, the rats were given access to the jelly cubes 24 hours per day.

Once the rats reached adulthood, they were given tests offering the opportunity to take a low risk to get a small treat or take a much higher risk to get a larger treat. The rats exposed to alcohol-laced jelly cubes were consistently more inclined to take the high-risk, high-reward option, even when the safer option would have given them more treats overall.

You are now preparing to write a report on this experiment. Complete the following tasks in preparation for your report writing.

1 Write a title for the report.

2 Create a suitable hypothesis for the experiment.

3 Identify the population of research interest.

4 Identify the type of research design chosen by the researchers and identify one advantage and one limitation of this design.

5 State the conclusion(s) the researchers could draw from their results.

This question is worth 10 marks.

SECTION D: ASSESSMENT TASK

MEDIA RESPONSE

You are to present a media response on Parkinson's disease that informs your audience of each of the following points (1–4).

1 What Parkinson's disease is and what its known causes are

2 The areas of the brain affected by Parkinson's disease and the imaging technologies that have been useful in identifying the causes of Parkinson's disease

3 The changes in function that a person might experience if they had developed Parkinson's disease

4 Some treatment options that are currently available

Your presentation can take the form of:

- a feature article for a major newspaper
- a script for a television or radio news report.

CHAPTER 05

THE COMPLEXITY OF PSYCHOLOGICAL DEVELOPMENT



KEY KNOWLEDGE INCLUDES:

- the interactive nature of hereditary and environmental factors on a person's psychological development, illustrated through twin and adoption studies
- the role of critical and sensitive periods in a person's psychological development
- the importance of attachment on an individual's emotional development: genetics; temperament and early life experiences (with reference to the work of Harlow & Ainsworth)
- the development of cognitive abilities from concrete to symbolic thinking (with reference to the work of Piaget)
- psychosocial development across the lifespan as an influence on the development of an individual's personality (with reference to the work of Erikson).

Psychology Area of Study Key knowledge points derived from *VCE Psychology Study Design 2016*, p.15; © The Victorian Curriculum and Assessment Authority (VCAA). Used with permission.

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FACTORS INFLUENCING PSYCHOLOGICAL DEVELOPMENT

Psychologists have traditionally focused their attention on the development occurring in early life stages as these changes generally provide a basis for future development and behaviour. However, development does not stop once an individual reaches a certain age; it continues throughout the lifespan.

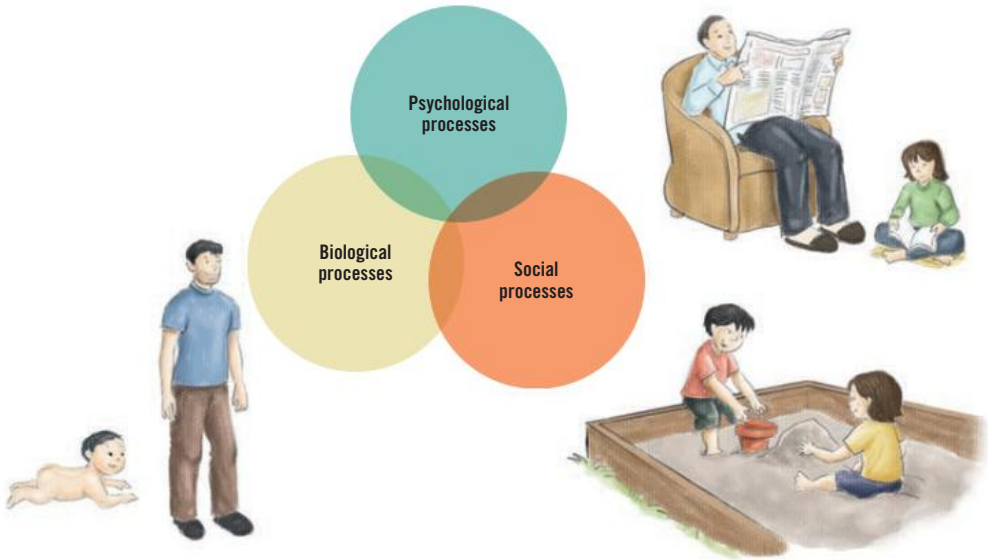


FIGURE 5.1 Changes in development are the result of biological, psychological and social processes. These processes are interrelated in the development of the individual throughout the lifespan.

Even though each of us can take pride in being 'one of a kind' as there is no such thing as a 'typical person', broad similarities can be found during each stage of life. Different factors influence the way an individual develops. The psychological development of an individual involves complex interactions between biological, psychological and social factors (see Figure 5.1). Biological factors include genetics and hormones and how bodily functions influence behaviour. Psychological factors include our thought processes such as our self-concept and how we take in and use information. Social factors include the interactions we have with others. All of these factors influence development and they all operate in an interrelated manner, influencing the contribution of the other factors.

THE 'NATURE VERSUS NURTURE' DEBATE

The terms 'nature' and 'nurture' are used in psychology to describe two major forces in the development of humans (and other animals). Psychologists have long debated whether nature (inherited factors) or nurture (environmental factors) has a greater influence on development. Most psychologists today would agree that there is interaction between both inherited factors and environmental factors in the development of an individual.

NATURE: INHERITED FACTORS INFLUENCING PSYCHOLOGICAL DEVELOPMENT

Nature refers to the inborn, inherited factors gained genetically from biological parents. An incredible number of personal features are set at conception when a sperm and an ovum (egg) unite and the genetic components of an individual are formed. For example, a characteristic such as eye colour is genetically determined by the genes inherited from biological parents. Some of these genetic characteristics are set, such as eye colour; other characteristics, such as height, are influenced by environmental factors as well as by genes.

Genes: How they affect inherited characteristics

Genes are contained within the DNA of every cell in the body and are inherited from a person's biological parents. The genetic material is arranged within the

nature The inborn, inherited factors gained genetically from biological parents

genes Contained within the DNA of each cell in chromosomes, provide pattern for RNA to produce the protein molecules called amino acids

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DNA in structures called chromosomes. A typical human cell has 46 chromosomes, or 23 pairs (see Figure 5.2). In each pair, one chromosome is inherited from the biological mother and the other from the biological father. Males and females have the same chromosomes, except for the sex chromosomes, in which the male has XY and the female has XX chromosomes.

DNA exists in the nucleus of every cell, where it serves as a template or pattern for the production of another molecular structure called RNA. The RNA produces the protein molecules, which are long chains of smaller molecules called amino acids. There are 20 different amino acids, and they can be arranged in numerous sequences to make up different protein molecules. The expression of a gene (DNA) results in the production of a protein molecule and these proteins are involved directly in the physical development of the body (Gray, 1994).



FIGURE 5.2 The 22 numbered chromosome pairs in the human body and the sex chromosomes

Sometimes genes are referred to being 'for' a particular characteristic or behaviour. This is not how our genes work. Genes contribute to different behaviours, but not as directly as this statement would suggest. There are no genes 'for' aggression, rather a gene may affect aggressive behaviour by promoting growth in the systems of the brain that respond to annoying external stimuli and that organise aggressive behaviour (Gray, 1994). There are some well-studied genetic disorders, such as Down syndrome, that occur because of atypical chromosome formation. People with Down syndrome have an extra chromosome – 47 instead of the typical 46. Geneticists have been able to identify the extra chromosome 21, and that is why the disorder is sometimes called 'trisomy 21'. Having the extra chromosome 21 will lead to some characteristic physical features, health development challenges and some level of intellectual disability. Though as each person has other genes that will differ, and different environmental factors affecting them, people with Down syndrome vary from person to person (Down Syndrome Australia, n.d.).

An individual's genotype refers to the set of genes that are inherited from their biological parents. The term phenotype refers to the observable properties of the body and behavioural traits. The same genes can have different effects on an individual's phenotype depending on the environment and the mixture of other genes. Take biological siblings, for example. They would share some of the same genes, but also have different genes and environmental experiences. Therefore, the phenotype can have some similarities and some differences. Identical twins share the same genes but will often differ in their phenotype because of the influence the environment has on the way genes are expressed. For example, one of the twins may prefer highly fatty food and exercise irregularly, whereas the other may eat more healthy foods and exercise regularly. Even though both individuals will share the same genes, their phenotype will differ and so they will look different in some ways (see Figure 5.3).



FIGURE 5.3 Identical twins will have the same genotype but differing phenotype because of exposure to different environmental influences.

Hormones

Hormones are chemical substances secreted into the bloodstream from various glands as a way for the body to adapt to different conditions. Specialised cells within the glands can sense when there is an imbalance in minerals, water, heat and so on in the body and hormones are released to target the problem, returning the body to balance (homeostasis). As well

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as playing a role in maintaining the body's internal balance, hormones have a role in initiating, mediating and regulating the process of growth, development, maturation, reproduction and senescence (biological ageing) (Berne & Levy, 1996).

Some genetic diseases can cause abnormal production (either too much or not enough) of hormones that can impact on typical developmental processes. Hypothyroidism, for example, is a disorder whereby the body does not produce enough thyroid hormone to adequately keep the body at homeostasis. The thyroid hormone is critical for the development of the central nervous system and it helps the body use energy, stay warm and keep the brain, heart, muscles and other organs functioning as they should. If thyroid hormone is deficient while a baby is in the womb, then the growth of the cerebral cortex, proliferation of axons, branching of dendrites and myelinisation of neurons can all be impaired. If the deficiency in thyroid hormone is not treated in young children, then they could suffer from irreversible brain damage and delayed developmental milestones, such as sitting, standing and walking. In older individuals, a lack of thyroid hormone can cause lethargy, decreased sweating, weight gain and low heart rate (Berne & Levy, 1996). The cause of hypothyroidism is more often environmental (such as lack of iodine in the food consumed), but it can be genetic or caused by other genetic disorders. About 1 in 5000 babies are born with congenital hypothyroidism; that is, they have either been born without a thyroid gland, or the gland fails to develop normally to produce enough hormone. There is no known cause of congenital hypothyroidism in most cases. However, a small number of cases (approximately 10 to 20 per cent) are caused by an inherited defect of a particular gene (chromosome 2) that plays a role in thyroid production (Genetic Science Learning Center, 2014).

NURTURE: ENVIRONMENTAL FACTORS INFLUENCING HUMAN DEVELOPMENT

Nurture refers to the environmental or external conditions that affect an individual's development. These are the experiences we have or the stimuli we are exposed to that influence or help to shape us. The care we are given as a child in terms of food, education, love and support received from our environment are all examples of nurture.

Whether an individual is exposed to an 'enriched' environment or a 'deprived' environment may impact on their development and, therefore, their behaviour. An enriched environment is one in which all of the basic needs and more are provided, such as nutrition, education and love, so that exposure to stimuli in the environment positively contributes to the growth and development of the individual.

A deprived environment, on the other hand, would be one in which basic needs are lacking, so that the individual is not exposed to stimulation to allow normal growth and development. An example may be an individual who does not receive an adequately nutritious diet to enable normal development, or a lack of some sensory stimulation from the environment such as a child not being exposed to language by their caregivers or socialised to learn how to interact with others.

The negative impact on growth and development caused by deprivation can depend on when the deprivation occurs and whether there are any interventions in place to overcome particular issues in the development process.

Research into the effect of nature and nurture on development suggests that the environment in which a child is raised can have a powerful impact on their physical, cognitive (intellectual) and emotional development. The lasting effect of early experiences, in particular, has been demonstrated by studies of abused children who often exhibit lifelong emotional problems (Rutter, 1995). However, research also suggests that extra care given to an abused child can sometimes reverse the effects of a poor start in life (Bornstein, 1995). These findings suggest that although we may be born with certain capacities (genetics), environmental forces play a crucial role in determining how these capacities actually develop – or whether they develop at all.

genotype A set of genes that are inherited from biological parents

phenotype Refers to observable properties of the body and behavioural characteristics

hormones Chemical substances that are released into the bloodstream from glands so that any imbalance in the physical system can be overcome

hypothyroidsim A disorder causing underproduction of the thyroid hormone, resulting in imbalance of the physiological systems

nurture The environmental or external conditions that affect an individual's development

For typical development to occur, the human brain and nervous system requires genetic signals from the DNA to develop normally, as well as essential environmental stimulation and input. If either inherited factors or environmental factors are lacking, then the result may be that the individual does not develop normally or typically. The relative impact of nature and nurture is difficult to ascertain given it is almost impossible to separate the effects of one over the other. Next, we look at the research using twin and adoption studies that highlight the interactive nature of the inherited and environmental factors on development.

5.1 CHECK YOUR UNDERSTANDING >>

1 A genotype refers to:
   - A the observable properties of the body and behavioural traits.
   - B the type of influence the environment has on the body.
   - C the genes that are inherited from biological parents.
   - D the environmental conditions at birth when the genes are being made.

2 The term nature is used to describe:
   - A the environmental conditions of an individual.
   - B a range of behaviours the individual can exhibit.
   - C the learned and inherited factors gained genetically from biological parents.
   - D the inborn, inherited factors gained genetically from biological parents.

3 What do psychologists mean by the term 'nurture'?

4 How do hormones influence human physiology?

5 Give an example of how inherited and environmental factors may influence change in human development.

TWIN AND ADOPTION STUDIES

In a twin study, the behaviour of identical twins is compared with the behaviour of fraternal twins. Identical twins develop from a single fertilised egg that splits into two, resulting in two halves that are identical replicas (genetically the same) and each half becomes a foetus. Fraternal twins, on the other hand, develop in the womb at the same time from separate eggs and from separate sperm. Fraternal twins are no more alike genetically than are brothers and sisters.

Twin studies have commonly been used to compare the relative influences of hereditary and environmental influences on intelligence. Most people are aware of a moderate similarity in the intelligence of parents and their children or of brothers and sisters. The closer two people are on a family tree, the more alike their intelligence quotients (IQs) are likely to be. The correlations grow smaller as the genetic similarity lessens (see Figure 5.4). A shared environment increases the correlations in all cases (Bouchard, 1983; Henderson, 1982).

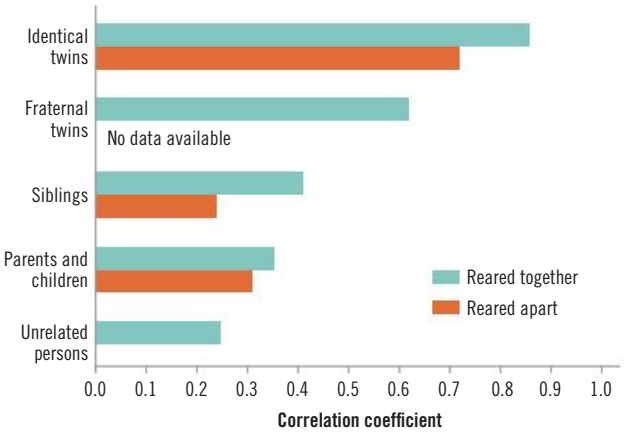


FIGURE 5.4 Hereditary influences – approximate correlations between IQ scores for people with varying degrees of genetic and environmental similarity (Bouchard 1983; Henderson 1982)

A person's IQ is a score derived from achievement on a standardised test for intelligence. An IQ shows how an individual has achieved on the test in comparison to others. The IQ scores of non-identical twins (fraternal twins) are more alike than those of ordinary brothers and sisters. Fraternal twins develop from two separate eggs fertilised at the same time, so they are no more genetically alike than ordinary siblings. Some psychologists believe the reason is environmental: parents treat twins more alike than ordinary siblings, resulting in a closer match in IQs.

More striking similarities in IQ are observed with identical twins, who develop from a single egg and have identical genes. Identical twins who grow up in the same family have highly correlated IQs. This is what we would expect with identical heredity and very similar environments. When identical twins are reared apart, the correlation drops, but only from 0.86 to 0.72. Psychologists who emphasise genetics believe figures like these show that differences in adult intelligence are due to heredity approximately 50 per cent of the time (Neisser et al., 1996; Casto, DeFries, & Fulker, 1995; Plomin & Rende, 1991).

Psychologists who emphasise the impact of environmental factors point out that some separated twins differ by as much as 20 IQ points. In every case in which this occurs, there are large educational and

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environmental differences between the twins. Also, separated twins are almost always placed in homes socially and educationally similar to those of their birth parents. This would tend to inflate apparent genetic effects by making the separated twins' IQs more alike. Another frequently overlooked fact is that foetal twins develop in the same environment before birth (in the same womb). If this environmental similarity is taken into account, intelligence would seem to be less than 50 per cent heredity (Devlin, Daniels, & Roeder, 1997).

Strong evidence for an environmental view of intelligence comes from adoption studies – the study of families who have one adopted child and one biological child. With an adopted child, a parent can only contribute the environment (see Figure 5.5). If intelligence is highly genetic, the IQs of biological children should be more like their parents' IQs than are the IQs of adopted children. However, studies show that children reared by the same mother resemble her in IQ to the same degree regardless of whether they share her genes (Weinberg, 1989; Kamin, 1981; Horn, Loehlin, & Willerman, 1979). In this case, the environment of the model and the mother's influence (her nurturing) have a greater influence on the children.

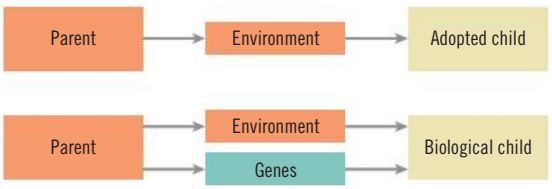


FIGURE 5.5 Comparison of an adopted child and a biological child reared in the same family

Psychologists also study the IQ results of children adopted by parents of high and low socioeconomic status. Children who grow up in high socioeconomic homes develop higher IQs than those reared in low socioeconomic homes. Presumably, the homes with a higher socioeconomic status offer an enriched environment, with better nutrition, greater educational opportunities and other advantages (Capron & Duyme, 1992). Overall, it has been found that genetic similarity among white middle-class family members appears to go hand in hand with intellectual similarity (Grigorenko, 2000, cited in Cianciolo & Sternberg, 2004, p. 97).

A particularly striking environmental effect is illustrated by the fact that 14 nations have shown average IQ gains of from five to 25 points over a recent 30-year period (Horgan, 1995; Flynn, 1987, 1990). These IQ boosts, averaging 15 points, occurred in too short a time for genetics to explain them. It is more likely that the gains reflect environmental forces, such as improved education and nutrition, and living in a technologically complex society (Horgan, 1995).

Educational experience can also have a large influence on IQ. Dropping out of school early can reduce a person's adult IQ by up to 24 points. Conversely, IQ rises as people spend more time in school (Ceci, 1991). This is another clear sign that improved environments can raise intelligence.

Few psychologists seriously believe that heredity is not an important factor in intelligence, and all acknowledge that environment also affects intelligence. Although estimates of the influence of heredity and environment continue to vary, ultimately both camps agree that improving social conditions and education can raise intelligence.

Although there is probably no limit to how far an IQ can drop in an extremely poor environment, heredity does seem to impose upper limits on IQ, even under ideal conditions. Gifted children tend to come from environments where parents spend time with their children, answer their questions and encourage intellectual exploration (Snowden & Christian, 1999).

The fact that intelligence is partly determined by heredity tells us little of any real value because genes are fixed at conception. Improving the environments in which children learn and grow is the main way in which we can assure that they reach their full potential (Turkheimer, 1998). It might help to think of inherited intellectual potential as a rubber band that is stretched by outside forces. A long rubber band may be stretched more easily, but a shorter one can be stretched to the same length if enough force is applied. Of course, a superior genetic gift may allow for a higher maximum IQ. In the final analysis, intelligence reflects development as well as potential, nurture as well as nature (Rose, 1995; Weinberg, 1989).

twin studies Research into the effects of hereditary and environmental influences on development using identical and fraternal twins

identical twins Siblings developed from a single fertilised egg that splits into two halves that are genetically identical

fraternal twins Siblings who develop in the womb at the same time, but come from separate eggs and sperm

intelligence quotient A score achieved on a standardised intelligence test relative to how others achieved

adoption studies Research into the effects of hereditary and environmental influences on development using adopted and non-adopted siblings and children

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Critics have suggested that these studies may be flawed in some ways, as in some cases the twins were together several months before adoption, adoption agencies attempted to place the twins in similar homes and even complete strangers, if brought together, are likely to find some similarities in their lives. However, these studies highlight the increased interest in the genetic basis of human development and the need for further research into genetic and environmental factors affecting human development (Bouchard et al., 1996; Wilcox & Bouchard, 1996).

5.1 FOCUS ON RESEARCH

TWIN STUDY: THE TWO JIMS

Jim Springer and Jim Lewis are identical twins who were separated at 4 weeks of age and reunited at the age of 39 years. When they were brought together, there appeared to be some uncanny similarities between the twins. Both worked as part-time deputy sheriffs, spent their holidays in Florida, owned dogs named 'Toy' and drove the same type of car. One twin named his son James Allan and the other named his son James Alan. Both men married and divorced women named Betty (Santrock, 1997). They shared a dislike of spelling, but liked maths. They both enjoyed carpentry and mechanical drawing, had almost identical smoking and drinking habits and chewed their fingernails down to the quick. Both men suffered from haemorrhoids and gained 4 kilograms at the same point in their development.

The Jims were not similar in all facets of their lives: one expressed himself better orally and the other was better at writing. They wore their hair completely differently. One Jim preferred to wear his hair slicked back with sideburns, and the other wore his over his forehead.

Jim and Jim are just one set of twins who took part in the Minnesota study of twins reared apart, which was directed by Thomas Bouchard and colleagues. In this study, fraternal and identical twins from all over the world were brought to the University of Minnesota to investigate their lives. The study included personality testing, medical tests and history and personal information about diet, smoking and exercise habits (Bouchard, Lykken, Mcgue, Segal & Tellegen, 1990).

QUESTIONS

1. The Two Jims is an example of a case study. What is an advantage of using this type of research method and what is a limitation of the method?
2. Can any conclusions regarding the influence of hereditary and environmental influences on development be made from studies of people like the two Jims? Why or why not?
3. Define the terms 'validity' and 'reliability'. Does the case study of the two Jims provide valid and reliable data? Why or why not?

5.2 CHECK YOUR UNDERSTANDING >>

1 Fraternal twins:
   - A are genetically identical.
   - B develop in the womb from the same egg and sperm.
   - C are more alike genetically than other siblings as they shared the womb at the same time.
   - D develop in the womb from separate eggs and sperm.

2 Research into the hereditary influences on IQ have found that:
   - A people who are unrelated usually have very similar IQ.
   - B people with higher IQ would usually have a greater chance of having family members with high IQs too.
   - C there is no correlation between IQ and a person's genetics.
   - D children will not have an IQ similar to their parents.

3 Why are identical and fraternal twins used as research participants into the effects of heredity on development?

4 What is one criticism of using an adoption study to research the effects of nature and nurture?

5 How do hereditary and environmental factors influence development?

TYPICAL DEVELOPMENT

Maturation refers to the biological growth processes that begin at conception and lead to the maturity of the organism. These innate changes occur in the body, brain and nervous system automatically in an orderly sequence at about the same time for most members of a species. Because these changes are innate, they are not overly influenced by environmental experiences.

Many of our basic abilities are closely tied to maturation. For example, children generally begin to sit without support, then crawl, and then stand before they start walking. These physical and motor abilities become evident only when the child has developed the necessary strength and coordination to complete such tasks. Until a toddler's body is physically mature enough to walk, 'practice walking' has little effect. In this sense, maturation also makes new behaviours possible.

Although the rate of maturation can vary greatly among children, generally the order of maturation is the same for all. The age at which the ability develops is also reasonably predictable. This predictability enables psychologists to establish developmental norms (see Figure 5.6). If a child is well outside of a developmental

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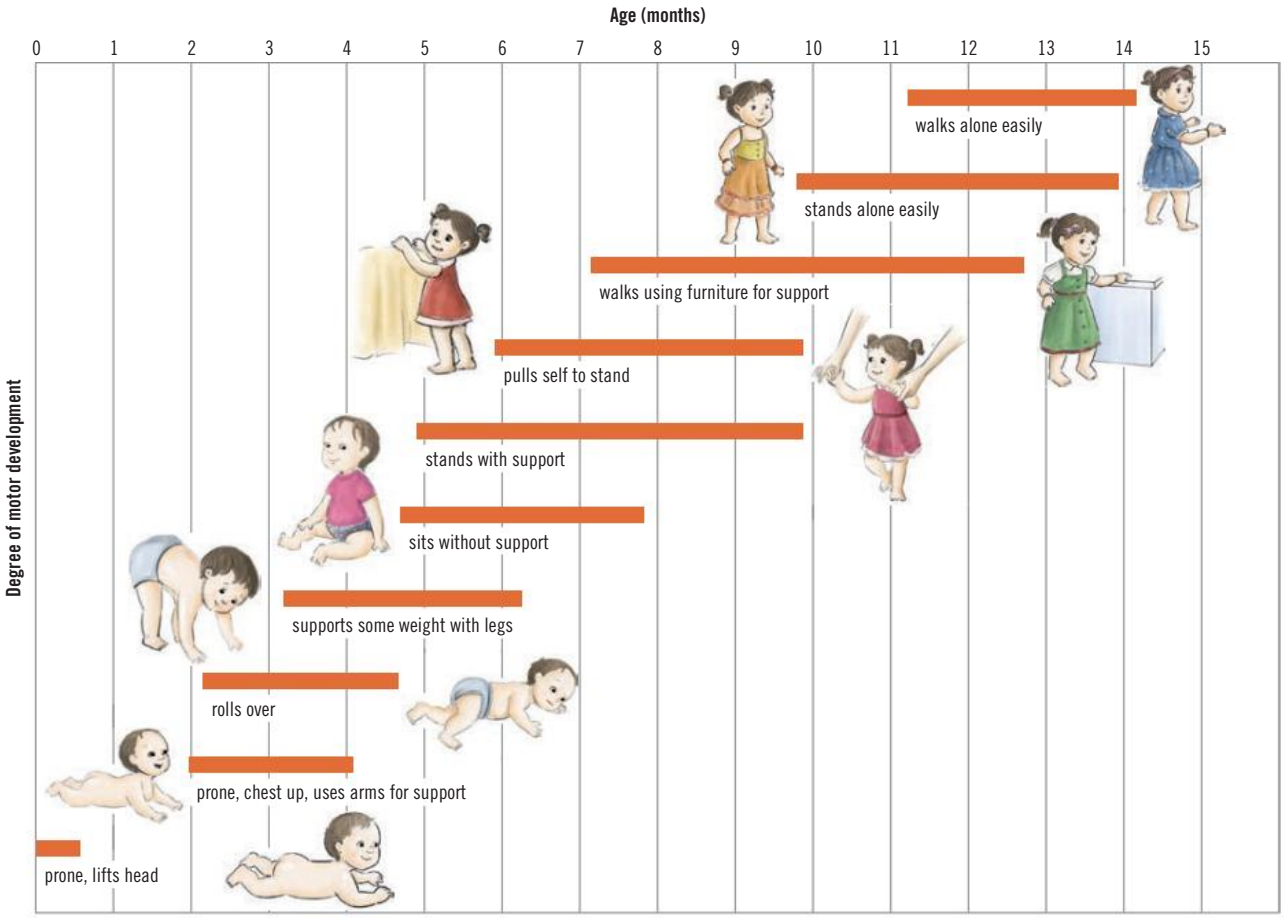


FIGURE 5.6 Most infants develop the same motor skills at approximately the same age. However, while the order of developmental stages is similar, it is not unusual for infants to display these skills 1 or 2 months earlier or later.

norm, a health professional may look to environmental (nurture) and genetic and hormonal (nature) factors that are contributing to the delay.

Developmental norms are approximate ages when an average individual is expected to reach the various milestones of development. To establish a developmental norm for a population, you would need to take a representative sample of people from the population and test for a certain characteristic or behaviour, then calculate the 'average' score or what is typical for this smaller group. As the sample group is representative, it is unnecessary to measure or test all of the population.

These norms do not predict information such as the specific day on which a child will sit, crawl or walk unaided, or when a woman will start menopause, and they do not explain unique individual development. However, because they are descriptive, they suggest patterns that add to our understanding of typical and atypical human development and behaviour.

Developmental norms are useful because they allow psychologists to compare an individual's development with others in the same age group. They alert us to extremes and provide a framework for identifying abnormal development. For example, nerve or muscle damage may not be discovered until a parent notices that a baby has not tried to talk by the time they are 20 months old. However, a child who develops more slowly than the norm will not always lag behind. It is often said that Albert Einstein did not begin to talk until he was 3 years old – a year and a half late according to most norms.

Maturation is not necessarily the strongest influence on how an individual will develop. Although physical maturation clearly affects our development, the characteristics we inherit from our parents, and the experiences we have during as well as after our birth also have an impact.

maturation The physical growth and development of the body, brain and nervous system at fairly predictable stages in the lifespan

developmental norms A period of time in which the majority of people develop certain skills or abilities

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5.1 TRY IT YOURSELF >>

WHICH FOOT IS NORMAL?

You will need a ruler or tape measure for this activity.

1. As a class, each person takes a measurement of their left foot (alternatively it could be the right foot, but it must be the same foot in all cases).
2. Collate the data by adding up all of the measurements and dividing the total by the number of participants to obtain an average or mean score.
3. Plot these data on a graph. The mean score will be your class 'norm' for left (or right) foot size.
4. Discuss any possible difficulties of using only your class to obtain the 'norm' for foot size.
5. Write a paragraph explaining how foot size is influenced by hereditary and environmental factors.

TIMING OF EXPERIENCES ON PSYCHOLOGICAL DEVELOPMENT

When psychologists discuss maturation they focus on behaviours that occur at a particular time in an organism's development. These developmental activities are defined by how ready, or mature, the central nervous system and the body are to demonstrate a specific behaviour. The timing or stage of the lifespan of this development can be important for typical development to occur. Psychologists have classified periods of development as either occurring in a critical period or a sensitive period.

Sensitive periods

A sensitive period of development is the ideal time in which to learn a specific behaviour. In other words, it is a period of time during development when an organism is mature enough to demonstrate a behaviour, and it is the best time to be exposed to a particular environmental stimulus because the brain is developed to the degree that it is now able to process and respond to the stimuli. These sensitive periods usually start and end gradually, and span a longer period of time than a critical period.

A sensitive period is linked to the concept of 'experience-expectant learning', in that it is a stage in an organism's development where certain behaviours are expected to develop after exposure to certain stimuli. An organism may still acquire the learning at a later date, it just may take longer and require more effort to learn the behaviour than if the organism learned it during the sensitive period. Reading and writing are examples of this type of behaviour. Generally, we learn to read and write in the first years of school. However, there are some children who, for whatever reason, do not learn to read and write at this time. At some time in the future, if these individuals were to take adult classes in reading and writing, they may possibly learn these skills. However, the standard they reach and the effort required would depend greatly on both nature and nurture factors because they must have the cognitive capacity to do the task and they must have the opportunity to experience or be exposed to the task.

Critical periods

Critical periods of development are times of increased sensitivity to environmental influences when the conditions are optimal for certain capacities to emerge in an organism. Critical periods occur within a relatively short span of time, and development will generally not occur later if the organism does not receive the exposure to the stimuli from the environment within this time frame.

A critical period involves a small window of opportunity to learn a behaviour. If this window closes, the learning becomes impossible or nearly impossible in the future. Critical periods start and end abruptly and usually have shorter time frames than sensitive periods.

Research suggests that events that occur during a critical period can permanently alter the course of development (Bornstein, 1989). For example, if a pregnant woman contracts German measles, particularly in early pregnancy, the child may be born with heart defects, cataracts or hearing loss. But if the disease were contracted in the later stages of pregnancy, it would not cause damage to the baby. In this case, the critical period relates to not having exposure to a stimulus.

Often, certain events must occur during a critical period for a person to develop normally. For example, within the human nervous system, it appears that different areas of the brain used in learning develop fully at different times. The brain must go through a period of forming synapses and then pruning back unused connections to complete its development. Most of this synapse formation and pruning occurs in the first years of life (see Figure 5.7), but the frontal lobe has one of the longest periods of development (see Chapter 4).

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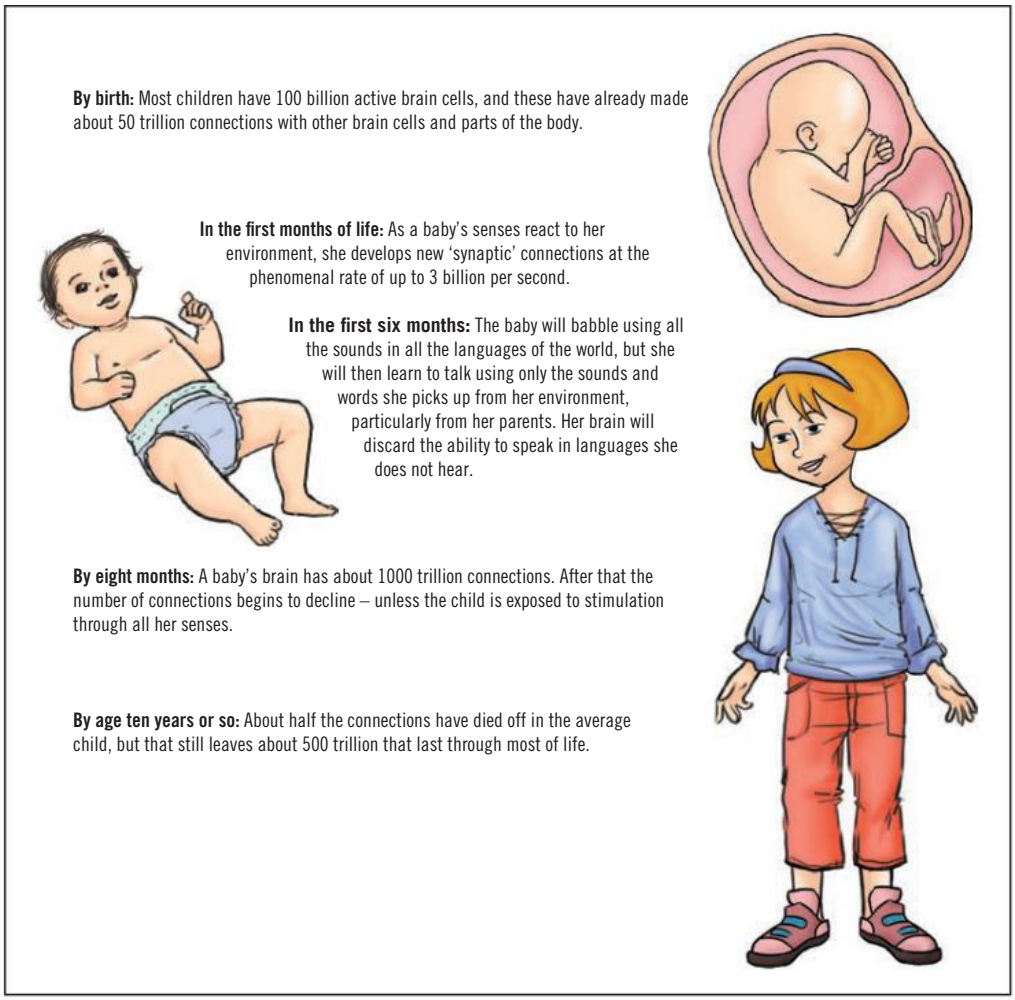


FIGURE 5.7 Brain development in the early years of life

Research conducted by Hubel and Wiesel in the 1960s showed that if a newborn kitten has its eye stitched shut early in its development (within 4 to 6 weeks), the kitten will become permanently blind in that eye. However, if the eye is sewn shut later in development (after 4 months), the kitten will not become blind in that eye. This study led the researchers to conclude that there must be a critical period for vision in kittens, and the neural pathway between the eye and the brain must have visual input at a particular time in development to develop properly. If this does not occur, the result will be blindness (Hubel & Wiesel, 1962).

So why do sensitive and critical periods exist? It would appear that most sensitive and critical periods can be found in the first years of development of most species. Many believe that the answer may be connected to the concept of plasticity and the reduction in plasticity of the human brain as we age.

We know that children have far more plasticity than adults, and this implies that critical periods are important in development. For example, if severe damage occurs in the left hemisphere of a child's brain before the age of two, the brain can shift language processing to the right side of the brain. If the damage occurs between the ages of two and six, new language areas tend to develop in both hemispheres. Such drastic shifts in language processing would be impossible for an adult brain (Mueller et al., 1999).

sensitive period The ideal period of time to be exposed to certain environmental stimuli for development to occur; if exposure does not take place within this time, learning will be more difficult to achieve

critical period A short period of time in the lifespan to be exposed to certain environmental stimuli for development to occur; if exposure does not take place within this time, learning will be difficult and most likely not be achieved

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5.2 TRY IT YOURSELF >>

SENSITIVE AND CRITICAL PERIODS OF AN ANIMAL

Conduct a research investigation on sensitive and critical periods of an animal.

Use the Internet and other sources such as textbooks to determine a sensitive period of development and a critical period of development of your chosen species. You may find it helpful to research a sensory ability such as vision or hearing. Compare your findings with a partner or the class.

LANGUAGE DEVELOPMENT

First language acquisition typically begins in infancy and early childhood. As with other behaviours, language in humans is linked to both innate (maturational) and environmental (experiential) factors. Researchers generally agree that there is, in fact, a window of opportunity for children to acquire their first language – some might call this a critical period.

The first research into language acquisition came from examples of 'feral' children and others who were deprived of language input during infancy and early childhood. ('Feral' children is a name commonly used to describe children found to be living in poor conditions, and one which suggests that they are children who behave as if reared in the wild, by animals.) One of the first cases of a child with an inability to develop language skills was reported in 1801 when a 'wild boy', known as Victor, was found in Aveyron, France. The child was found at the age of 12 or 13, having lived apparently by himself in the forests. Victor was unable to walk in an upright manner and communicate with others verbally, and had a high tolerance for cold as he had spent most of his life outside. After five or so years of attempting to instruct Victor, the doctor taking care of him deemed him beyond education. Victor never learned language with any proficiency and was only able to engage in basic communication with his carers.

Many years after Victor, another case of a feral child, a girl known as Genie, emerged. Genie was a 13-year-old girl when she was found living in appalling conditions. She had been kept strapped to a toilet chair for most of her life because her father assumed she was retarded at birth and had chosen to keep her isolated from others. When Genie was found, she could make noises, but nothing approximating language. Researchers decided that it was an ideal opportunity to test the theory that a nurturing environment could somehow make up for a total lack of language before the age of 12. Unfortunately, Genie never became proficient at speaking and communicating – she was unable to make up for the time spent deprived of language. Cases like Victor and Genie demonstrate that if language acquisition has not taken place in the early years of life, then an individual will probably not be able to develop this skill later in life.

5.3 CHECK YOUR UNDERSTANDING >>

1 The term 'maturation' is defined as:
   - A an orderly sequence of changes based on the nervous system.
   - B an orderly sequence of changes based on psychological factors.
   - C a genetic disposition to elicit behaviours in a random order.
   - D a genetic predisposition to produce an identical response to certain environmental stimuli.

2 If a kitten is not exposed to visual stimuli within approximately the first 6 weeks of life, it will become blind. The development of visual perception for cats therefore occurs during:
   - A developmental norms.
   - B maturation.
   - C a critical period.
   - D a sensitive period.

3 After visiting the maternal and child health nurse, Sara's mother is taking her to see the doctor. She is worried because Sara is 18 months old and cannot walk, but she can stand by pulling herself up using the furniture. With reference to developmental norms, why might Sara's mother be concerned?

4 What is the purpose of a developmental norm?

5 State a similarity and a difference between sensitive and critical periods.

EMOTIONAL ATTACHMENT IN PSYCHOLOGICAL DEVELOPMENT

Like all humans, babies are social creatures. Babies grow up in the company of others, and early social development lays a foundation for future relationships with parents, siblings, friends and relatives. Many factors contribute to an infant developing into a successful 'normal' adult. Two of these basic factors are gaining an awareness of self and gaining an awareness of others.

Imprinting

Konrad Lorenz (1903–1989), an Austrian ethologist (a person who studies the natural behaviour patterns of animals), was curious as to why baby geese follow their mothers. The obvious explanation seemed to be 'it's instinctive', but Lorenz showed otherwise. He observed the specialised learning ability of young animals to fix

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their attention on the first object with which it has experience, and to follow that object thereafter. Precocial birds – species such as chickens, ducks and geese – all share the same characteristic of being able to walk once hatched. Because newly hatched chicks are able to wander around from birth, they can easily become separated from their mothers. To overcome this problem, the species have evolved so that they form instant attachments to their mothers (or in some cases the first thing that moves), and will recognise and stay near her.

'MOTHER' LORENZ

Normally the first large moving object a baby goose sees is its mother. Lorenz hatched geese in an incubator, so the first moving object they saw was Lorenz. From then on, these goslings followed Lorenz (see Figure 5.8). They even reacted to his call as if he were their mother (Lorenz, 1937).

As you can see, baby geese are not born knowing that they should follow a mother goose. Instead, they are born with a tendency to follow large moving objects. Normally that would be their mother, but it need not be. Mother-goose following is acquired during a critical period by exposure to an adult goose (or whatever else happens to be around). The rapid and early learning of permanent behaviour patterns of this type is called imprinting.



FIGURE 5.8 'Mother' Lorenz leads his charges. The goslings have imprinted on Lorenz because he was the first moving object they saw after they hatched.

If newly hatched ducklings do not imprint on their mother (or some other object) within 30 hours, they never will (Hess, 1959). Ducklings have imprinted on rubber balls, wooden blocks and other unlikely objects. In many animals, imprinting has lifelong consequences (Lorenz, 1962).

Attachment

True imprinting is limited to birds and a few other animals. However, human infants do form an emotional attachment to, or close emotional bond with, their primary caregivers. There is a critical period (roughly the first year of life) during which this must occur for optimal development.

Mothers usually begin to cultivate a parent–child bond within hours of giving birth (see Figure 5.9). For example, they touch their own infants and hold them closer than they do other babies (Kaitz, Zvi, Levy, Berger, & Edelman, 1995). A direct sign that an emotional bond has formed appears at approximately 8 to 12 months of age. At that time, infants may display separation anxiety when left alone or with a stranger.



FIGURE 5.9 Mothers usually begin to cultivate a lasting bond with their infant within hours of giving birth.

At birth, children rely totally on their caregivers to look after all their needs. During the infancy stage, children become more independent. They will attempt to feed themselves (sometimes not so successfully), dress themselves and go to the toilet independently. Research suggests that how a child copes with new situations is greatly influenced by the development of its secure attachment with the primary caregiver. Furthermore, it is suggested that infants take the combined effects of the biological, cognitive and social influences that have helped shape their development up until about the age of 2 years into childhood and beyond.

language acquisition To obtain or acquire the ability to understand language and to use words and sentences to communicate

imprinting The rapid and early learning of attachment to the first moving object viewed at birth in some species of animal

attachment A close emotional bond shared usually between mother and child, or primary caregiver and child

EMOTIONAL DEVELOPMENT: ATTACHMENT THEORY

Sigmund Freud suggested over 100 years ago that love and stable relationships come not from trial-and-error learning in adolescence and adulthood, but result from skills that begin to be learned in infancy (roughly the first year of life). He suggested that an infant's tie to their mother is the first and the longest relationship, which will in turn act as a basis for future relationships (Waters, 2004). Freud believed that infants become attached to their mothers because they are the providers of oral satisfaction (feeding) and the mother is the person most likely to feed the infant (Santrock, 1997). (See Figure 5.10.)

At the time, Freud's ideas were unique, given that most psychologists assumed that the social and emotional life of infants would be forgotten in later years and was therefore irrelevant. The question really was: could early experiences really affect adulthood and how we develop relationships with others? Further investigation into the importance of attachment in the early period of life on later relationships began a shift in thinking away from Freud's position that the bond is centred on feeding and oral satisfaction. This investigation confirms that the period of infancy is in fact a critical period for human infants to form attachments to their caregivers for optimal development.

In common terms, attachment refers to a relationship between two people who feel strongly about each other and who exhibit behaviours to continue the relationship. In developmental psychology, attachment refers to the close emotional bond or relationship between an infant and the mother or primary caregiver.

Attachment theory suggests that a number of important factors contribute to attachment, including that attachment is universal to all humans, as it appears in all cultures and across all races of people. Attachment theory also suggests that attachment has a biological basis because its main function is to increase chances of survival by helping the child seek proximity to someone who will take care of their physical and emotional needs so that they feel secure. Seeking attachment is an innate or inborn behaviour; it is instinctive, meaning it is not learned through reasoning or teaching. The attachments formed are hierarchical, occurring primarily between a mother and infant. Although multiple attachments often occur, for example with a father, siblings and friends, the mother–infant relationship is generally ranked highest.

Researchers such as Konrad Lorenz have explored the relationship between animals and their caregivers, and concluded that the bonds of infant care and the attachment of young to their caregivers is very important for survival. Harry Harlow and Robert Zimmerman (1959) explored the attachment of infant monkeys to their mothers. They concluded that Freud's initial theory that infants formed attachment for oral satisfaction was incorrect, and suggested that the monkeys formed attachment more for contact comfort than for food.



FIGURE 5.10 Freud believed that attachment between mother and child centred on feeding and oral satisfaction.

5.4 CHECK YOUR UNDERSTANDING >>

1 The rapid learning of permanent behaviour whereby an animal will form instant attachment to the first thing it sees on birth is called:
   - A maturation.
   - B nervous system attachment.
   - C imprinting.
   - D plasticity.

2 A direct sign that an emotional bond has formed between mother and child appears at approximately 8 to 12 months of age when:
   - A the mother and child are happy doing things together.
   - B the mother can leave the child without the child becoming angry.
   - C the child enjoys spending time with all caregivers equally.
   - D the child displays separation anxiety when left alone of with a stranger.

3 Freud believed that infants become attached to their mothers:
   - A even though they will not remember the relationship and it is therefore irrelevant.
   - B in a random way that is not important for future relationships.

→

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C later in life if not given the opportunity to attach in early life.

D to gain oral satisfaction through feeding.

4 Define the term 'attachment' and explain why the formation of emotional attachment between caregiver and child is important.

5 Describe a similarity and a difference between imprinting and the formation of human attachments with caregivers.

HARLOW AND HIS MONKEYS

During the 1950s and 1960s, psychologist Harry Harlow conducted a number of experiments to investigate the factors influencing the development of attachments (emotional bonds) of infant rhesus monkeys to their mothers. In one of his best-known experiments, Harlow (1958) studied the role of feeding in infant–mother attachment. To do this he used eight infant rhesus monkeys that had been separated from their mother at birth.

The monkeys were taken from their mothers at birth and kept in cages containing two surrogate mothers. A surrogate is anyone or anything that 'substitutes for' or 'plays the part' of something else. The surrogate mothers were made of wire mesh and were roughly the same size and shape as real monkey mothers. However, one of the surrogate mothers was covered in terry-towelling cloth and the other was left uncovered. A feeding bottle was attached to each surrogate in the same area where a breast would be on a real mother. Four of the animals were placed in cages with the feeding bottle on the cloth surrogate and the other four in cages with the feeding bottle on the wire surrogate. The monkeys were not placed in cages with other infants, as they may have preferred to comfort each other. If an infant's attachment to its mother was based primarily on feeding, the infant monkeys should have preferred and become attached to whichever surrogate mother had the bottle.

The findings of the experiment were that, regardless of which surrogate provided the nourishment, the cloth surrogate was preferred to the wire surrogate. None of the monkeys would spend more than one or two hours in any 24-hour period on the wire surrogate. Although the infants in the two groups drank the same amount of milk and gained weight at the same rate, all eight monkeys spent far more time climbing and clinging to the cloth surrogate. By the age of about 3 weeks, all the monkeys were spending approximately 15 hours a day in contact with the cloth surrogate.

To examine what would happen if the monkeys were scared or stressed, Harlow introduced a 'stressor'.



GETTY IMAGES/SCIENCE SOURCE

FIGURE 5.11 A rhesus monkey with a cloth mother surrogate in one of Harlow's experiments



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FIGURE 5.12 A mechanical moving teddy bear was introduced as a fear stimulus

He placed a mechanical moving spider and a teddy bear that beat a drum in the cages with the monkey. The results were that the terrified monkey would seek comfort from the cloth surrogate, regardless of whether or not it had the feed bottle, by rubbing its body against the cloth surrogate. If by chance the monkey fled in blind terror to the wire surrogate, it would soon leave it for the contact comfort of the cloth surrogate, even if the wire surrogate had the feed bottle.

From these results, Harlow concluded that 'contact comfort', which was provided by the softness of the cloth covering, was more important than feeding in the formation of an infant's attachment to its mother. He generalised his findings to suggest that contact comfort was also most likely a crucial factor in human infant–parent attachment.

surrogate A surrogate is anyone or anything that 'substitutes for' or 'plays the part' of something else

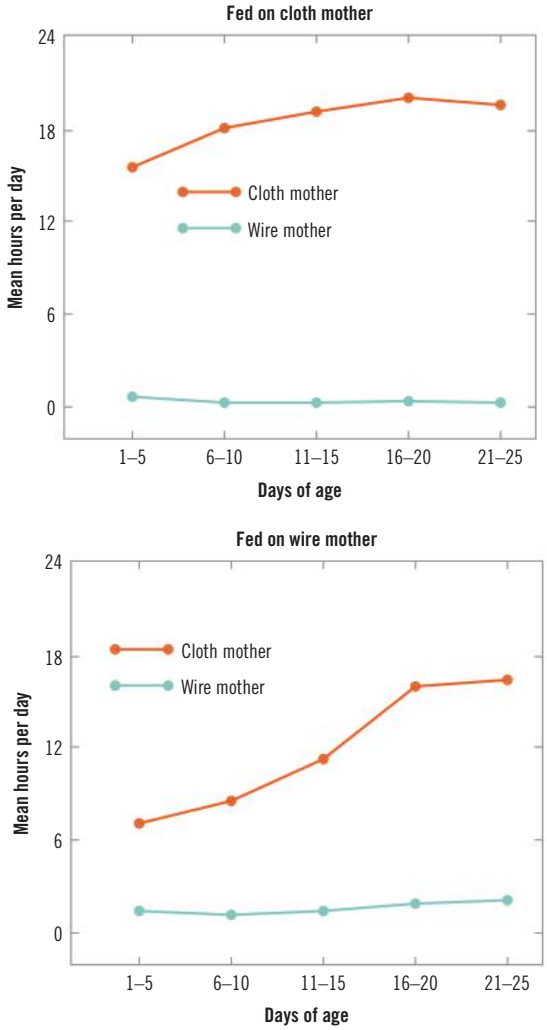


FIGURE 5.13 Time spent on cloth and wire mother surrogates

5.5 CHECK YOUR UNDERSTANDING >>

1. In Harlow's experiments on infant–mother attachment, he used a cloth surrogate and a wire surrogate mother. He found that the infant monkeys:
   - A spent more time on the wire surrogate.
   - B spent more time on the cloth surrogate.
   - C preferred the surrogate that had the food.
   - D spent an equal amount of time on both surrogates.
2. Identify the independent and dependent variables in Harlow's experiment (1958).
3. Outline the procedure Harlow followed to test the effects of the IV on the DV.
4. What did Harlow conclude from this study?
5. Harlow introduced a stressor into the study. what effect did this have on the infant monkeys?

JOHN BOWLBY

In the 1940s, British psychiatrist John Bowlby (1907–1990) began work on attachment theory by observing children in institutions. Bowlby found that some institutions provided a higher level of care and nurturing than others. Some provided for basic needs such as shelter and food, but lacked human contact with the children. According to Bowlby (1988), the release of two movies had a profound effect on research workers in the 1950s: one by René Spitz, *Grief: a peril in infancy* (1947), and the other by James Robertson, *A two-year-old goes to hospital* (1952). The movies documented the need for physical needs to be met, but also the need for care and social interaction. Both movies highlighted the need to focus more research in this area.

At the end of World War II, the number of children separated from their parents and left in the care of institutions was high. Bowlby saw firsthand the significance of catering not only to children's physical wellbeing, but also to their emotional needs. Bowlby believed that children who suffered loss and failure in early relationships were left more open to adverse psychological consequences later in life, such as an inability to form close relationships. As a result, Bowlby believed that mothers should not be separated from their infants for any period of time and this idea is sometimes called the maternal deprivation hypothesis.

This is a view both refuted and supported by evidence. Some research into delinquent behaviour in adolescence shows that delinquency is more likely to occur in children who have suffered some sort of separation experience in childhood. This separation experience could be due to family breakdown, or separation or divorce of parents. Bowlby considered that the delinquency of the adolescents provided evidence to support his maternal deprivation hypothesis. Other researchers such as Rutter (1981) have refuted this theory and instead proposed that the delinquency could be due to the conflict, arguing and disagreement that is often a part of family breakdown, rather than the loss of attachment to the caregiver.

Later, Bowlby (1969) and his colleagues at Tavistock in England continued to study attachment behaviour of infants to their mothers, noting that young children maintain physical proximity with their mothers. The types of behaviours they observed infants engaging in to gain attention from their mothers were signal behaviours such as crying and smiling as well as behaviours that physically maintained proximity, such as clinging or following a caregiver (Vaughan & Hogg, 1998). As a result of these studies Bowlby suggested that there are four phases in the development of attachment (see Table 5.1).

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TABLE 5.1 Phases in the development of attachment

PHASE	DEVELOPMENTAL CHARACTERISTICS
Phase 1: Preattachment (birth through to 3 months)	The infant responds to people, but does not discriminate between people.
Phase 2: Preliminary attachment (3–12 months)	The infant will begin to respond to familiar people with smiles and will prefer to be with the primary caregiver more so than others. An infant will express this by becoming upset or difficult to calm when not with the mother or familiar caregiver.
Phase 3: Clear-cut attachment (1 year old – 2 1/2 years old)	During this phase the infant is more mobile and can crawl or walk to be closer to their caregiver, using them as a secure base from which to explore the environment. If the caregiver is not there, the infant will most likely cry and become fretful.
Phase 4: Goal-directed partnership (2 1/2 years onwards)	The infant will begin to adjust to times when the caregiver is not present. They will become more willing to stay with other people or be by themselves for short amounts of time.

Spitz (1945) reported on babies who had been left in an overcrowded institution for a 2-year period by mothers unable to look after them. The babies were cared for in the very basic sense – they were fed and given a cot to sleep in. However, they were rarely handled and were confined to their cots for most of their sleeping and waking hours (see Figure 5.14). They were essentially deprived of the care that mothers would generally give their children. The babies were later found to be less advanced, mentally and socially, when compared with other institutionalised children who had been given adequate care, and the rate of survival for these infants was extremely low. Spitz coined the term 'hospitalism' to describe the psychological condition these children suffered (Vaughan & Hogg, 1998).


GETTY IMAGES/TARO YAMASAKI

FIGURE 5.14 Overcrowded and understaffed, many institutions could not supply adequate care to infants

5.6 CHECK YOUR UNDERSTANDING >>

1 Bowlby found that the first year of life and the responsiveness of the caregiver were important elements to a child's _____ later in life.
   - A cognitive behaviour
   - B social behaviour
   - C memory formation
   - D sporting ability

2 Signal behaviours such as crying and smiling are used by infants to:
   - A attract attention from their caregiver.
   - B tell their caregiver that they are hungry.
   - C maintain physical proximity to the caregiver.
   - D All of the above

3 Bowlby considered that adolescent delinquency provided support for his maternal deprivation hypothesis. Explain evidence that would refute this hypothesis.

4 What effect did Spitz (1945) report institutionalised children suffered from?

5 Draw a flowchart showing the four phases in development of attachment according to Bowlby.

MARY AINSWORTH

Like Bowlby, the Canadian psychologist Mary Ainsworth (1913–1999) described a list of behaviours she observed as evidence of an infant's attachment to a specific caregiver (Ainsworth, 1972). These behaviours included crying to attract the caregiver's attention, smiling more at the caregiver than others, vocalising more in the presence of a caregiver than when alone or with strangers, crying when being put down, following the caregiver and flight to the caregiver when in danger (Peterson, 1989).

To test and measure the quality of an infant's attachment to the primary caregiver, Ainsworth created a laboratory experiment that has come to be known as the Strange Situation. The experiment took

signal behaviours Behaviours that physically maintain proximity to a caregiver (e.g. crying, smiling, following)

Strange Situation An experiment designed to measure the quality of an infant's attachment to the primary caregiver

place in a room (see Figure 5.15) and then a fixed sequence of events was orchestrated, with the infant's reactions being observed and recorded. The mother and infant would enter the room, and the infant was free to play and explore (toys are provided), before a stranger would enter the room and sit down. The mother would then go out of the room, leaving the infant in the room with the stranger for a 3-minute period (see Figure 5.16). Finally, the mother would return to the room and the observer would record three types of behaviours in the infant: any contact-seeking behaviour (where the child sought the mother or stranger), exploratory play and behaviour, and crying or distress. The quality of the infant's play and the level of distress (crying) when the mother was present was compared to play and distress (crying) when the mother was absent and the infant was left in the room with a stranger.

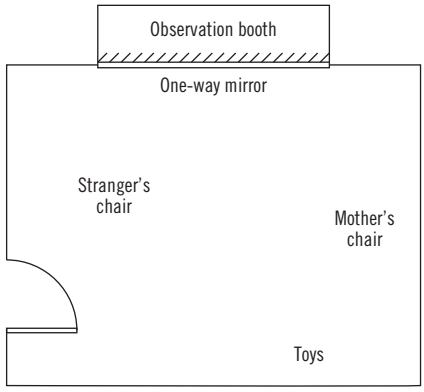


FIGURE 5.15 The layout of the Strange Situation experiment used to measure quality of attachment of infants to their mothers

Here are the events that occurred in the Strange Situation (Figure 5.15):

- The infant enters with mother.
- The infant plays with mother present.
- The stranger enters.
- The mother leaves infant alone in room with the stranger.
- The mother returns.

Ainsworth was then able to develop three categories of infant behaviour. The first category, group A, is called the 'avoidant attachment' type, as infants seemed relatively indifferent to their mothers. They rarely cried when their mother left them alone in the room, and showed little attention to her when she returned. Group B were the 'securely attached' type; they protested vigorously when their mother left the room, they anxiously looked for her during her absence, and responded with pleasure and gave her a lively greeting when she returned. Group A's exploration of the room was not affected by the absence of their mother, whereas group B explored more when their mother was in the room. Finally, group C infants, who were the 'anxiously attached' type, showed great distress when their mothers left the room, and were not calmed easily when she returned. Group C infants also appeared to be more anxious than any of the other groups, both before, during and after the separation from their mothers, and they did not actively explore the room even when their mother was in the room.

It is important to note that group B type infants, the securely attached, were not necessarily more strongly attached to their mothers, but just more confident in her and in their relationship. Ainsworth believes that attachment security depends on how sensitive and responsive a caregiver is to an infant's signals. Infants who are group B type (securely attached) tend to have mothers who are more sensitive, accepting and expressive of affection towards them than are the mothers of those who are insecurely attached (group A or C type) (Petersen et al., 1991). Mothers of group A type infants are insensitive to their signals, they do not often have close body contact with their infant and, instead of being affectionate, they are often irritable and behave in an angry manner. The mothers of group C type infants are insensitive and awkward with their infants and are not affectionate, but not as rejecting as the group A mothers (Santrock, 1997).

The Strange Situation seems to be a good measure of the attachment in infants to their mothers for societies such as Australia, New Zealand, Canada and the United States. The scenario is not unfamiliar to infants in these societies, because it is fairly normal for infants to be left in the care of babysitters (family or childcare centre) or on the lounge room floor to play with toys. In other societies it is not the norm to leave infants with babysitters or alone on the floor. Instead it is normal that an infant would be carried most of the time and cared for primarily by their mothers. The results of placing culturally different infants in the Strange Situation are completely different. For example, in a study using Japanese infants, more

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FIGURE 5.16 Mary Ainsworth identified three types of attachment using the Strange Situation experiment by observing the behaviour of infants towards their mothers.

than 40 per cent of infants were classified as being group C type babies, or insecurely attached to their mothers. This was because the infants became so upset when their mothers left the room and refused to be comforted when she returned (Miyake, Chen, & Campos, 1985). Even with these limitations, the Strange Situation has provided a wealth of information about the processes involved when infants become attached to their caregiver (Peterson, 1989).

THE IMPORTANCE OF ATTACHMENT ON EMOTIONAL DEVELOPMENT

Research by Alan Sroufe (1985, 1990) found a connection between attachment in early life and development in later years. In one study, infants who were type B (securely attached to their mothers) in early infancy were less frustrated and happier at 2 years than were type A and C (insecurely attached infants) (Matas, Arend, & Sroufe, 1978). In other studies, securely attached infants were more socially competent and had better academic results in grade 3 (Egeland, 1989).

Many other studies have found a link between secure attachment and other aspects of children's competence. Some of the saddest cases of child abuse have provided evidence of the importance of attachment. As discussed earlier, deprivation refers to the loss or withholding of normal stimulation, nutrition, comfort, love and so forth, and there have been several documented cases of children who were almost totally deprived of human contact for several years.

Davis (1949) reported cases of two children, Anna and Isabelle, each of whom had been kept in near-total isolation for the first few years of their lives.

Anna was illegitimate and was kept in a room without windows, seated in a chair with her hands tied, as her 'punishment'. When discovered by the authorities, they thought that she could not hear or see. Later care showed that these senses were in fact intact and she was able to learn to communicate in short phrases. Before her death at 10 years of age, she could look after her bodily needs and understand simple directions.

Isabelle spent her first years in a darkened room with only the company of her deaf and mute mother. When first examined by specialists, she was thought to be both deaf and mentally retarded. She not only learned to talk, but accelerated through several stages of cognitive and social development and completed high school.

These two cases highlight the difference of having 'someone', or an attachment, as opposed to being totally deprived. It is impossible to say whether or not Anna and Isabelle were substantially different from each other in terms of their intellectual capacity at birth. However, after their release from the horrific conditions they lived in, Isabelle, who had the company of her mother, made greater progress than Anna, who had nobody.

Studies such as deprivational cases show us that it is important to receive sufficient care for adequate socialisation to take place. What is not apparent is whether care must come from a parent. A study of kibbutz children in Israel, in which child care is group-centred rather that parent-centred, has not pointed to any intellectual or social deficit (Kohen-Raz, 1968). Likewise, an American study of children of working mothers has reported that adequate development can take place in day-care centres. Moreover, daily periods of maternal separation were not found to interfere with a child's attachment to their mother built up in their baby years (Farran & Ramey, 1977). We can conclude that close contact with other humans is important for the young child, a role normally (but not necessarily) played by the parents.

Bowlby found that the first year of life and the responsiveness of the caregiver were important elements to a child's social behaviour later in life (Santrock, 1997). If the infant is comfortable with and finds security of a stable and routine attachment to the mother or caregiver, then an infant is able to organise other elements of development in a coherent way. The infant will feel assured that their caregiver will support them and trusts in the relationship. If the opposite occurs and there is instability in the caregiving relationship – whether physical distance, erratic patterns of parental behaviour or even physical or emotional abuse – then this may interfere with the child's sense of trust and security. Potentially, this may give rise to anxiety and psychological problems later in childhood or even decades later in life. The infant would not feel secure in the relationship and would mistrust the caregiver, wondering, 'Are you going to be there for me?' Overall, research findings to date substantiate the proposition of attachment theory that a child's attachment history does matter (Reebye, Ross, & Jamieson, n.d.).

So far, most of the discussion has focused on the role of the parent or caregiver in building appropriate positive attachments and other life experiences. However, some studies have investigated other factors, such as the child's temperament and genetics, to more fully understand the factors that influence attachment.

TEMPERAMENT AND GENETICS

Temperament refers to an individual's behavioural style and characteristic way of responding to the environment. Temperament includes an individual's sensitivity, activity levels, prevailing mood, irritability and adaptability (Kagan, 1989). There appears to be a lot of variability in the temperament of babies and infants.

Researchers Chess and Thomas (1996) classified three types of temperaments: easy, difficult and slow-to-warm-up. An 'easy' temperament is one where an infant generally shows a positive mood, they can develop routines easily for things such as sleeping and eating, and they can adapt to changes readily. 'Difficult' temperaments describe those infants that often react negatively, cry or show anger, have difficulty developing sleeping and eating routines and are slow to accept changes. The third temperament, the 'slow-to-warm-up' infants, are those with low activity levels, they are somewhat negative, show limited ability to adapt to a change in routine and have a low-intensity mood (Santrock, 1997). Other researchers have devised other ways of classifying temperament, such as by measuring emotionality, sociability and activity level (Buss & Plomin, 1984).

Twin and adoption studies have found that there is a moderate correlation between genetics and temperament (Santrock, 1997). This means that, like intelligence, the closer two people are related biologically, the more alike their temperament will be. More often than not there is consistency between a child's temperament and that of their biological parents. Parents with children who could be classified as 'easy' are more likely to share similar temperaments themselves, and parents with 'difficult' children likewise share similar characteristics in temperament.

Some researchers have criticised attachment theorists such as Bowlby and Ainsworth for not acknowledging the role of factors such as genetics and temperament in children's social development and competence. Take, for example, a child who inherits a low tolerance for stress who may fail to form a secure attachment to their caregiver(s). This child could also be classified as a 'difficult' child, and therefore the impact on the child's emotional development and their ability to form relationships with others are contributed to by genetics and temperament.

There are differing views on the role of infant temperament in the formation of attachment relationships. Attachment theorists have suggested that temperament has no direct effect on the quality of attachment because even though infants with a difficult temperament may be challenging for caregivers, secure attachment can still be achieved if caregivers respond in a way that promotes the attachment bond. Temperament researchers, on the other hand, have argued that infant–caregiver interactions in the Strange Situation test reflect the infant's temperament rather than the quality of the relationship (Gervai, 2009). Attachment is clearly at the foundation of human emotional development. Animal studies and case studies of humans who have been deprived of early care have shown that developing attachment with caregivers in early life (suggested in the first year) influences whether the individual will develop normal relationships with others.

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5.2

FOCUS ON RESEARCH

SHY BABIES NEED SECURE PARENT BOND TO HELP PREVENT POTENTIAL TEEN ANXIETY

Shy babies need to have a strong bond with their parents to avoid developing anxiety disorders in their teens, according to a study co-authored at the University of Waterloo.

It's been known for some time that young children who react with behavioural inhibition or shyness to new situations have an increased risk of internalising problems as they grow older. 'But with this study,' said co-author, Professor Heather Henderson, 'we now understand that infants and young children with an inhibited temperament who also have insecure early attachment relationships are most likely to become socially anxious teens – especially boys.'

Attachment is especially vital, the researchers found, when a baby shows behavioural inhibition or shyness to new situations or people. Their paper appears in *Child Development*, the journal of the Society for Research in Child Development.

This is the first long-term empirical study of the combined influence of attachment and behavioural inhibition as predictors of teen anxiety. While the researchers found that behavioural inhibition was associated with higher anxiety when toddlers also had insecure attachment relationships, this association was particularly strong for boys in the study.

Professor Henderson and her collaborators say further study is needed to understand how a child's gender influences development of anxiety.

'The most important message from this study is that competent responsive parents who form a secure relationship with their young children, can be an extremely important protective factor in their child's development,' said Professor Henderson.

The longitudinal study, conducted by Professor Henderson of the Department of Psychology at Waterloo, and collaborators at the University of Maryland and the National Institute of Mental Health, included 165 adolescents aged 14 to 17 from middle-to-upper class European American families who had been periodically assessed throughout early childhood, beginning at 4 months old, and who later, as adolescents, completed a number of anxiety assessments.

Toddlers' attachment to parents was measured using the Strange Situation Paradigm which includes a series of separation and reunion episodes with their mothers. The toddlers' behaviour, particularly during reunion episodes, was observed and coded in order to form attachment classifications. Toddlers who quickly approached the parent, were easily soothed and were willing to return to exploring the room were classified as secure. In contrast, toddlers who avoided contact, or showed anger and unmoderated distress, or other types of atypical response upon the parent's return, were classified as insecure.

Behavioural inhibition, the other factor in this study, was repeatedly assessed over early and middle childhood using laboratory observations and maternal report measures. Assessments focus on the toddler and then

→

young child's reaction to unfamiliar objects, people or situations. If they repeatedly respond with fear or social withdrawal, they are classified as behaviourally inhibited.

'Anxiety disorders are among the most common psychiatric problems seen in children and adolescents,' says Professor Henderson, 'we can use this information about early influences to help change the developmental pathways of at-risk children before clinically significant problems emerge.'

Source: University of Waterloo (2015, February 17). Shy babies need secure parent bond to help prevent potential teen anxiety. *ScienceDaily*. Reproduced with permission.

QUESTIONS

1. What is a longitudinal study?
2. The researchers used a number of methods in this study. Identify and explain two methods they used.
3. Identify the sample used in the study and two methods they may have used to obtain the sample.
4. Are the results from the study able to be generalised? Why or why not?
5. Identify and explain an ethical consideration the researchers would have followed when conducting this study.

5.7 CHECK YOUR UNDERSTANDING >>

1 Ainsworth's three categories of infant behaviour were:
   - A avoidant attachment, secure attachment and independent attachment.
   - B secure attachment, dependent attachment and emotional attachment.
   - C autonomous attachment, secure attachment and anxious attachment.
   - D avoidant attachment, secure attachment and anxious attachment.

2 Attachment refers to:
   - A an infant's ability to follow large objects with their eyes.
   - B the grip an infant will develop on their caregiver.
   - C the close emotional bond an infant develops with their caregiver.
   - D None of the above

3 When the mother went out of the room, leaving the infant in the room with the stranger during the Strange Situation experiment, an observer would record which three types of behaviours in the infant?
   - A Any orienting responses, crying or distress and habituation
   - B Crying or distress, happiness and play, contact seeking

→

temperament Refers to an individual's behavioural style and characteristic way of responding to the environment

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C Dishabituation, crying or distress and contact seeking

D Crying or distress, contact seeking and exploratory play

4 What was the purpose of the Strange Situation experiment?

5 Can the results of the Strange Situation experiment conducted by Ainsworth be generalised to other cultures? Why or why not?

COGNITIVE DEVELOPMENT: PIAGET'S THEORY

Generally speaking, children's thinking is less abstract than an adult's because they use fewer generalisations, categories and principles. This is because children have less experience and exposure to stimulation in the environment. Children also tend to base their understanding on particular examples and objects they can see or touch. This is called concrete thinking. Concrete thinking is used to describe thought processes that rely on experiences in the real world. Once a child can learn to mentally represent ideas, they move away from concrete thinking to what Swiss psychologist Jean Piaget (1896–1980) called symbolic thinking, which involves the ability to mentally represent people, objects and events – even those that are not present – by using abstract concepts such as words, gestures and numbers.

Cognitive development looks at how thinking processes change over the lifespan. Piaget is famous for his theory on the ways in which children develop their cognitive abilities (Piaget, 1951, 1952). He studied children's reasoning abilities in hundreds of experiments. The data he collected led to the development of the theory that children experience a series of developmental stages from infancy through to adolescence. Piaget labelled these stages the sensorimotor stage, the preoperational stage, the concrete operational stage and the formal operations stage. According to Piaget, at each of these stages children become able to reason in a qualitatively different and more advanced way as they shift from concrete thinking to symbolic thinking abilities. Piaget's theory of cognitive development provides a valuable map of how thinking abilities unfold.

Before the age of 6 or 7 years, children's thinking is very concrete. Younger children cannot understand conservation. This means they are not able to understand that the properties of a substance can remain the same, even when its appearance changes (such as clay or water) (see Figure 5.18). To illustrate this, imagine that you were visiting Georgia, a child of 5 years. If you show her a short, wide glass full of milk and a tall, narrow glass (also full), she will tell you that the taller glass contains more milk. Georgia will say this to you even if she watches you pour milk from the short glass into an empty tall glass. She is not bothered by the fact that the milk appears to be transformed from a smaller to a larger amount. Instead, she responds only to the fact that taller seems to mean more. After about age 7 years, children are no longer fooled by this situation. From age 7 years onwards, there is a definite trend towards more logical, adult-like thought (Flavell, 1992).

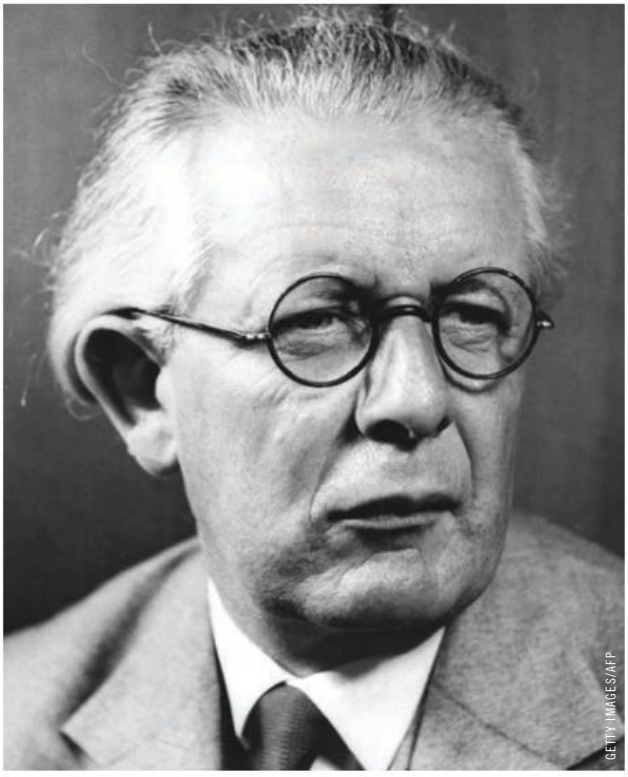


FIGURE 5.17 Jean Piaget (1896–1980), Swiss psychologist



FIGURE 5.18 Children under the age of 7 years intuitively assume that a volume of liquid increases when it is poured from a short, wide container into a taller, thinner one. This girl thinks the tall container holds more than the short one. Actually, each holds the same amount of liquid. Children make such judgments based on the height of the liquid, not its volume.

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MENTAL ADAPTATION

Piaget was convinced that intellect grows through processes he called assimilation and accommodation. Assimilation is the use of existing mental patterns in new situations. Let's say that a plastic hammer is Oliver's favourite toy. Oliver holds the hammer properly and loves to hit blocks with it. For his birthday, Oliver gets an oversized toy spanner. If he uses the spanner for hitting, it has been assimilated to an existing knowledge structure. This is the same knowledge structure that he uses to understand what a hammer is used for.

In accommodation, existing ideas are modified to fit new requirements. For instance, a younger child might think that a $2 coin is worth less than a (larger) 50c coin. As the child begins to spend money, they will be forced to rethink what 'more' and 'less' mean, and that bigger does not necessarily mean more. Thus, new situations are assimilated to existing ideas, and new ideas are created to accommodate new experiences.

Piaget's theories have had a profound effect on our thinking about children (Beilin, 1992).

5.8 CHECK YOUR UNDERSTANDING >>

1 Which is the correct sequence of stages in Piaget's theory of cognitive development?
   - A Sensorimotor, concrete operational, preoperational, formal operations
   - B Preoperational, sensorimotor, concrete operational, formal operations
   - C Preoperational, concrete operational, sensorimotor, formal operations
   - D Sensorimotor, preoperational, concrete operational, formal operations

2 According to Piaget, mental adaptation involves both:
   - A plasticity and assimilation.
   - B assimilation and intuition.
   - C accommodation and assimilation.
   - D assimilation and object permanence.

3 What is cognitive development?

4 Define the terms 'assimilation' and 'accommodation'.

5 Using an example, explain how a child may use mental adaptation to learn new information about their environment.

PIAGET'S FOUR STAGES

Piaget believed that all children pass through a series of distinct stages in intellectual development. Many of his ideas came from observing his own children as they solved various thought problems.

The sensorimotor stage (0–2 years)

In the first 2 years of life, a child's intellectual development is mostly non-verbal (not speaking). During the sensorimotor stage, children are mainly concerned with learning to coordinate purposeful movements with information from the senses by looking at, touching and mouthing objects in their immediate environment. For example, very young infants will instinctively grasp a rattle. They feel it, they see it and hear it, but initially they do not realise that if they shake their arm they can make the rattle produce a noise. When they do realise this, they may begin to purposefully shake everything they get hold of, trying to reproduce the sound. Eventually they start to distinguish between things that make noise and things that do not. This indicates that they are beginning to integrate sensory and motor information and to coordinate their motor responses.

During this stage they gradually learn that there is a relationship between their actions and the external world. They learn that they can manipulate objects and produce effects.

Also, object permanence, or an understanding that objects continue to exist when they are out of sight, emerges at this time (see Figure 5.19). At approximately 18 months of age, children begin to actively pursue disappearing objects. By age 2 years, they can anticipate the movement of an object behind a screen. For example, when watching an electric train, a child looks ahead to the end of a tunnel, rather than staring at the spot where the train disappeared. Before they reach the age where they have accomplished object permanence they will also find a game of 'peekaboo' appealing. When you place your hands over your face, then open them up to reveal your face at the same time saying 'peekaboo', the child will generally have a look of amazement on their face and laugh as if it is one of the funniest things they have seen. Literally, when you remove your hands covering your face, the child thinks that you are appearing as if out of nowhere. Once the child has accomplished object permanence, this game ceases to be funny.

concrete thinking Refers to the thought processes that rely on experiences in the real world

symbolic thinking A cognitive skill that enables us to use symbols, gestures or images to mentally represent people, objects and events that may not be present

assimilation In Piaget's theory, the application of existing mental patterns to new situations (that is, the new situation is assimilated to existing mental schemes)

accommodation In Piaget's theory, the modification of existing mental patterns to fit new demands (that is, mental schemes are changed to accommodate new information or experiences)

object permanence The concept that an object will continue to exist, even when it is hidden from view

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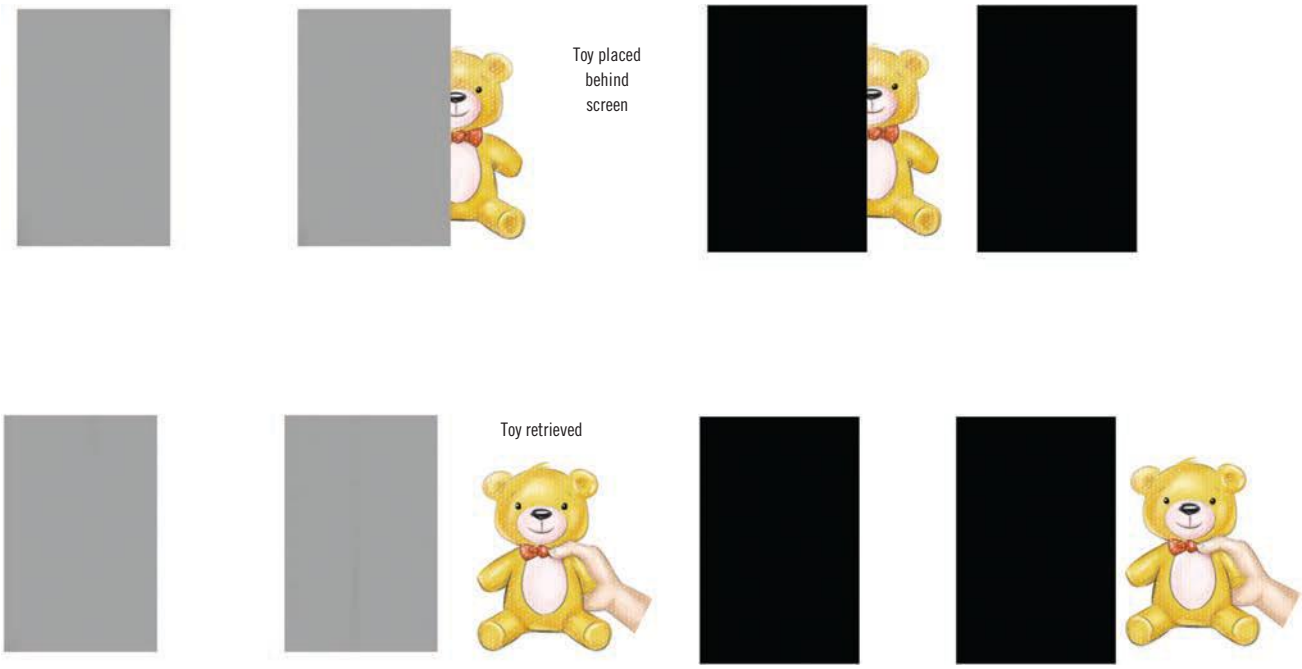


FIGURE 5.19 Staging an 'impossible event'

In Figure 5.19, the panels on the left show a possible event, in which an infant watches as a toy is placed behind the rightmost of two screens. After a delay of 70 seconds, the toy is brought into view from behind this right screen. In the two panels on the right, an impossible event occurs. The toy is placed behind the left screen and retrieved from behind the right. (A duplicate toy was hidden there before testing.) Eight-month-old infants react with surprise when they see the impossible events staged for them, implying that they remember where the toy was hidden.

In general, developments in this stage indicate that the child's conceptions are becoming more stable. Objects cease to appear and disappear magically, and a more orderly and predictable world replaces the confusing and disconnected sensations of infancy.

The preoperational stage (2–7 years)

During the preoperational stage, children begin to think symbolically and use language. The child's thinking is still very intuitive. In addition, the child's use of language is not as sophisticated as it might seem. Children have a tendency to confuse words with the objects they represent. If a child calls a toy block a 'car' and you use it to make a 'train', they may be upset. To children, the name of an object is as much a part of the object as its size, shape and colour.

During the preoperational stage, the child is also quite egocentric. The child's ego seems to stand at the centre of their world. To illustrate this, imagine that you are showing a 3-year-old child a two-sided mirror. Then you hold it between the two of you so the child can see themself in it. If you ask the child what they think you can see, they imagine that you see their reflected image instead of your own. The concept of egocentrism helps us to understand why children appear to be selfish or uncooperative at times. If a child wants a new truck for Christmas and then you ask them, 'What does Mummy want for Christmas?', they are likely to say 'a new truck'. The child is not being selfish in the ordinary sense, they just don't realise that other people's views differ from theirs (see Figure 5.20).



FIGURE 5.20 Crossing a busy street can be dangerous for preoperational children. Because their thinking is still egocentric, younger children cannot understand why the driver of a car cannot see them if they can see the car. Children under the age of 7 years also cannot consistently judge speeds and distances of oncoming cars.

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Piaget suggested that preoperational children are egocentric due to their limited understanding of mental states such as desires, belief, thought, intentions and feelings. However, between the ages of 3 and 4 years, children normally gain a richer understanding of mental life.

FOCUS ON RESEARCH 5.3

THE 'SWISS MOUNTAIN SCENE' TEST

To test his theory that children below the age of 5 years are egocentric, Piaget conducted research in which a number of children under 5 years were presented with a papier-mâché model of a mountain range consisting of three mountains. The mountains were different colours. One had snow on the top, one a house and one a red cross. The child was allowed to walk around and explore the model. The child then sat on one side and watched an experimenter place a doll in a variety of locations on the mountain model. The child was then shown 10 pictures of different views of the model and asked to choose the one that represented how the doll would view it (Piaget & Inhelder, 1956).

Results indicated that 4-year-olds were completely unaware of viewpoints other than their own, and always chose a picture that matched their views of the model. Six-year-olds showed some awareness, but often chose the wrong picture. Only 7- and 8-year-olds consistently chose the picture that represented the doll's view.

According to Piaget, children below the age of 7 years are bound by the egocentric illusion. They fail to understand that what they see is relative to their own positions, and instead take it to represent 'the world as it really is'. However, later research suggests that the children tested failed to take the doll's 'viewpoint', because the task was unfamiliar and too complex for them. When more familiar situations were used (such as Grover, a *Sesame Street* character, driving a car along a toy road), children could accurately report on this character's perspective (Flavell, 1977).

QUESTIONS

1. Write a hypothesis for Piaget's experiment.
2. Identify the independent and dependent variables.
3. Do the results of this experiment support Piaget's description of the cognitive abilities of children in the preoperational stage? Give reasons for your answer.

The concrete operational stage (7–11 years)

An important development during the concrete operational stage is mastery of conservation, the concept that mass, weight and volume remain unchanged when the shape of objects changes (see Figure 5.21). Children have learned conservation when they understand that rolling a ball of clay into a different shape such as a 'snake' does not increase the amount of clay. Likewise, pouring liquid from a tall, narrow glass into a shallow dish does not reduce the amount of liquid. In each case, the volume remains the same, despite changes in shape or appearance.

During the concrete operational stage, children begin to use concepts of time, space and number. For example, a child will count the number of sleeps before a significant event. The child can think logically about very concrete objects or situations, categories and principles. Such abilities explain why children stop believing in Santa Claus when they reach this stage.



FIGURE 5.21 During the concrete operational stage, children can conserve volume. They realise that Santa's sack could not possibly hold enough toys for millions of boys and girls.

Another important development at this time is the ability to reverse thoughts or mental operations. The following conversation with a 4-year-old boy in the preoperational stage shows what happens when a child's thinking lacks reversibility (Phillips, 1969):

'Do you have a brother?'

'Yes.'

'What's his name?'

'Frederic.'

'Does Frederic have a brother?'

'No.'

Reversibility of thought allows children in the concrete operational stage to recognise that if 4 + 2 = 6, then 2 + 4 does too. Younger children must memorise

intuitive Able to make sense of something immediately without using reasoning

conservation The concept that the weight, mass and volume of matter remain unchanged (are conserved) even when the shape or appearance of objects changes

reversibility of thought Recognition that relationships involving equality or identity can be reversed (for example, if A = B, then B = A)

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each relationship separately. Thus, a preoperational child may know that 4 + 10 = 14, without being able to tell you what 10 + 4 equals.

The formal operations stage (11 years and up)

Sometime after about the age of 11 years, children begin to break away from concrete objects and specific examples. This thinking is based more on abstract principles, such as democracy or honour. In the formal operations stage, children can think about their thoughts, and they become less egocentric. Older children and young adolescents also gradually become able to consider hypothetical possibilities. For example, if you ask a younger child 'What do you think would happen if it suddenly became possible for people to fly?', the child might respond, 'People can't fly'. Older children are able to consider the possibilities and discuss their implications.

Full adult intellectual ability is attained during the stage of formal operations. Older adolescents are capable of inductive reasoning (logical reasoning that begins with the specific and moves to the general) and deductive reasoning (logical reasoning that begins with the general and moves to the specific), and they can comprehend more advanced mathematics, physics, philosophy, psychology and other abstract systems. They can learn to test hypotheses in a scientific manner. Of course, not everyone reaches this level of thinking.

Also, many adults can think formally about some topics, but their thinking becomes concrete when the topic is unfamiliar. This implies that formal thinking may be more a result of culture and learning than of maturation. In any case, after late adolescence, improvements in intellect are based on gaining knowledge, experience and wisdom, rather than on any leaps in basic thinking capacity.

If we relate this to the development of the brain, formal operations begin as the brain becomes more myelinated and therefore is capable of more integrative processes that use more areas of the brain in a collaborative manner. It also corresponds to the development of the frontal lobes, where much of our higher-order thinking is done.

5.3 TRY IT YOURSELF >>

PIAGET'S FOUR STAGES

For each statement, write down which of the four stages suits the cognitive ability and give a reason for your answer.

STATEMENTS

1. When something goes wrong with my computer or the television, I press every button I can to try to fix the problem.
2. When buying a drink from the school canteen, I will try to get the best value for money by picking the tallest bottle.
3. To answer a maths problem, I need to work it out on paper, I can't solve the problem in my head.
4. I often stand in front of the television and get told off by others as they can't see the screen. I don't know why they keep saying they can't see it as I can see the screen.
5. I find the game of peekaboo very amusing.
6. I get annoyed at logic problems and find dealing with concrete examples much easier.
7. I would rather have a 50c coin than a dollar coin, as it is bigger.
8. If something is broken I use a system of trial and error to fix it rather than sit back and think about a solution to the problem.
9. I understand the concept of ethics and morality.

Make up your own set of statements and test someone in your class.

LATER RESEARCH AND PIAGET'S THEORY

Piaget's theory is a valuable 'road map' for understanding how children think. Some more recent research suggests that intellectual growth is not as related to age and stage as Piaget claimed. Today, many psychologists are convinced that Piaget gave too little credit to the effects of learning. For example, children of pottery-making parents can correctly answer questions about the conservation of clay at an earlier age than Piaget would have predicted (Bransford, Sherwood, Vye, & Reiser, 1986). According to learning theorists, children continuously gain specific knowledge; they do not undergo stage-like leaps in general mental ability.

INFANT COGNITION

Is there any evidence suggesting that Piaget underestimated the abilities of infants? Piaget believed that infants under the age of 1 year cannot think. Babies, he said, have no memory of people and objects that are out of sight. Yet research suggests that infants begin forming representations of the world very early in life. For example, babies as young as 3 months appear to know that objects are solid and do not disappear when out of view (Johnson & Nanez, 1995; Baillargeon & DeVos, 1992). Others have found that babies have memories at age 6 to 8 months that Piaget did not recognise until they reached the age of

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18 months (Hayne & Rovee-Collier, 1995; Shields & Rovee-Collier, 1992; Raymond, 1991).

Why did Piaget fail to detect the thinking skills of infants? Most likely, he mistook babies' limited physical skills for mental incompetence. Piaget's tests required babies to search for objects or reach out and touch them. Newer, more-sensitive methods are uncovering abilities Piaget could not have detected. One such method takes advantage of the fact that babies, like adults, act surprised when they see something 'impossible' or unexpected occur.

To make use of this effect, psychologist Renée Baillargeon (1991) put on little 'magic shows' for infants. In her 'theatre', babies watched as possible and impossible events occurred with toys or other objects. Some 3-month-old infants acted surprised and gazed longer at impossible events. One example is seeing two solid objects appear to pass through each other. By the time they are 8 months old, babies can remember where objects are (or should be) for at least 1 minute.

Piaget believed that such abilities emerge only after a long sensorimotor period of development. However, evidence continues to mount that babies are born with the capacity to form concepts about the world or acquire this ability early in life (Eimas, Quinn, & Cowan, 1994). Further study is likely to refine and amend the ideas that came from Piaget.

5.9 CHECK YOUR UNDERSTANDING >>

1 By 6 to 9 months of age, a child begins to understand that objects exist even when they are out of sight. This ability is called:
   A assimilation.
   B accommodation.
   C constancy.
   D object permanence.

2 _____ describes the concept understood by children in the concrete operational stages (ages 7 to 11 years) that quantity does not change just because shape of other observable features have changed.
   A Accommodation
   B Object permanence
   C Conservation
   D Constancy

3 The _____ stage is characterised by an ability to use abstract concepts.
   A concrete operational
   B preoperational
   C operational
   D formal operations

4 Draw a table and outline the four stages of cognitive development and identify the key accomplishments for each stage.

5 Compare the differences between concrete thinking and symbolic thinking.

PSYCHOSOCIAL DEVELOPMENT: ERIK ERIKSON'S EIGHT-STAGE THEORY

THE CYCLE OF LIFE: ROCKY ROAD OR GARDEN PATH?

In an influential book entitled *Childhood and Society* (1963), personality theorist Erik Erikson (1903–1994) suggested that we face a specific psychosocial dilemma, or 'crisis', at each stage of life. A psychosocial dilemma is a conflict between personal impulses and the social world. Resolving each dilemma creates a new balance between a person and society. A string of 'successes' produces healthy development and a satisfying life. Unfavourable outcomes throw us off balance, making it harder to deal with later crises. Life becomes a 'rocky road', and personal growth is stunted.

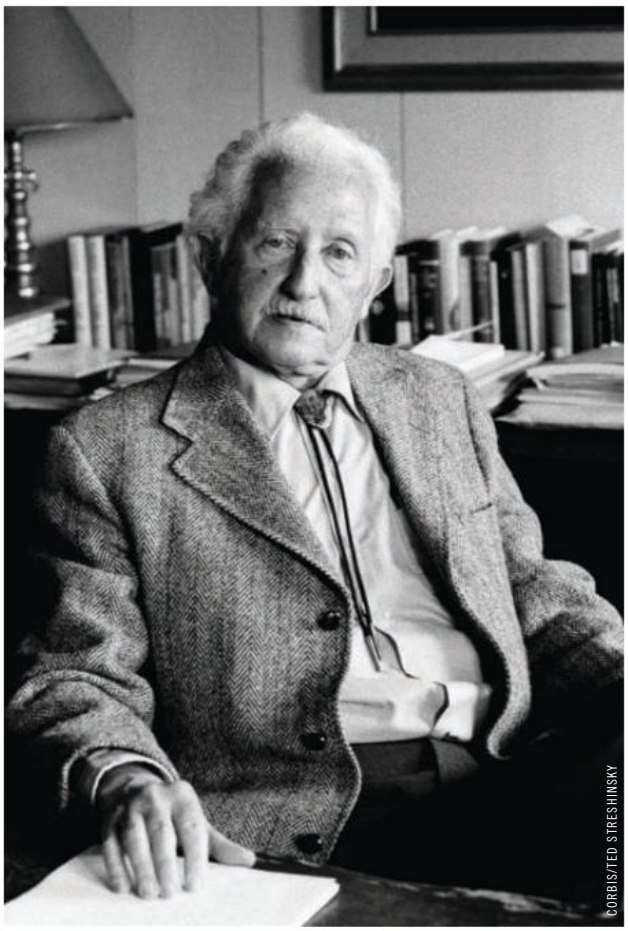


FIGURE 5.22 Erik Erikson (1903–1994), personality theorist

abstract principles Thinking in terms of concepts that cannot be necessarily seen

psychosocial dilemma A conflict between personal impulses and the social world

Stage one, first year of life: Trust versus mistrust

During the first year of life, children are completely dependent on others. Erikson believes that a basic attitude of trust or mistrust is formed at this time. Trust is established when babies are given adequate warmth, touching, love and physical care. The infant in this case is likely to be securely attached and to have confidence to explore new circumstances. Mistrust is caused by inadequate or unpredictable care and by parents who are cold, indifferent or rejecting. In this case the infant is likely to be insecurely attached and to lack confidence and positive expectations. Basic mistrust may later cause insecurity, suspiciousness or an inability to relate to others. Notice that trust comes from the same conditions that help babies become securely attached to their parents.

Trust and mistrust are not resolved once and for all in the first year of life; instead the issue arises at each stage of development. Therefore, an infant who has an attitude of mistrust because they do not receive the support and attachment in the first years of life may in later years trust a particular teacher or adult who takes time to instil a sense of trust, and can then overcome their earlier mistrust. Likewise, a child who starts out with an attitude of trust can also have their sense of mistrust activated by issues such as when their parents divorce or become separated, causing a conflict situation. Then the child may revert to mistrust.

Take, for example, a 4-year-old boy who was seeing a clinical psychologist at a court clinic as his adoptive parents of 6 months no longer wanted him. Their excuse was that he was cold and unloving, stole things and could not be trusted. Most of what they said about the boy was true, though when you know his history you can better understand him. A year after he was born, he was taken away from his mother, who had a drinking problem; his father was not known. He was taken into foster care, and had several foster families. At first he tried to relate to people, but the relationships never had a chance because he moved from home to home. In the end he gave up trying. He had trusted his mother, yet she had let him down, and the next relationships he tried failed, so he trusted no one. This type of mistrust would take years to undo, but given the right circumstances and patience, it might be done (Santrock, 1997).

Stage two, 1–3 years: Autonomy versus shame and doubt

In stage two, children express their growing self-control by climbing, touching, exploring and trying to do things for themselves. Parents can foster a sense of autonomy by encouraging children to try new skills. However, the child's first efforts can be crude. Often, they result in spilling, falling, wetting and other 'accidents'. Thus, parents who ridicule or overprotect their children may cause them to doubt their abilities and feel shameful about their actions. It is important at this stage that parents or caregivers allow their children time to develop skills, realise that they will make mistakes and that they must acquire skills at their own pace. This includes things like speaking and using cutlery. It is very easy to hurry and finish a child's sentence when they are taking too long, or refuse to allow them to feed themselves as they are 'too messy and take too long'. It takes time for the infant to learn to control their muscles so they can direct their behaviours. Children feel a great sense of pride when they are praised for their accomplishments, but they feel ashamed and doubt their ability when they are criticised for not succeeding.



FIGURE 5.23 Children's first attempts at feeding themselves may be messy, yet they will feel a sense of pride when they accomplish their goal.

Stage three, 3–5 years: Initiative versus guilt

In stage three, children move beyond simple self-control and begin to take initiative. Through play, children learn to make plans and carry out tasks. Parents can reinforce initiative by giving children freedom to play, ask questions, use their imagination

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and choose activities. Feelings of guilt about initiating activities are formed if parents criticise severely, prevent play or discourage a child's questions.

Stage four, 6–12 years: Industry versus inferiority

Many events of middle childhood are symbolised by the day when you first entered school. With dizzying speed, your world expanded beyond your family, and you faced a whole series of new challenges. Erikson describes the primary school years as the child's 'entrance into life'. In school, children begin to learn skills valued by society, and success or failure can affect a child's feelings of adequacy. Children learn a sense of industry if they win praise for productive activities, such as building, painting, cooking, reading and studying. If a child's efforts are regarded as messy, childish or inadequate, feelings of inferiority result. For the first time, teachers, classmates and adults outside the home become as important as parents in shaping attitudes towards oneself.

Stage five, adolescence: Identity versus role confusion

Adolescence is often a turbulent time. Caught between childhood and adulthood, the adolescent faces some unique problems. Erikson considers a need to answer the question 'Who am I?' the primary task during this stage of life. Mental and physical maturation brings new feelings, a new body and new attitudes. Adolescents must build a consistent identity out of their talents, values, life history, relationships and the demands of their culture (Douvan, 1997). Conflicting experiences as a student, friend, athlete, worker, son or daughter and so forth must be integrated into a unified sense of self. People who fail to develop a sense of identity suffer from role confusion, an uncertainty about who they are and where they are going.

Stage six, young adulthood: Intimacy versus isolation

What does Erikson believe is the major conflict in early adulthood? In stage six, the individual feels a need for intimacy in their life. After establishing a stable identity, a person is prepared to share meaningful love or deep friendship with others. By intimacy, Erikson means an ability to care about others and to share experiences with them. In line with Erikson's view, 75 per cent of university-age men and women rank a good marriage and family life as important adult goals (Bachman & Johnson, 1979). And yet, marriage or sexual involvement is no guarantee of intimacy: many adult relationships remain superficial and unfulfilling. Failure to establish intimacy with others leads to a deep sense of isolation (feeling alone and uncared for in life). This often sets the stage for later difficulties.

Stage seven, middle adulthood: Generativity versus stagnation

According to Erikson, an interest in guiding the next generation is the main source of balance in mature adulthood. Erikson called this quality generativity. It is expressed by caring about oneself, one's children and future generations. Generativity may be achieved by guiding one's own children or by helping other children (as a teacher, pastor or coach, for example). Productive or creative work can also express generativity. In any case, a person's concerns and energies must broaden to include the welfare of others and society as a whole. Failure to do this is marked by a stagnant concern with one's own needs and comforts. Life loses meaning, and the person feels bitter, dreary and trapped (Peterson & Klohnen, 1995).



FIGURE 5.24 Generativity at work

trust Established when an infant is given proper warmth, love, touching and physical care

mistrust Established when care is unpredictable or inadequate

autonomy Independence; doing things for oneself

initiative Using one's own resourcefulness to take control or solve problems

industry Becoming more active or productive

inferiority Weakness or inadequacy; low standard

generativity Caring about oneself, one's children and future generations

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Stage eight, late adulthood: Integrity versus despair

What does Erikson see as the conflicts of old age? Old age is a time of reflection. According to Erikson, a person must be able to look back over life with acceptance and satisfaction. The person who has lived richly and responsibly develops a sense of integrity (self-respect). This allows the person to face ageing and death with dignity. If previous life events are viewed with regret, the elderly person experiences despair (heartache and remorse). In this case, life seems like a series of missed opportunities. The person feels like a failure and knows that it is too late to reverse what has been done. Ageing and the threat of death then become sources of fear and depression.

To squeeze a lifetime into a few pages, we must ignore countless details. Although much is lost, the net effect is a clearer picture of an entire life cycle. Is Erikson's description, then, an exact map of your future? Probably not. Still, the dilemmas we have discussed reflect major psychological events in the lives of many people. Knowing about them may allow you to anticipate typical trouble spots in life. You may also be better prepared to understand the problems and feelings of friends and relatives at various stages in the life cycle.

5.10 CHECK YOUR UNDERSTANDING >>

1 According to Erikson, if a person has conflicted experiences during stage five, they may suffer _____ later in life.
   - A signal behaviours
   - B spontaneous habituation
   - C mental breakdown
   - D role confusion

2 According to Erikson's theory, stage five, identity versus role confusion, occurs during which period of life?
   - A Young adulthood
   - B Adolescence
   - C Middle adulthood
   - D Late adulthood

3 The psychosocial dilemma that confronts children in the second stage is:
   - A autonomy versus shame and guilt.
   - B intimacy versus role confusion.
   - C autonomy versus shame and doubt.
   - D autonomy versus trust and doubt.

4 Define the term 'psychosocial dilemma'.

5 Choose a stage of Erikson's theory and identify the major crisis an individual faces during this stage.

integrity Self-respect
despair Heartache or remorse

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CHAPTER SUMMARY

Hereditary and environmental factors in psychological development

- Human development depends on the interactive nature of hereditary and environmental factors for typical psychological development to occur. Both hereditary factors such as genetics and hormones and environmental factors such as social factors and the care and stimulation an individual is exposed to contribute to and influence development.
- Twin studies using identical and fraternal twins have been used to measure the influence of hereditary and environmental factors on development.
- Studies have shown that hereditary influences may set the limits for development of some abilities, but that the environment will determine whether the individual can develop according to the inherited capacity.
- Heredity and environment contribute to the development of an individual's biological, cognitive and social patterns. Therefore both nature and nurture influence an individual's psychological development.

Critical and sensitive periods

- There are narrow times of increased sensitivity to environmental influences that can permanently alter the course of development. These are called critical periods, when exposure to certain stimuli must occur in order for learning to occur (it depends on it).
- A sensitive period is linked to the concept of experience-expectant learning, in that it is a stage in the organism's development where we would expect certain behaviour to develop. As exposure and learning are expected to occur, if it does not occur during this sensitive period the organism may still acquire the learning at a later date, it just may take longer and require more effort to learn the behaviour than if the organism learned it during the sensitive period.

The importance of attachment

- Many of these critical periods, such as forming attachments to other humans and language development, occur in the first years of life. If an individual were deprived of the nurture (environment) with which to thrive or there were problems with the nature (genetic) component of an individual, then development might not follow the norm.
- Harry Harlow used infant monkeys to study the role of feeding on infant–mother attachment. He concluded that contact comfort was more important than feeding in the formation of an infant's attachment to its mother.
- Mary Ainsworth devised a unique way to measure the attachment of infants to their mothers. This is called the Strange Situation, where infants are placed in a room with a stranger. She was able to develop three categories of infant behaviour: Group A is the avoidant attachment type, group B is the securely attached type, and group C is the anxiously attached type.
- Temperament and genetics may also play a role in attachment and therefore the emotional development of children. Some psychologists argue that infants may fail to form attachment to caregivers because of temperament and genetic factors and not because of the quality of the care and attention given by the caregiver.

The development of cognitive abilities

- Piaget studied children's reasoning abilities in hundreds of experiments. The data he collected led to the development of the theory that children experience a series of four developmental stages from infancy through to adolescence: the sensorimotor stage, the preoperational stage, the concrete operational stage and the formal operations stage. According to Piaget, at each of these stages children become able to reason in a qualitatively different and more advanced way.

Psychosocial development

- Personality theorist Erik Erikson suggests that we face a specific psychosocial dilemma, or 'crisis', at each stage of life. A psychosocial dilemma is a conflict between personal impulses and the social world. Resolving each dilemma creates a new balance between a person and society. A string of 'successes' produces healthy development and a satisfying life. Unfavourable outcomes throw us off balance, making it harder to deal with later crises, and our personal growth may be stunted.

APPLY YOUR KNOWLEDGE AND SKILLS

SECTION A: MULTIPLE-CHOICE QUESTIONS

Answer the following questions by writing the correct letter in your workbook. Only one answer is correct for each question.

1 What do psychologists mean by the term 'nature'?

- **A** The environmental influence on development
- **B** The genetic influence on development
- **C** The cognitive influence on development
- **D** The social influences on development

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2 Identical twins are used in studies to look at the effects of:

- **A** environment on development.
- **B** genetics on development.
- **C** environment and genetics on development.
- **D** deprivation on development.

3 A critical period refers to:

- **A** the most important time in the life of an organism.
- **B** cell growth and degeneration over time.
- **C** the optimal time for certain capacities to emerge in an organism.
- **D** All of the above

4 Experience-expectant learning is associated with:

- **A** critical periods.
- **B** sensitive periods.
- **C** emotional expectations.
- **D** imprinting.

5 The independent variable in Harlow's 1958 experiment on attachment was:

- **A** whether the surrogate was made from wire or cloth and contained the feed bottle.
- **B** whether the monkey preferred the wire or cloth surrogate mother.
- **C** the amount of time the monkeys spent on the surrogates.
- **D** the attachment the monkeys formed for the surrogates.

6 The dependent variable in Harlow's 1958 experiment on attachment was:

- **A** whether the surrogate was made from wire or cloth and contained the feed bottle.
- **B** whether the monkey preferred the wire or cloth surrogate mother.
- **C** the amount of time the monkeys spent on the surrogates.
- **D** the attachment the monkeys formed for the surrogates.

7 Harlow findings were that:

- **A** the monkeys spent more time on the wire surrogate and only spent time on the cloth surrogate to feed.
- **B** contact comfort was not important; feeding capability was important.
- **C** contact comfort was the most important factor in infant and mother attachment.
- **D** the surrogates providing the food were the most important factor in the infant and mother attachment.

8 Bowlby:

- **A** believed that children have basic needs like shelter and food, and as long as these are met, they will develop normally.
- **B** observed children in institutions and saw that they were well cared for.
- **C** believed that infants can thrive without their mothers as long as their physical needs are well taken care of.
- **D** observed that children who lacked relationships with others early in life, were open to negative psychological consequences later in life.

9 Ainsworth identified a number of behaviours in infants that she thought were evidence of an infant's attachment to a caregiver. Which of the following is not an example of attachment?

- **A** Crying to attract the caregiver's attention
- **B** Crying when being put down by the caregiver
- **C** Vocalising more in the presence of the caregiver than with others or when alone
- **D** Ignoring the caregiver

10 Ainsworth's category of 'anxiously attached' infants were characterised as showing:

- **A** great distress when their mothers left the room, and were not easily calmed when she returned.
- **B** indifference to their mothers and rarely cried when their mothers left the room and showed her little attention when she returned.
- **C** great distress when their mothers left the room, and greeted her with pleasure when she returned.
- **D** great distress when their mothers left the room, and were easily calmed when she returned.

11 Temperament refers to an individual's:

- **A** ability to deal with stress.
- **B** ability to control their anger.
- **C** sensitivity, activity levels, mood, irritability and ability to adapt.
- **D** temper.

12 According to Piaget, when children behave in an egocentric manner, they are in the _____ stage of development.

- **A** sensorimotor
- **B** preoperational
- **C** concrete operational
- **D** formal operations

13 The formal operations stage of Piaget's theory involves the accomplishment of:

- **A** object permanence.
- **B** conservation.
- **C** goal-directed behaviour.
- **D** hypothetical thinking.

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14 Maturation is involved in which of the following behaviours?

- **A** Beginning to walk
- **B** Beginning to speak
- **C** Beginning to crawl
- **D** All of the above

15 Stage seven of Erikson's theory of psychosocial development was called:

- **A** integrity versus despair.
- **B** intimacy versus isolation.
- **C** initiative versus guilt.
- **D** generativity versus stagnation.

SECTION B: SHORT-ANSWER QUESTIONS

1 Discuss how developmental norms might be useful for:

- **a** a school teacher who wants to know what children are capable of at different ages
- **b** a doctor who wants to know if a child's growth is normal
- **c** a toy manufacturer making children's toys.

2 Explain the importance of both hereditary and environmental influences on development.

3 Distinguish a difference between a critical period and a sensitive period.

4 What is a similarity between a critical period and a sensitive period?

5 What did the results of Harlow's infant–mother attachment research demonstrate?

6 Identify and describe the three types of infant behaviour Ainsworth categorised in the Strange Situation experiment.

7 Identify a criticism of Piaget's theory on cognitive development.

8 Describe the difference between concrete thinking and symbolic thinking.

9 What is a similarity between Piaget's cognitive development theory and Erikson's theory of psychosocial development?

10 Draw a flowchart of Erikson's psychosocial development theory.

SECTION C: EXTENDED-RESPONSE QUESTION

Read the following article and answer the questions.

In 1991, Oxana Malaya was found at the age of eight, living with a pack of dogs on her parent's farm, in the Ukraine. Apparently, her alcoholic parents left her outside one night when she was three years old, and she crawled into a hovel where they kept the dogs. That is where she is reported to have lived the next five years of her life, eating raw meat and scraps, and surviving as a member of the pack of dogs. When found, reports were that she could hardly speak, she ran around on all fours like a dog, and barked like a dog.

In 2006, a British child psychologist visited Oxana then aged 23 to see how she had integrated into society. She reported that: 'Her language is odd. She speaks flatly as though it's an order. There is no cadence or rhythm or music to her speech, no inflection or tone … When she walks, you notice her strange stomping gait and swinging shoulders, the intermittent squint and misshapen teeth. Like a dog with a bone, her first instinct is to hide anything she is given. She is only 1.52 metres tall …'

The psychologist tested her cognitive level and found that Oxana had the mental capacity of a 6-year-old. She was able to count, but not perform addition. She could not read or spell her own name. At an orphanage school, they taught her to walk upright, to eat with her hands and, crucially, to talk.

Source: Adapted from Grice, E. (2006, July 19). Gone to the dogs: The girl who ran with the pack. *The Age*.

QUESTIONS

1 Identify the sampling procedure that was used to collect the data for this particular research on deprivation.

2 What is a limitation of this procedure?

3 Identify another sampling procedure and describe a procedure to obtain a sample using this method.

4 Outline an advantage of using a case study.

5 In terms of psychological research methods, provide one reason to explain why this is best classified as a case study rather than an experiment.

6 Studies like Oxana's have made useful contributions to our understanding of development. Provide two reasons why it is difficult to generalise the findings of this study.

7 What were the findings of this case study and how can they be helpful?

This question is worth 10 marks.

SECTION D: ASSESSMENT TASK

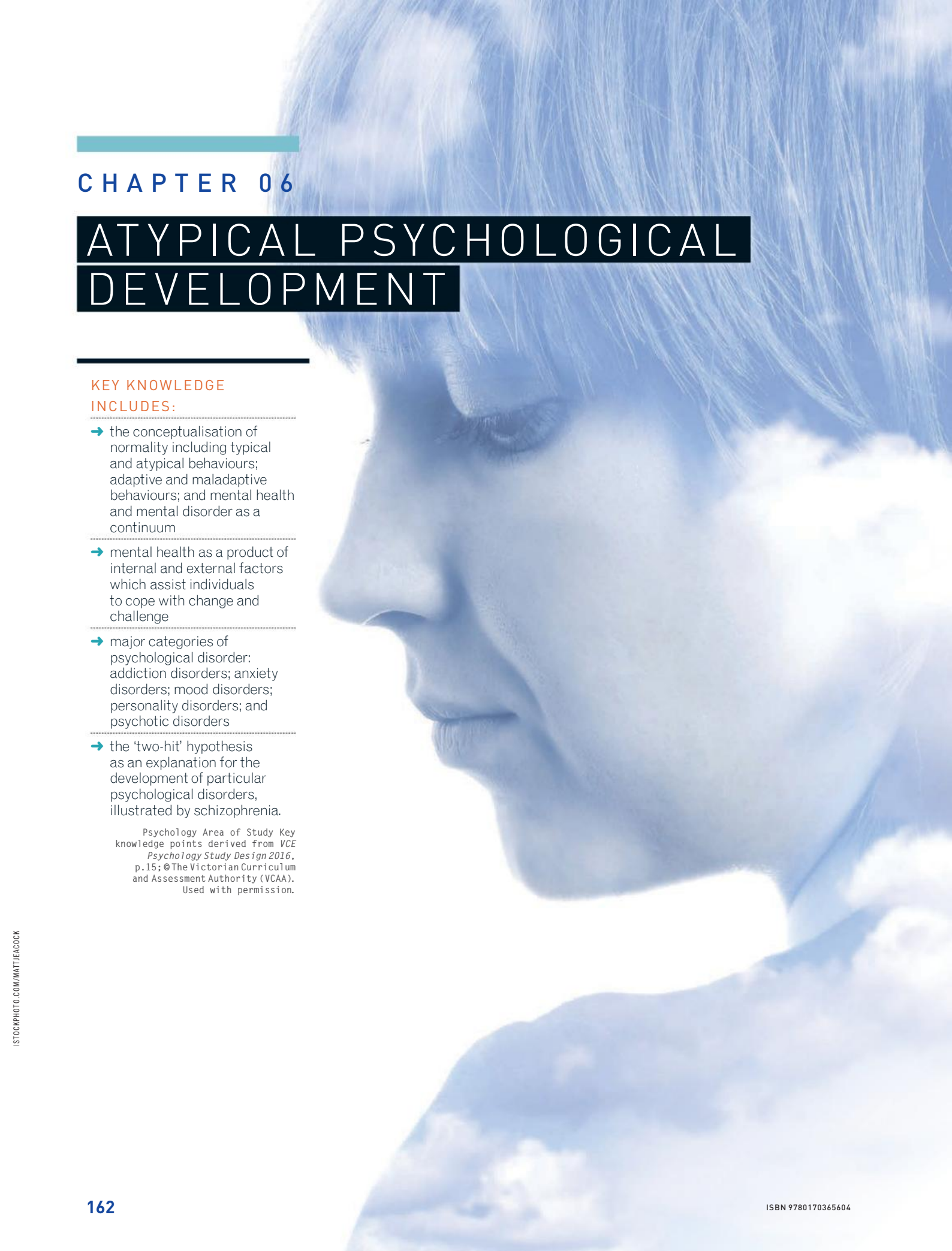
DIGITAL PRESENTATION

You are to present a digital presentation on Erikson or Piaget's theories that informs your audience of:

- **a** what the theory is and the area of development it attempts to explain
- **b** the stages of the theory (name, age range and crisis or major accomplishments)
- **c** an evaluation of the theory.

CHAPTER 06

ATYPICAL PSYCHOLOGICAL DEVELOPMENT



KEY KNOWLEDGE INCLUDES:

- the conceptualisation of normality including typical and atypical behaviours; adaptive and maladaptive behaviours; and mental health and mental disorder as a continuum
- mental health as a product of internal and external factors which assist individuals to cope with change and challenge
- major categories of psychological disorder: addiction disorders; anxiety disorders; mood disorders; personality disorders; and psychotic disorders
- the 'two-hit' hypothesis as an explanation for the development of particular psychological disorders, illustrated by schizophrenia.

Psychology Area of Study Key knowledge points derived from *VCE Psychology Study Design 2016*, p.15; © The Victorian Curriculum and Assessment Authority (VCAA). Used with permission.

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NORMALITY: TYPICAL AND ATYPICAL BEHAVIOUR

What is the normal bedtime for a teenager? What sports are normal to play and watch? Do I look normal when I go to out on the weekend and interact with my friends? Normality (and, conversely, abnormality) is a difficult concept to define. Popular conceptions of normality are derived from looking at what a majority of people do. For example, on casual dress days at school, most people wear jeans – so if someone is wearing something else, say their pyjamas, would they be characterised as abnormal? If most people in a particular year level are more than five feet tall but someone is shorter than that, are they abnormal?

In young children, normal behaviour is often defined by comparing development and behavioural capabilities with other children of the same age. Most of the major developmental milestones such as language acquisition (how many words children know and can use at particular ages) and movement (such as crawling and walking) are well documented. Developmental norms assist health practitioners and caregivers to make a judgment based on the comparison of what most people of a particular age can do or not do in order to determine whether behaviour is normal.

When something is considered normal or abnormal, terms such as 'typical' or 'acceptable' are also commonly used. These terms are ambiguous and very subjective, and require some level of value judgment. They can also have cultural and social variations, because what might be acceptable in one culture or society may not be acceptable or typical in another (Sadock & Sadock, 2003). However, most psychologists define typical behaviour as behaviour that represents most people, or, if used in the context of the individual, typical could also mean the common, most likely behaviour exhibited by that individual. Atypical behaviour relates to those behaviours that do not represent the behaviour of the majority, or, if used to describe an individual's behaviour, it could mean that the behaviour is not usual for them. Atypical behaviours are those that deviate from the 'norm' or what is deemed normal in a social context. The judgment being made regarding the behaviour is done through comparing it to others behaviour within the same social context.

Most of the time we can use the terms 'typical' and 'normal' interchangeably, and the decision to determine whether a particular behaviour is typical or normal needs to be made using one or more of the approaches to defining normal behaviour discussed later in the chapter.

Typical behaviour can also specifically refer to the individual. Does the individual typically (normally) behave in a particular manner? We all have our own quirks and individual qualities, so ascertaining whether a behaviour is a typical pattern of behaviour for that individual or not (atypical) may alter the perception of the behaviour. If a person typically (always) wears pyjamas to school, then wearing pyjamas would be normal behaviour for that person, but not typical behaviour for most people within society. Another example might be if your best friend, who would typically give you a hug or a handshake when you met them, started to avoid you and merely grunted 'hello' when they saw you, you might think this was atypical behaviour for them. However, this behaviour may be typical of your little brother, who is grumpy in the morning and hates you hugging him.

Generally, psychologists agree that normality refers to patterns of behaviour or personality traits that are typical, or that conform to some standard of proper and acceptable ways of behaving. By this definition, wearing pyjamas to school on a casual dress day may be considered abnormal, as it is not typical behaviour compared to most people. Likewise, behaviour that is considered unacceptable, such as smoking in a car with children, can also be considered abnormal.

Abnormal or atypical behaviour does not necessarily pose a problem to the individual or to society. There are many behaviours that could be defined as 'abnormal' or 'atypical' behaviour that are positively valued by society, such as being abnormally talented at playing an instrument or sports. To determine whether a behaviour is harmful or has the potential to impact on the individual or society, we often use the terms 'adaptive' and 'maladaptive' to distinguish behaviours that positively contribute to the individual's ability to live a full and productive life and those that have a potentially negative impact.

typical behaviour Behaviour that represents what most people do

atypical behaviour Behaviour that does not represent the behaviour of the population of interest

normality Patterns of behaviour or personality traits that are typical, or that conform to some standard of proper and acceptable ways of behaving

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ADAPTIVE AND MALADAPTIVE BEHAVIOUR

Adaptive behaviour is determined by an individual's social and practical ability or competence of daily skills to meet the demands of everyday living. As we age, our needs and requirements change. To meet these changes, each person needs to adapt in order to grow and develop skills to meet their changing needs. These adaptations range from learning to dress oneself and taking care of personal hygiene when a child to managing personal finances and paying bills when an adult.

Maladaptive behaviour is defined as behaviour that interferes with an individual's practical ability or competence to complete daily skills in order to meet the demands of everyday living. Maladaptive behaviours cover a wide spectrum. They vary from minor behaviours that may only slightly impair an individual's overall functioning to more serious behaviours that do interfere with an individual's practical ability or competence of daily skills to meet the demands of everyday living. These behaviours can prevent an individual from reaching goals in life, having fulfilling relationships with others and working effectively.

Some behaviours that are commonly accepted by society, but not necessarily encouraged, are considered maladaptive once they begin to detract from the person's ability to undertake normal daily activities. For example, drinking alcohol in moderation is not considered maladaptive. If the person drinks alcohol excessively and they are unable to carry out their normal daily activities, it would be considered maladaptive. The concept of whether a behaviour is maladaptive or not is a very important component in diagnosing problems such as drug abuse.

A maladaptive behaviour, such as avoidance of an unpleasant situation, can begin as a minor maladaptive behaviour, but escalate to impair functioning over time. For example, if a student has not studied for a SAC, they create an unpleasant situation for themselves. If, on the morning of the SAC, they tell their parents that they feel ill and can't go to school, this may not result in severe consequences for them. However, if the student responded in the same way each time they had an assessment, their behaviour could develop into more maladaptive behaviour that interferes with their education in the long term.

Some behaviours can be defined as atypical but not maladaptive, such as wearing pyjamas to school. This is atypical because it is not a behaviour that most people would demonstrate; however, it is not harmful and does not stop the person's normal functioning, so it is not maladaptive. Some behaviours can be defined as typical and still meet the definition of maladaptive behaviour. For example, if a university student drank excessive amounts of alcohol at every party they attended, this behaviour would be considered typical. However, because the behaviour is potentially harmful, it would be considered maladaptive. In other circumstances, behaviour can be both atypical and maladaptive, such as jogging along the freeway without wearing clothes (most people do not do it and it is potentially dangerous).

6.1 CHECK YOUR UNDERSTANDING >>

1 Adaptive behaviours are those that:
   - A enable a person to change behaviour to ensure they have a good time.
   - B enable a person to function effectively and to meet the requirements of everyday living.
   - C decrease the effectiveness of functioning.
   - D do not change as a person grows older.

2 Herman likes to separate all the food on his plate and he makes sure none of the different foods touch. If they do touch, he gets very upset and refuses to eat. This is an example of:
   - A adaptive behaviour.
   - B maladaptive behaviour.
   - C developmental norm.
   - D normal behaviour.

3 Which of the following elements is considered sufficient to make a decision that a behaviour is abnormal?
   - A Deviancy
   - B Maladaptiveness
   - C Suffering
   - D None of the above

4 Identify a difference between adaptive behaviours and maladaptive behaviours.

5 Explain the difference between typical and atypical behaviours.

CONCEPTS OF NORMALITY

Because some behaviour may be considered normal in one context but not normal in another, there are a number of different approaches that are used to explain the concept of normality. We will now examine several of these.

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THE SOCIOCULTURAL APPROACH

The sociocultural approach considers whether behaviour is typical according to the cultural values and beliefs of a particular society – whether behaviour fits in with the norms of that society. Culture is one of the most influential contexts in which any behaviour is judged.

In some cultures it is considered normal to talk loudly, wave your arms in a spirited manner during a conversation, or hug or kiss someone in public; in other cultures, the norm is to be more demure. In some cultures, women are considered normal and even virtuous if they remain housebound, do not work and have little say in matters of the outside world. However, in modern-day Western cultures these same women might be diagnosed as suffering from agoraphobia or be considered significantly disempowered (Widiger & Sankis, 2000). In Australia it is illegal and considered abnormal to be married to more than one person at the same time, but in some Middle Eastern countries this is considered a tradition and seen as normal and acceptable behaviour. We can see that there is a fine line between classifying behaviours as normal and abnormal across certain cultural contexts.

Social nonconformity refers to disobeying the standards set by society for what is acceptable conduct. Social nonconformity can result from faulty socialisation, and often leads to destructive or maladaptive, self-destructive behaviour (such as drug abuse) and emotional instability. However, we must be careful to distinguish between unhealthy nonconformity and healthy creativity and uniqueness. People who dress or act differently to the majority are not necessarily nonconformist in an unhealthy way, nor is their behaviour necessarily unacceptable or maladaptive – unique individuals are generally emotionally stable and function normally in society (see Figure 6.1).

When individuals do not conform to society's norms, many judgments are made about their decisions and behaviours. A lack of ability to conform to society's expectations can be an indicative factor of a lack of mental wellbeing. Cultural relativity (the idea that judgments are made relative to the values of one's culture) can affect the diagnosis of what may be considered a psychological disorder (Alarcon, 1995). All cultures classify people as abnormal if they consistently fail to communicate with others or are consistently unpredictable in their actions. That is, for behaviour to be considered abnormal, not only should it be unacceptable, unusual and out of keeping with acceptable social norms, but it must also be enduring and persistent, leading to disability in several domains of the person's life.



FIGURE 6.1 Social nonconformity does not automatically indicate abnormality.

THE FUNCTIONAL APPROACH

The functional approach defines normality by the level of one's ability to interact and involve oneself in society. 'Functioning' refers to the ability to undertake everyday tasks such as personal hygiene, going to work or eating food. If you do not regularly wash or eat, or you are unable to hold a job, according to the functional approach you would be defined as abnormal. Another example is staying in bed all day. It is 'normal' to stay in bed all day every now or then, when you are sick or very tired, but to do it every day is considered maladaptive and abnormal according to the functional approach.

adaptive behaviour Behaviour that allows a person to competently meet and adapt to the demands of everyday living

maladaptive behaviour Behaviour that is potentially harmful and prevents a person from meeting and adapting to the demands of everday living

sociocultural approach Defines normality by determining whether behaviour is typical according to the cultural values and beliefs of a particular society

norm A general 'rule' or standard

social nonconformity Failure to conform to societal norms or the usual minimum standards for social conduct

functional approach Defines normality by the level of one's ability to interact and involve oneself in society

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Psychologists can use a 36-item self-administered assessment device that assesses disability in adults over the age of 18 called the World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0) to assess functionality. It asks the individual to rate how much difficulty they have had across six domains, including understanding and communicating, getting around, self-care, getting along with people, life activities (household, work and school activities) and participation in society during the past 30 days (American Psychiatric Association [APA], 2013).

THE HISTORICAL APPROACH

Over time, a particular culture's definition of normal and abnormal behaviour can change. Thus, the historical approach to defining normality depends on the period of time, century or era in which the judgment is made. For example, in Ancient Greece, homosexuality was considered normal; yet, Western society frowned on homosexuality and it was classified as a mental disorder by various psychiatric associations around the world up until the 1970s. In the early 1970s, homosexuality was removed as a 'diagnosis' from psychiatric diagnostic manuals, meaning it was no longer considered 'abnormal' to be homosexual. In many countries today, particularly in Australia, there is greater acceptance of homosexuality; however, homosexuals are still fighting to be treated equally and to be allowed to legally marry. Australia still appears divided on this issue, although around the world the historical context is changing. In 2015, Ireland voted to approve a change to the constitution to extend civil marriage rights to same-sex couples (see Figure 6.2).



FIGURE 6.2 Definitions of normal behaviour depend on the period of time, century or era in which the judgment is made. For example, same-sex marriages are no longer described as abnormal in some parts of the world.

THE SITUATIONAL APPROACH

The situational approach to classifying what is considered normal refers to the social situation, behavioural setting or general circumstances in which the behaviour occurs (see Figure 6.3).



FIGURE 6.3 Shouting would be considered normal behaviour at a football match, but it could be seen as abnormal at a funeral.

Almost any imaginable behaviour can be considered normal in some contexts, as the following example indicates. In October 1972, a plane carrying a rugby team called the Old Christians crashed in the snow-capped Andes of South America. Incredibly, 16 of the 45 people who had been on board at the time of the crash survived for 73 days in deep snow and subfreezing temperatures. They were forced to use extremely grim measures to do so – they ate the bodies of those who had died in the crash. In any other situation, this would be classified as abnormal, but although cannibalism is certainly a taboo subject, this behaviour may be viewed differently considering the context or situation that these people found themselves in. Their behaviour may be more acceptable because of the situation and the need to adapt: the survivors would have died if they had not eaten those who were already dead.

THE MEDICAL APPROACH

According to the medical approach to normality, an individual is considered to be normal if they are physically healthy; as such, abnormality is determined by having an illness that has an underlying physical cause. Someone who is colour-blind would not be considered medically normal, nor would someone who has a common cold.

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Psychologists and psychiatrists following this approach assume that mental illness is a reflection of medical abnormality. Therefore, they suggest mental illness can be diagnosed, treated and sometimes even cured using specific drugs or medical procedures. In support of this approach, there is a growing body of research that suggests a link between biological factors and mental disorders such as schizophrenia and depression. For example, there is now some evidence to show that schizophrenia is related to overactivity in brain dopamine systems (Heinrichs, 1993). Dopamine is a neurotransmitter that is found in the brain and is believed to be associated with emotional response. It appears to trigger a flood of unrelated thoughts, feelings and perceptions, which may account for voices, hallucinations and delusions in schizophrenia (Gottesman, 1991).

THE STATISTICAL APPROACH

Some psychologists try to define normality using objective measures such as statistics. The statistical approach defines normality based on the experiences and behaviour of the statistical majority. For example, if an individual obtains an extremely high or low score on an IQ test, an extremely high or low ATAR score or a very high or very low score on an anxiety scale, this individual would be in the statistical minority and would therefore be considered abnormal.

Usually, the results of such tests will form a normal curve (bell-shaped curve). A bell-shaped curve has a large number of scores in the middle, tapering to very few extremely high and low scores. Notice that most people in the levels of anxiety graph in Figure 6.4 score in the central region of the curve. A person who deviates from the average by being anxious all the time (high anxiety) might be considered abnormal. So, too, might a person who never feels anxiety. These people's scores would be located on the extreme left or right side of the normal curved graph.

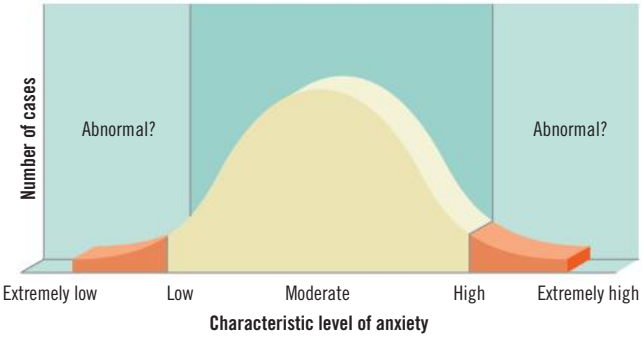


FIGURE 6.4 The number of people displaying a personal characteristic may help define what is statistically abnormal.

One limitation of the statistical approach to normality is that it does not distinguish between abnormal behaviour that is desirable and that which is not desirable. For example, it is statistically abnormal for a person to score above 145 or below 55 on an IQ test, in which the average IQ score is 100. In our society it is desirable to score at the high end of a normal IQ curve, and it is a score below 55 that is considered undesirable (Wakefield, 1992); although both scores are actually considered abnormal, only one is considered undesirable.


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FIGURE 6.5 Bill Gates, co-founder of the software company Microsoft, is reported to have an IQ of 160. According to the statistical approach, this is classified as abnormal.

Another problem with statistical definitions is the issue of where to draw the line between normality and abnormality. To take another example, we could obtain the average (normal) amount of food eaten per day for people of a particular age and sex. It is probably fair to say that a person who feels driven to eat four packets of biscuits, two loaves of bread and half a chicken in two hours has an eating problem, because this would be very much outside the norm. But as we move back towards the norm, we face the statistical problem of where to draw the line that determines what is normal and abnormal: how far must people deviate in order to be considered abnormal? If it is deemed normal to eat two serves of fruit and five serves of vegetables a day, is a person abnormal if they eat three serves of fruit

historical approach Defines normality by the period of time, century or era in which the judgment is made

situational approach Defines normality by the social situation, behavioural setting or general circumstances in which the behaviour occurs

medical approach Defines normality as an individual being physically healthy and abnormality as having an illness that has an underlying physical cause

statistical approach Defines normality according to the experiences and behaviour of the statistical majority

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and six of vegetables? Or is the behaviour not deemed abnormal unless they eat five or six serves of fruit and eight or nine of vegetables? As you can see, statistical boundary lines tend to be somewhat arbitrary (Widiger & Trull, 1991).

Table 6.1 provides a summary of the different approaches to normality.

TABLE 6.1 Summary of the different approaches to normality

APPROACH	DEFINITION OF NORMALITY	ADVANTAGES	LIMITATIONS
Sociocultural	Obeying societal standards for acceptable conduct	There are some universal norms; e.g. all cultures consider it normal to be able to communicate with others and behave in a predictable fashion	Different cultures often have different ideas about acceptable behaviour
Functional	Functioning or coping adequately in society	Provides an understandable framework in which to classify normality	People's ideas about functionality vary
Historical	Obeying standards for acceptable conduct in a particular era	Standards change over time, which may be positive	Normality may not be consistent in every culture in a particular era
Situational	Obeying popular or common standards in a particular social situation	Almost any behaviour can be classified as normal in some contexts	Sociocultural or functional views of normality may impact on situational factors
Medical	The absence of illness with an underlying physical cause	Allows professionals to communicate, diagnose, treat and possibly cure illness	Mental illness may be a social problem rather than a physical one
Statistical	Fitting in with the most commonly occurring characteristics in a society	Commonly occurring characteristics or behaviours are usually seen by society as acceptable and positive	Some extreme characteristics are desirable, but also classified as abnormal; it doesn't give any information about the meaning of the deviations from the norm

6.1 TRY IT YOURSELF >>

NORMAL VERSUS ABNORMAL

Images of what is considered normal and abnormal are all around us. For example, celebrities are airbrushed on magazine covers to portray flawless images, leading teenagers to believe that a skin blemish is abnormal.

Obtain a piece of poster paper and draw a line down the middle of the page. Label one half 'Normal' and one half 'Abnormal'. Cut out images or articles from magazines or newspapers that reflect the views of society, and attach them to the appropriate side of your poster paper.

QUESTIONS

1 Discuss these images and their classifications with your class.
   a Are they a negative or positive influence on an individual?
   b Are all the 'abnormal' behaviours negative?

6.2 CHECK YOUR UNDERSTANDING >>

1 The approach to defining normal behaviour can change over time, so that a behaviour that was considered normal 50 years ago may now be considered abnormal. This approach is called the _____ approach.
   A statistical
   B medical
   C sociocultural
   D historical

2 Crying at a funeral instead of laughing hysterically is considered normal behaviour in this context. Which of the approaches to defining normality is used to reach this judgment?
   A The situational approach
   B The medical approach
   C The sociocultural approach
   D The historical approach

3 The sociocultural approach uses:
   A cultural values and beliefs of a particular society to make a judgment on normality.
   B the context or situation in which the behaviour is made to inform a judgment regarding normality.

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C the physical wellbeing of an individual to make a judgment if their behaviour is normal or not.

D small groups of the population to make a judgment if behaviour is normal.

4 Explain two limitations of using the statistical approach to defining normal behaviour.

5 Describe some of the information a psychologist may use to define behaviour as abnormal using the functional approach.

WHAT IS HEALTH?

The World Health Organization (WHO) defines health as 'a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity' (WHO, 1948). This holistic approach to health means that health is not simply the absence of physical illness – we also need to feel mentally, socially and spiritually well to have a complete sense of good health.

Maintaining health or wellness is a lifelong pursuit and people who attain optimal wellness are both physically and psychologically healthy (Figure 6.6). They engage in positive thinking, show emotional resilience and are optimistic and self-confident (Lightsey, 1996). People who enjoy a sense of wellbeing also have supportive relationships with others, do meaningful work, and live in a clean environment.



FIGURE 6.6 Mental and physical health is a lifelong pursuit.

MENTAL HEALTH AND MENTAL ILLNESS

Mental health (as opposed to ill health or mental disorder) is often defined as the psychological state of someone who is functioning at a satisfactory level of emotional and behavioural adjustment. This also means that they are functioning well in the usual domains of their everyday life: work, study and relationships.

However, we cannot function at optimal levels at all times. We could feel stressed from the pressures of VCE, part-time work, friends and parental expectations. We could feel low when our team loses in football or netball, or on top of the world when our team wins. These are very normal feelings. Feeling 'blue' or 'down' in itself does not constitute mental ill-health or a mental illness, so it is important that we have normal human emotions in perspective.

While most people experience mental health problems at some point, not all problems can be considered mental illness. Mental health problems indicate a disruption to an individual's usual level of social and emotional wellbeing, including when our abilities are negatively affected (Hunter Institute of Mental Health, 2014). Mental health problems are generally not significant, nor do they last for a lengthy period of time, so they do not meet the criteria to make a diagnosis of a mental illness. Mental health problems are often triggered by normal life experiences such as stress. Once the stressor is removed, many mental health problems are resolved, symptoms stop or are reduced. If the stressor is not removed or the individual is not able to overcome the symptoms, then it is possible for a mental health problem to develop into a mental illness.

A person who has developed resilience will be more protected from developing mental illness because they have the ability to bounce back during or following difficult times. They may be able to resolve these situations more quickly and positively because they can adapt and cope. Support from family, friends, a counsellor or other professionals can also lead to better outcomes when mental problems arise. Grief following the loss of a loved one and relationship issues are common triggers for mental health problems.

Mental illness is a psychological state characterised by significant emotional, cognitive or social difficulties or disability serious enough to require psychiatric intervention. The term 'mental illness' is often used interchangeably with the term 'mental disorder'.

health A state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity

mental health The psychological state of someone who is functioning at a satisfactory level of emotional and behavioural adjustment

mental illness The psychological state of someone who has emotional or behavioural problems serious enough to require psychiatric intervention

Mental illness can be diagnosed by a mental health professional by determining if the combination of symptoms and severity of the symptoms over time meet certain criteria.

The scientific and systematic study of abnormal experience, cognition and behaviour is known as psychopathology (Sims, 2003). The term 'psychopathology' also refers to mental disorders themselves or to psychologically unhealthy behaviour. Thus, it covers not only maladaptive (inappropriate) behaviour – such as drug addiction, compulsive gambling (Figure 6.7) or a loss of contact with reality – but also any behaviour that interferes with personal growth and self-fulfilment (Carson, Butcher, & Mineka, 1997).



FIGURE 6.7 Compulsive gambling is indicative of psychologically unhealthy behaviour that can be a sign of mental illness.

MENTAL HEALTH AND MENTAL DISORDER AS A CONTINUUM

In a continuum model, mental health and mental disorder are seen as related but distinct dimensions. A continuum is used to show the different levels of a particular concept or how a concept can change over time. The ends of the continuum, or extremes of the scale, are distinct from each other, and the elements in between are arranged in a continuous sequence that shows how the concept changes slowly so that adjacent elements of the continuum are not perceptibly different from each other. Not every person will experience the extremes of the continuum, but statistics suggest nearly half (45 per cent) of the population will experience a mental disorder at some stage in their lives (SANE, 2015).

A fundamental difference between mental health and mental illness is that everyone has some level of mental health all of the time, whereas it is possible to be without mental illness. For this reason, mental health and mental illness are depicted on two separate dimensions (see Figure 6.8). On one continuum, optimal mental health is found at one extreme and poor mental health at the other extreme, while on a separate continuum, mental illness (symptoms of a diagnosable disorder) is found at one extreme and no mental illness is found at the opposite end. This style of continuum is helpful to show that an individual can be mentally healthy with a mental illness and that someone can have poor mental health without a mental illness. For instance, a person who is diagnosed with bipolar disorder may have a diagnosed mental disorder, but also maintain good mental health (Hunter Institute of Mental Health, 2014).

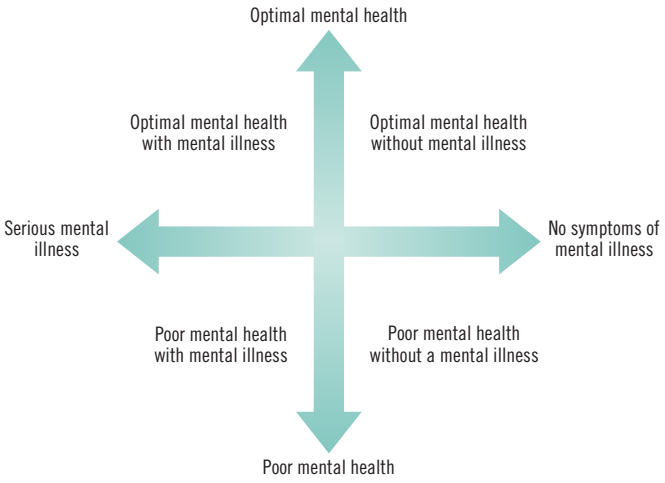


FIGURE 6.8 The mental health and mental illness continuum

When we learn about mental illness, we may be susceptible to developing the psychological equivalent of 'medical school syndrome'. Medical school syndrome is a form of hypochondria that affects some people in training to be a physician – as medical students learn about symptoms of physical illness, they may see such symptoms in themselves and begin to think they are unwell. Hypochondria refers to a preoccupation with minor bodily problems and the presence of illnesses that appear to be imaginary.

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The psychological equivalent may afflict VCE students learning about mental health and illness because students are always encouraged to apply what they learn to their own lives and experiences. However, this is one topic where doing so may cause confusion and unnecessary worry. It is quite natural to question whether or not you may have a mental illness. In all likelihood none may exist – it is absolutely acceptable and 'normal' to feel stressed and experience symptoms discussed within this chapter because adolescence is a time filled with challenges and pressures. However, it is also equally important not to trivialise your experiences and feelings when feeling stressed for fear that you would 'look stupid' or that your friends will think of you as 'weak'. If you feel something is wrong, seek the help of a trusted teacher or school counsellor (Figure 6.9), and also remember that many people experience symptoms of mental illness during their lifespan.



FIGURE 6.9 Talking about your worries with a school counsellor is a positive step towards maintaining good mental health.

FOCUS ON RESEARCH 6.1

ONE IN FIVE: FACTS ABOUT MENTAL ILLNESS IN AUSTRALIA

- In 2007, of the 16 million Australians aged 16–85 years, almost half (45% or 7.3 million) had a lifetime mental disorder; that is, a mental disorder at some point in their life.
- One in five (20% or 3.2 million) Australians have experienced a mental disorder at some time in the last 12 months.
- Younger people are more likely to experience a mental illness than older people. The prevalence of mental disorders is greatest in the 18–24 age group and then declines with age.
- Anxiety disorders and substance misuse disorders are the most common illnesses in any 12-month period in the 18–24 age group (see Table 6.2).

TABLE 6.2 Prevalence of mental disorders in Australian adults: 12-month period (2007)

	MALES		FEMALES	
DISORDERS	POPULATION ESTIMATE	% OF TOTAL POPULATION	POPULATION ESTIMATE	% OF TOTAL POPULATION
Anxiety disorders	860 700	10.8	1 442 300	17.9
Affective disorders	420 100	5.3	575 800	7.1
Substance use disorders	556 400	7.0	263 500	3.3
Any mental disorder	1 400 100	17.6	1 797 700	22.3

Source: ABS. (2007). *National survey of mental health and wellbeing: Summary of results* (Cat. no. 4326.0)

psychopathology The scientific and systematic study of abnormal experience, cognition and behaviour; also a term used to refer to psychologically unhealthy behaviour

hypochondria A preoccupation with minor bodily problems and the presence of illnesses that appear to be imaginary

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- Women experience higher rates of mental disorders than men (22% compared with 18%) and rates are higher for single adults. Women are more likely to experience depression and anxiety disorders, while men are more likely to experience substance abuse.
- Unemployed adults have a higher incidence of mental illness, compared with people in full-time employment. Homelessness seems to be a significant factor in mental health – more than half (54%) the people who had ever been homeless had a disorder, nearly three times the rate of people who had a home.
- One third (34%) of people living in one-parent families had a mental disorder compared with 19% of people in couple families with children.
- People living in country or rural areas are about 30% more likely to report symptoms of mental illness than their city counterparts (ABS, 2007).
- Children and adolescents who live in low-income, step or blended, and sole-parent families are also more likely to suffer from a mental illness (Al-Yaman, Bryant, & Sargeant, 2002).

QUESTIONS

1 What was the population of interest for this research?
2 What type of statistics have been used to represent the data in this study? Explain your answer.
3 Give an example of two conclusions that can be drawn from these research findings.

6.3 CHECK YOUR UNDERSTANDING >>

1 Health is characterised by:
   A mental wellbeing.
   B physical wellbeing.
   C social wellbeing.
   D All of the above
2 Which of the following is not a way of defining psychopathology?
   A Distress and impairment
   B Measuring personality
   C Maladaptive behaviour
   D Deviant from the norm
3 Mental illness is defined as:
   A a physiological state characterised by significant arousal of all bodily systems leading to medical intervention.
   B a slight disruption to an individual's usual level of social and emotional wellbeing.
   C a psychological state characterised by significant emotional, cognitive or social difficulties or disability serious enough to require psychiatric intervention.
   D a preoccupation with minor bodily problems and the presence of illnesses that appear to be imaginary.
4 Explain the difference between a mental health problem and a mental disorder.
5 Why is a continuum model useful for describing mental health?

BIOPSYCHOSOCIAL APPROACH TO PHYSICAL AND MENTAL HEALTH

As can be seen from its definition, health is not simply influenced by one or two factors. Indeed, there are many determinants that combine to influence the health of individuals and communities. These factors are broadly classified as protective factors and risk factors.

Protective factors enhance or have a positive effect on the health of an individual. Someone who maintains good physical and psychological health and maintains a good social support network is promoting their own wellbeing. Risk factors impede or have a negative effect on the health of an individual. Therefore, someone who has poor physical and psychological health and does not have a strong social network is not promoting their own wellbeing.

Protective factors and risk factors also have a biological, psychological and social perspective. The biopsychosocial model of health and illness considers health and illness in the context of these perspectives; that is, health and illness outcomes are determined by the interaction and contribution of both internal and external factors (see Figure 6.10).

Coping is the process of 'constantly changing cognitive and behavioural efforts to manage specific external and/or internal stressors that are appraised as taxing or exceeding the resources of the person' (Lazarus & Folkman, 1984). Coping includes the ability to adapt to changes and challenges in order to maintain health or overcome health problems. In order to cope with changes and challenges, a person may need to adjust the way they think, feel and behave.

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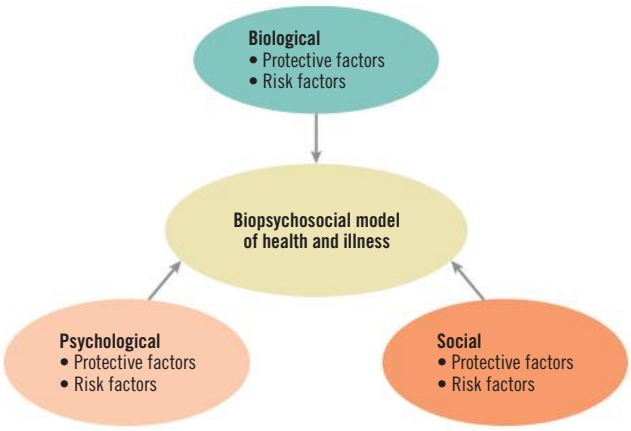


FIGURE 6.10 The biopsychosocial model of health and illness proposes that health and illness outcomes are a result of contributing biological, psychological and social factors.

STRESS: A CHALLENGE FOR MENTAL HEALTH

Stress refers to a state of mental or physical tension that occurs when an individual must adjust or adapt to their environment but they do not feel they have the capacity to do so. Therefore, stress is thought to occur when the demands on an individual exceed the perceived ability of that individual to cope. Stress is the state experienced when an individual is exposed to a stressor. A stressor is the object or the event that causes stress, such as an exam, the death of a family member or financial difficulties.

When you think about stress, you probably consider it to be a negative experience. But stress can be a positive experience as well as a negative one, and whether or not we experience stress can be largely determined by the way in which we appraise situations. Canadian physiologist Hans Selye, a researcher who coined the term 'stress' in the 1930s, observed that 'to be totally without stress is to be dead' (Selye, 1976). Growing up, travelling (Figure 6.11), going to a party, waiting your turn at a theme park during a crowded holiday at the Gold Coast, skiing at Mount Buller and other positive activities can be considered stressful. These activities can produce eustress, or a positive psychological response to a stressor that means the stress is evaluated as something the individual finds motivating or challenging and which they can generally cope with.

Experiencing eustress releases adrenalin into the body to help us perform at an optimal level. Activities that are perceived as challenging and rewarding may therefore be energising even though they produce a certain level of stress.

Stress becomes distress whenever emotional or physical pressures are intense, repeated, unpredictable and uncontrollable. Distress is a negative psychological response to stress that impedes our ability to perform and cope at an optimal level (see Figure 6.12). Stress in these situations can become magnified and damage is likely to result, not only to the person suffering, but also to the community. A Lifeline/University of Sydney survey in 2009 showed that the cost of distress to the community in terms of increased visits to doctors and missed days from work is approximately $300 000 per day (Lifeline, 2009).



FIGURE 6.11 Travelling can produce eustress.

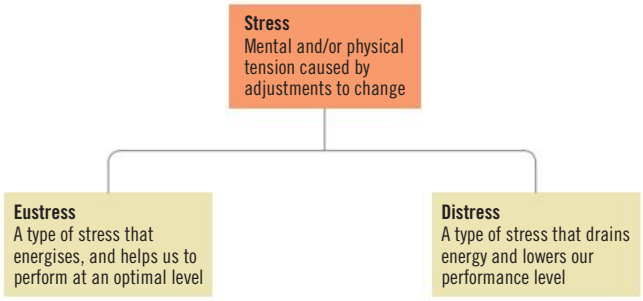


FIGURE 6.12 The two types of stress

protective factors Enhance or have a positive effect on the health of an individual

risk factors Impede or have a negative effect on the health of an individual

coping The process of adapting to manage specific external and/or internal stressors that are appraised as taxing or exceeding the resources of the person

stress Refers to a state of mental or physical tension that occurs when an individual must adjust or adapt to their environment but they do not feel they have the capacity to do so

stressor The object or the event that causes stress

eustress A positive psychological response to a stressor

distress A negative psychological response to stress

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It can be difficult to assess the point at which eustress becomes distress and vice versa. The Yerkes–Dodson curve demonstrates the relationship between arousal level (pressure) and performance. If arousal is too low, stress is too low, and performance is therefore low. If arousal is too high, stress is too high, and performance is therefore also low. For optimal performance, our arousal must be somewhere in the middle (see Figure 6.13). It is generally accepted that the optimal level of arousal is higher for simple, physically active tasks than for complex, highly skilled tasks.

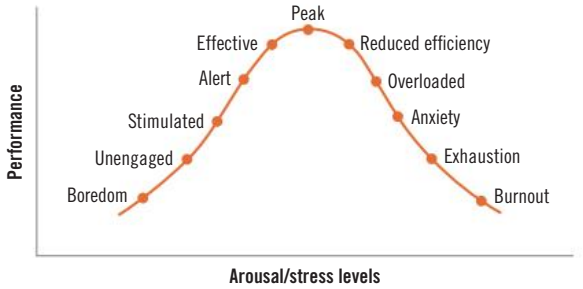


FIGURE 6.13 The Yerkes–Dodson curve of stress and performance: insufficient or excessive arousal results in insufficient performance.

6.4 CHECK YOUR UNDERSTANDING >>

1 Protective factors and risk factors differ in that:
- A protective factors impede health and risk factors enhance health.
- B risk factors enable a person to cope with stress.
- C protective factors enable a person to improve health while risk factors impede health.
- D protective factors are due to genetic factors and risk factors are due to the environment.

2 Amanda is sitting the end-of-year psychology exam tomorrow. She feels she has prepared well and even though she is a little nervous, she feels up for the challenge. Amanda is likely experiencing:
- A distress.
- B eustress.
- C delusions.
- D homeostasis.

3 The Yerkes–Dodson curve shows that:
- A as stress increases, performance always increases.
- B as stress decreases, performance always increases.
- C all stress impacts negatively on performance.
- D some stress can produce optimal levels of performance.

4 Explain how social factors may work as both protective factors and risk factors to a person's health.

5 Using the biopsychosocial framework, describe how a person may be more likely to cope in a stressful situation.

INTERNAL FACTORS: ASSISTING INDIVIDUALS TO COPE WITH CHANGE AND CHALLENGE

Biological factors

Biologically, there are many genetic factors that influence our health. Genetic factors are those biological factors that can enhance (or reduce) an individual's risk of, or vulnerability to, developing a particular condition. Predetermined genetic risk factors cannot be directly controlled, but some non-genetic risk factors that affect our biology are well within our control. These factors include personal behaviours that affect our biological condition such as smoking, drinking alcohol, using or not using illicit substances, keeping active and eating healthily (WHO, 2001).

Research into mental illness has shown that certain mental disorders develop because of the interaction between environmental stressors and an underlying biological vulnerability to the disorders. It appears that not everyone has an equal chance of developing a mental disorder, because it depends at least in part on the inherited characteristics and chemical makeup of the individual. An individual may have an innate ability to manage high levels of stimulation from the outside world (Walsh, 2008) and therefore adapt more readily to change and to cope better with challenges.

Physical exercise

Physical exercise is any form of exerting oneself physically to keep fit (Figure 6.15). Regular exercise alters the hormones, circulation, muscle tone and a number of other aspects of physical functioning. Together, such changes can lower risks for disease (Baum & Posluszny, 1999) and be effective in reducing stress-based arousal. Swimming, cycling, dancing, yoga, most sports, and especially walking, are valuable outlets (Anshel, 1995).

A review of the usefulness of exercise in depression showed evidence that exercise did indeed help people recover from depression. It is believed that exercise increases the level of serotonin in the brain, the neurotransmitter that is reduced when a person experiences depression (Sadock & Sadock, 2003).

Exercise is known to not only reduce resting heart rate, but also respiratory rate, blood pressure and core temperature threshold for sweating. It also reduces levels of cortisol (the stress hormone) and norepinephrine in the blood. Exercise is also known

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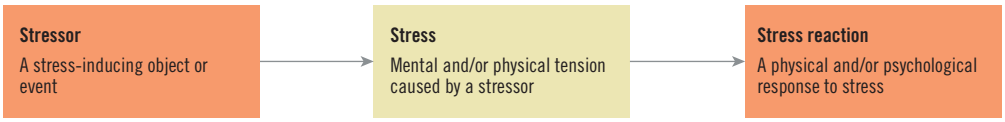


FIGURE 6.14 The relationship between a stressor, stress and a stress reaction



FIGURE 6.15 Regular physical exercise helps to maintain good physical and mental health.

to boost the body's immune status. The physiological effects of exercise are surprisingly very similar to those that are induced by the relaxation response. People who are more internally (physically) healthy will in turn cope better with external challenges.

Psychological factors

Positive mental health can influence onset, course and outcomes of both physical and mental illnesses. Psychological beliefs such as optimism, personal control and a sense of meaning are known to be protective of mental health as well as physical health (WHO, 2004).

Stress is a subjective experience that depends on how we interpret a stressor and also our own perception of our ability to cope. Richard Lazarus and Susan Folkman attempted to create a framework for evaluating how we cope with stressful events, known as the transactional model of stress and coping. Lazarus and Folkman suggested that stressful experiences are transactions between a person and their environment. The transactional model suggests that our stress responses are mediated by our appraisal of the stressor and also by the external factors such as social and cultural resources at our disposal (Lazarus & Cohen, 1977; Antonovsky & Kats, 1967; Cohen, 1984). As a result, stress responses are dependent on our emotions and other psychological factors.

Lazarus and Folkman suggest that when responding to stress, we initially engage in a primary appraisal, in which we decide if a situation is threatening or positive, or relevant or irrelevant to our situation. This then sets in motion a process of secondary appraisal, in which we assess what resources are available to us in terms of coping with the situation. For example, most of us would feel stressed if we were asked to deliver a speech at an assembly at school. But how we appraise public speaking will affect how we react to it – is it an intense threat or a challenge?

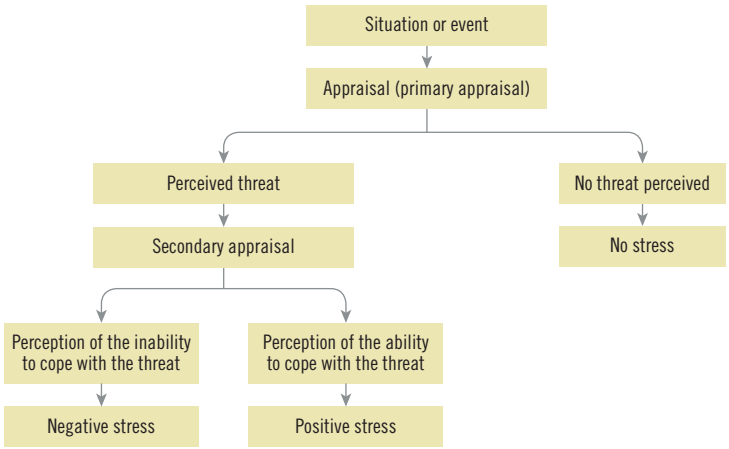


FIGURE 6.16 How we appraise a situation or event influences how much stress we experience and how effectively we respond.

During the secondary appraisal, the individual will assess their ability to cope with the threat and may draw on resources from internal sources, such as willpower and inner strength, and external sources, such as friends and family, to overcome the threat. There are a number of coping strategies that may be used, including problem-focused coping and emotion-focused coping.

Problem-focused coping refers to strategies used to attempt to deal with the cause or source of the stress or threat. For instance, if you were experiencing stress because of a Psychology SAC where you didn't understand the task, then problem-focused coping might involve asking one of your classmates or the teacher to explain the task again.

Emotion-focused coping involves strategies used to reduce the negative emotional response caused by the stressor. This might include coping with the stress of the SAC situation by crying about it and releasing the pent-up worry. Another strategy might be talking to your friends from other classes about not understanding a SAC and feeling better as they express that they don't understand their subjects either. Emotion-focused coping strategies are generally not as effective because they do not target the cause or source of the problem.

Everyone has at one time or another used defence mechanisms to keep from being overwhelmed by immediate threats. Defence mechanisms can provide time for a person to learn to cope in a more effective, problem-focused manner. However, people who overuse defence mechanisms become less adaptable because they consume great amounts of emotional energy to control anxiety and maintain an unrealistic self-image. Table 6.3 describes various defence mechanisms.

TABLE 6.3 Freudian defence mechanisms

MECHANISM	DESCRIPTION	EXAMPLES
Denial	People protect themselves from an unpleasant reality by refusing to accept or believe it. It is often closely linked with death, illness and other painful and threatening events.	Die-hard sports fans refuse to believe that their favourite team has lost the final. You refuse to believe the results of medical tests that indicate a serious illness.
Repression	People repress, unconsciously prevent or hold back threatening thoughts and impulses. Feelings of hostility towards a family member can lead to repression.	You forget the name and appearance of a childhood bully who used to give you a hard time at school.
Reaction formation	People behave in a way that is opposite to how they really think or feel. Impulses are held in check by exaggerating the opposite behaviour.	You pay particular attention to and assist another student you dislike. A mother resents her children, but smothers them with love.
Regression	People return to an earlier level of development or to earlier less-demanding habits or situations.	An adolescent begins thumb-sucking again in a stressful situation. An older child regresses to childish speech and bedwetting after a new sibling is born.
Projection	People exaggerate negative traits in others or attribute their own feelings, shortcomings or unacceptable impulses to others.	A politician states that the opposition has no respect for the government in power and that this is creating disharmony in parliament, when, in fact, the opposite is true. A greedy shopkeeper cheats on his customers, although he believes they are forever cheating him.
Rationalisation	People justify their behaviour by giving reasonable and 'rational' but false reasons for it.	A student blames the pressures of VCE for failing the driver's licence test. A student blames family illness, lost books or a broken-down car for being late for or missing an examination.
Compensation	People counteract a real or imagined weakness by emphasising desirable traits or trying to excel in the area of weakness or in other areas. Compensatory reactions may be a defence against feelings of inferiority.	An athlete with a disability excels in wheelchair sprints. A vision-impaired person develops a keen sense of smell.
Sublimation	People work off unmet desires or unacceptable impulses by doing activities that are constructive.	A person channels aggressive tendencies into a highly physical sport such as boxing.

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The transactional model focuses on how a person interacts with their external environment and stress is seen as a result of how a person appraises a situation and their abilities to cope with it. Stress is thought to be experienced when the demands on an individual exceed the necessary resources present to deal with a stressor, even if that stressor is not life-threatening or if it poses only a perceived (not an actual) threat.

The transactional model is useful for helping people understand their role in interpretation and appraisal of a stressor. It also distinguishes between the experience of eustress and distress. However, it has been criticised as being too simplistic and not giving due consideration to the uncontrollable factors that underpin our body's response to a stressful situation.

Delivering a talk at an assembly, asking a person out on a date and sitting an examination are all day-to-day stressors that are not life-threatening, but they are still important issues for us because they challenge our sense of control over these situations. Whenever we cannot (or think we cannot) control our immediate environment, we are vulnerable to feel stressed. Therefore, just the perception of lack of control is as threatening as an actual lack of control (DasGupta, 1992). If the answer to the question 'What can I do about this situation?' is 'Absolutely nothing', then you will feel emotionally stressed. Sometimes we may also emphasise the threat and make it more of a challenge than it would ordinarily be, by imagining failure, embarrassment and rejection – which often actually invites disastrous consequences (Lazarus, 1993).

A sense of being able to reach our goals makes us feel as if we have some control. Whenever we lack a sense of competency to deal with life's demands, we feel threatened (Bandura, 1986). Our personalities also play a role in how we cope with stress. Some people thrive on stress, while others thrive in a calmer environment.

The many psychological effects of stress can be divided into three distinct categories: emotional effects, cognitive effects and behavioural effects.

Emotional effects may range from feeling increased levels of frustration, depression, anxiety, tension, irritability, anger and aggression, to feeling unable to cope with normal activities.

Our cognitive functions, or the way we process information and think about things, may also be affected by prolonged arousal. For example, we may find it difficult to focus our attention and direct our concentration. Our thoughts may be dominated by whatever is stressing us, and we may become confused, forgetful and unable to make rational decisions or solve problems. Our ability to think in a logical manner may also be negatively affected.

Prolonged stress also results in negative behavioural changes. Our normal sleeping patterns may be interrupted, causing us to experience excessive tiredness during the day. Eating habits may change too, as we may restrict food intake or indulge in more food, or high-calorie food, more often. Generally, we may experience a negative feeling about ourselves and feel that we are in conflict with our life situation but powerless to change it. As a result, we may withdraw from social contact. Some individuals may also indulge in a range of maladaptive or harmful behaviours, including drug abuse or excessive exercise.

6.2 TRY IT YOURSELF >>

APPRAISING YOUR STRESSORS

The transactional model of stress and coping states that stress is about how we appraise the situation.

- List 10 things that have created stress for you in the last week.
- Investigate how each stressor was appraised and how it could have been appraised differently, if necessary.

QUESTIONS

1 What sort of resources could have enabled you to interpret the stressor as a challenge rather than a strain?

2 Is it likely that you will appraise the same situation in the same way in the future? Why or why not?

problem-focused coping Refers to strategies used in an attempt to deal with the cause or source of stress

emotion-focused coping Refers to strategies used to reduce the negative emotional response caused by the stressor

defence mechanisms Emotion-focused coping used to reduce the effects of stress

6.2 FOCUS ON RESEARCH

YES, A MOLEHILL DOES SOMETIMES BECOME A MOUNTAIN!

In a year-long study, Richard Lazarus (1985) and his associates (who researched the transactional model of stress and coping) studied the impact of minor but frequent stresses on the health of individuals. He had 100 men and women keep track of the frequency and severity of the daily 'hassles' that they endured. Participants also reported on their physical and mental health. As Lazarus and his co-workers suspected, frequent and severe hassles turned out to be better predictors of day-to-day health than major life events were. However, major life events did predict changes in health one or two years after the events took place. It appears that daily hassles are closely linked to immediate health and psychological wellbeing (Johnson & Sherman, 1997; Roberts, 1995). Major life changes have more of a long-term impact.

Following up on this, Lazarus found that the personal importance of hassles affects the amount of stress produced (Lazarus et al., 1985). Microstressors (small stressors) that are viewed as central to one's self-worth are many times more likely to cause trouble. For many people, these hassles are linked to work, family and relationships. Psychologist Rand Gruen noted that 'taking care of paperwork or being organised can be central for some people' (Fisher, 1984). This observation clearly emphasises that stress occurs in people, not in the environment. The experience of stress is related to personality, values, perceptions and personal resources (Moos & Swindle, 1990).

QUESTIONS

1. Identify the independent variable in Lazarus' original study.
2. Identify the dependent variable in Lazarus' original study.
3. Write a possible hypothesis for Lazarus' original study.

6.5 CHECK YOUR UNDERSTANDING >>

1. Regular exercise can improve mental health by:
   - A reducing stress hormones such as cortisol.
   - B increasing stress hormones such as cortisol.
   - C making a person more tired.
   - D increasing resting heart rate and blood pressure.
2. Georgio is stressed because he has a 5-hour shift at his part-time job and he has two SACs tomorrow. He doesn't feel like he is prepared enough for the assessment and won't have time to study because of work. A problem-focused coping strategy may be to:
   - A avoid work and not turn up for his shift.
   - B write a post on social media to gain sympathy from his friends.
   - C call his boss and ask to swap shifts so he can study.
   - D meditate to relieve some stress and worry.
3. After being diagnosed with cancer, Suri refuses to take the medication her doctor gave her and tells people that she will be fine. This is an example of which defence mechanism?
   - A Sublimination
   - B Projection
   - C Denial
   - D Regression
4. Explain how a problem-focused coping strategy is more effective at reducing stress than an emotion-focused strategy.
5. What effect does stress have on cognitive ability?

EXTERNAL FACTORS: COPING WITH CHALLENGES

Social factors (culture and environment) consist of the conditions into which people are born, grow, live, work and age (WHO, 2011), and they also play a large role in a person's health. For example, an accepting society and social network can be a great support for a person's state of health.

Feelings of acceptance and worth play an important role in the development of an individual's self-worth and importance. That is why a positive public perception of mental illness and a reduction of social stigma is important to encourage those suffering from mental illness to seek treatment.

Environmental factors can also alleviate the impact of stress, its perception and the stress response. Good physical and mental health, often go hand in hand with a pleasant, clean environment. A predictable and equitable availability of basic resources such as food, electricity and water reduces the perception of stress and helps to alleviate mental health problems. Studies have shown that environmental factors such as poverty, low income, poor housing, and chronic and severe physical illness can contribute to mental illness.

SOCIAL SUPPORT

Social support refers to the close, positive relationships we develop with others (see Figure 6.17). This support facilitates good health and morale (Greenglass, Burke, & Konarski, 1998). The presence of a secure and established network of friends and family is a protective factor against mental illness. One reason for this is that support from family and friends serves as a buffer to cushion the impact of stressful events (Taylor, 1999). Talking about problems and expressing

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tensions can be extremely helpful. Research has shown that isolation can increase stress-related bodily changes, including hormones and anxiety symptoms, and that seeking social support to avoid isolation is an important method of coping with stress.



FIGURE 6.17 The positive relationships we develop with others help us cope with stress.

Although sometimes it is a rite of passage for youngsters to believe that their families do not understand them, it has been found that families are one of the most stable and enduring sources of support for people all over the world. The knowledge that there is support to fall back on enhances the relaxation response in times of stress.

Similarly, a network of good friends is also a key to feeling supported. Friends often support us with unconditional positive regard and this enhances the feeling that we can rely on them in times of crisis, thereby making the relaxation response accessible. Peer group support is a key mechanism for youngsters to feel accepted and valued. It can be easy to fall into groups that may have an unhealthy influence on your time and values; it is therefore important to seek out those groups that enhance your self-image and contribute positively to your personal growth.

Social support is also found in other community-based activities; for example, at the local netball, football or cricket club. This has the double advantage of providing both physical exercise and social support.

So how do these factors work together to impact on mental health and illness? If we look at a physical health issue such as diabetes, the risk factors could be either biological (e.g. there is a family history of diabetes or a history of having hypertension and a high body mass index), psychological (e.g. having a mental illness) or social (e.g. not having a strong social network) (Strodl & Kenardy, 2006). Research also shows that having diabetes more than doubles the risk of developing depression, because the person has to cope with biological and hormonal factors associated with having diabetes, as well as needing to manage the disease on a daily basis. The interaction between biological, psychological and social factors can affect an individual's ability to cope.

If a person has a strong family history of mental illness and they then used illegal substances such as marijuana, ecstasy or speed, this interplay can put them at an increased risk of developing a mental illness. In this situation, an environmental or social behaviour (drug use) exploits the biological vulnerability (family history of mental illness) in a person to result in mental disorder.

Similarly, a person may have a family history of mental illness, but maintain strong social networks and good physical and psychological health, which can contribute to preventing the development of a mental disorder.

In order to maintain good psychological health, it is therefore important to understand some of the protective and risk factors that we are exposed to or confronted with that can improve or compromise our mental wellbeing.

6.6 CHECK YOUR UNDERSTANDING >>

1 Social support can include:
   - A community groups such as sporting clubs.
   - B friends.
   - C family.
   - D All of the above

2 People with strong social support:
   - A have been found to have poor mental health.
   - B are more likely to develop mental illness.
   - C are less isolated and can cope better with stress.
   - D often use drugs and other substances to cope with stress.

3 Explain how social support can be considered both a protective factor and a risk factor.

4 Using an example, describe how social, biological and psychological factors interact to prevent the development of a mental disorder.

5 Using an example, describe how social, biological and psychological factors interact to contribute to poor mental health.

social support The close, positive relationships we develop with others

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CLASSIFYING MENTAL DISORDERS

Unlike physical illness, such as a bout of influenza, mental illnesses are not always tangible. The symptoms of mental illnesses rely on personal accounts of symptoms and experiences, and this can be problematic for classification.

To help provide guidelines and a standard for classification of mental illnesses, categorical approaches to defining mental disorders have been developed. A mental disorder is a significant impairment in psychological functioning (Widiger & Trull, 1991) and these disorders can be grouped into broad categories with common symptoms. One example of the categorical approach to classifying mental disorders is that provided by the *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)*, the fifth edition of the manual published by the American Psychiatric Association (2013) (see Figure 6.18).

There are positive and negative aspects to labelling mental disorders. Psychologists all over the world use the *DSM-5* classification system – it provides a common language for therapists, researchers, social agencies and health workers. The manual also helps professionals diagnose specific mental disorders and select appropriate therapies. For example, when one health professional in Australia diagnoses someone as having schizophrenia and treats them in a certain way, another health professional in the UK using the *DSM-5* would also apply the same diagnosis and treatment for another individual with similar symptoms. This approach allows for consistent diagnoses and treatments from hospital to hospital, clinic to clinic, all over the world. The *DSM-5* is not the only system of classifying mental disorders, yet most activities in mental-health settings – from diagnosis to therapy to billing of insurance companies – are influenced by the *DSM-5*.

The major categories of psychological disorder include addiction disorders, anxiety disorders, mood disorders, personality disorders and psychotic disorders. The *DSM-5* groups disorders more specifically than this; for example, there are a few major categories for mood disorders – such as depressive disorders (see Table 6.4) – and another for bipolar disorders. Each of these major categories are types of mood disorders, but have some distinct differences, so they are categorised separately.

Depressive disorders and bipolar disorders are then further categorised and there are a number of disorders that fall under these major categories. We look at some of the different categories next.



FIGURE 6.18 The *DSM-5* is both a scientific document and a social one.

6.7 CHECK YOUR UNDERSTANDING >>

1 What is the *Diagnostic and Statistical Manual of Mental Disorders* used for?
   - A Deciding whether a person should be hospitalised
   - B Only to treat people with mental disorders
   - C The diagnosis and treatment of mental disorders
   - D None of the above

2 The categorical approach:
   - A groups disorders into common symptoms.
   - B measures the severity of symptoms.
   - C allows psychologists to avoid labelling people.
   - D groups dangerous and violent behaviours only.

3 A category in the *DSM-5* is anxiety disorders, which includes:
   - A anti-social personality disorder.
   - B depression.
   - C post-traumatic stress disorder.
   - D schizophrenia.

4 Explain an advantage of using the categorical approach to defining mental disorders.

5 Explain a disadvantage of using the categorical approach to defining mental disorders.

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TABLE 6.4 Some of the major categories of mental disorders listed in the *DSM-5*

CATEGORY	GENERAL SYMPTOMS	EXAMPLES OF DISORDERS
Substance-related and addictive disorders	Poor functioning at home or at work; inability to stop using the drug; drug intoxication or drug withdrawal; delirium, dementia or amnesia; psychosis; emotional and sexual problems; sleep disturbances	Dependence on alcohol, barbiturates, opiates, cocaine, amphetamines, marijuana or nicotine; dependence on gambling
Schizophrenia – spectrum disorders and other psychotic disorders	Hallucinations, delusions, social withdrawal, retreat from reality, inability to control thoughts and actions	Schizophrenia
Depressive disorders	Disturbances in affect (emotion); depression, sadness or hopelessness	Depression, seasonal affective disorder (SAD)
Anxiety disorders	Feelings of fear, apprehension, anxiety, anxiety-based distortions of behaviour	Phobias, obsessive-compulsive disorder (OCD), panic disorder, post-traumatic stress disorder (PTSD)
Personality disorders	Deeply ingrained, unhealthy personality patterns	Anti-social personality disorder, borderline personality disorder

Note: This is not a list of all of the categories in the *DSM-5*.

SUBSTANCE-RELATED AND ADDICTIVE DISORDERS

The *DSM-5* category 'Substance-related and addictive disorders' encompasses 10 classes of substances. These include alcohol; tobacco; caffeine; cannabis; sedatives, hypnotics, anxiolytics; stimulants; inhalants; hallucinogens; opioids and other/unknown substances.

When taken in excess, these drugs have a direct, intense activation of the brain reward system. This involves reinforcement of behaviours and the production of memories, which may result in normal activities being neglected. Each class of drugs typically activates the system and produces feelings of pleasure sometimes referred to as a 'high', although they may have different ways of producing the changes in the brain.

Addictive disorders, for example gambling, are also included in this category because they also activate reward systems similar to those activated by drugs of abuse and have some similar behavioural symptoms.

ADDICTIVE DISORDER: GAMBLING

Gambling is a serious social problem sanctioned by many societies worldwide as a harmless pastime, but in reality it has significant costs to individuals, families, societies and workplaces. Gambling occurs in many domains – we can bet on many sports in person, online or over the phone; we can bet at card-game evenings; and we can bet on the pokies and gaming tables at casinos and in most hotels and pubs.

Social gambling usually occurs with family and friends, and lasts for a limited period of time, with predetermined and acceptable losses (American Psychiatric Association, 2000). People often hide behind the notion that drinking and gambling are part of our wider Australian culture, yet what often begins as entertainment and pleasure can for some people change to become a serious issue. Pathological gambling occurs when gambling becomes maladaptive behaviour and hurts the gambler, their family, their friends and the people who care for them (Victoria. Department of Justice, 2009). Pathological gambling is often characterised by a failure to resist the impulse to gamble despite severe and devastating personal, family and occupational consequences.

Signs that gambling may be pathological and not just entertainment include:

- gambling to avoid dealing with personal problems or disappointments
- skipping work or study to gamble
- spending more time gambling than with family and friends

categorical approach A method of categorising mental illness that groups psychological problems into broad categories or groups that share common symptoms

Diagnostic and Statistical Manual of Mental Disorders (DSM-5) The fifth edition of a manual published by the American Psychiatric Association that groups psychological problems into categories based on similar symptoms, in order to try to diagnose and treat mental disorders

- thinking about gambling every day
- gambling to win money, not just for fun
- gambling to win back money lost by gambling
- feeling depressed because of gambling
- lying or keeping secrets about gambling
- borrowing money to gamble
- arguing with family and friends about gambling
- gambling for longer periods of time than originally planned
- gambling until every dollar is gone
- losing sleep thinking about gambling
- using money on gambling that should be used to pay bills
- trying to stop gambling, but being unable to
- becoming moody when trying to stop or cut down on gambling
- trying to increase the excitement of gambling by placing bigger bets
- breaking the law to get money to gamble (Victorian Responsible Gaming Foundation, 2014).



FIGURE 6.19 Gambling occurs in many domains; when people cannot resist the urge to gamble and ignore the financial and social consequences of potential losses, they suffer from an addictive mental disorder known as pathological gambling.

TABLE 6.5 The differences in perceptions and behaviours: gambling as a recreational activity versus moderate and severe problem gambling

NO GAMBLING PROBLEM	MODERATE GAMBLING PROBLEM	SEVERE GAMBLING PROBLEM
» Entertainment » Hobby » Social activity » Pleasant surroundings	» Guilt » Arguments » Secrecy » Some depression » High expenditures » Anxiety » Win back losses	» Depression » Relationship breakdowns » Debt and poverty » Crime (theft) » Chasing big losses

Source: Victorian Responsible Gaming Foundation

Pathological gambling often begins in adolescence for men and later in life for women. This disorder tends to be a chronic problem and is seen to comprise four stages:

1 *the winning stage* – the first stage, where a big win hooks the person to gambling (interestingly, women often become hooked on gambling as an escape from problems rather than as a result of a big win)
2 *the progressive-loss stage* – the person starts living around their gambling addiction and behaviours, and making concessions for their gambling behaviours
3 *the desperate stage* – the person gambles in a frenzy, often with huge debts, and sometimes even indulges in criminal activities to obtain money in order to keep gambling
4 *the hopeless stage* – the person develops the insight that the lost money can never be regained (Sadock & Sadock, 2003).

Australians spent more than $19 billion on gambling in 2008–09. The actions of one gambler negatively affect the lives of five to 10 others. This means that up to five million Australians could be affected by problem gambling each year, including friends, family and employers of people with a gambling problem (Australian Government, 2015).

ANXIETY DISORDERS

Anxiety refers to feelings of apprehension, dread or uneasiness and is a response to an unclear or ambiguous threat. As you may have noticed, the physical reactions that accompany anxiety are similar to those that accompany fear and stress.

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Feeling anxious is a very normal emotion, and you probably feel it often. The Yerkes-Dodson curve shows that moderate levels of anxiety will improve performance, and sometimes high levels of anxiety will be appropriate when they are consistent with the demands of the situation (see Figure 6.13). However, there is a big difference between feeling anxious some of the time and actually suffering from an anxiety disorder – Figure 6.20 shows these differences.

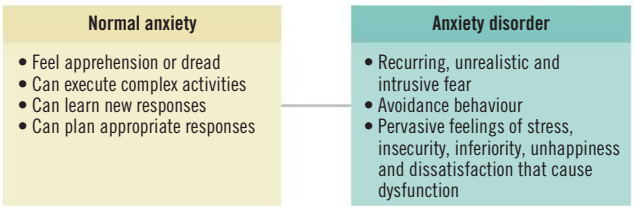


FIGURE 6.20 Feeling anxious at times is a very normal emotion – there is a difference between feeling anxious in some situations and actually suffering from an anxiety disorder.

Additionally, people respond to different situations in different ways, so if one person feels anxiety in a particular situation while another person does not, this is not evidence that the anxious person is suffering from an anxiety disorder.

When anxiety is out of proportion to a situation, it may be detrimental to an individual's wellbeing, and result in an anxiety disorder. A problem exists when intense or persistent anxiety prevents people from doing what they want or need to do. Their anxieties mean they struggle to preserve control (Zinbarg et al., 1992) – they simply cannot stop worrying. An anxiety disorder may prevent a person from learning new information, plan an appropriate response to an issue, or carry out complex activities that we routinely do in everyday life, thereby revealing a problem (Treatment Protocol Project, 2004).

Individuals with anxiety disorders are known to have specific, recurring fears that they recognise as irrational, unrealistic and intrusive (Treatment Protocol Project, 2004). Typically, people with anxiety-related problems feel threatened, but may not be able to do anything constructive about it. In general, anxiety-related problems involve high levels of physical signs of anxiety; restrictive, self-defeating behaviour patterns; a tendency to use elaborate defence mechanisms or avoidance responses to get through the day; and pervasive feelings of stress, insecurity, inferiority, unhappiness and dissatisfaction with life.

Anxiety, fears and phobias are probably the most common psychological disturbances today. A US study found that on any given day, roughly 7 per cent of the (USA) adult population could be diagnosed as having an anxiety disorder (Landers, 1989).

There are several individual disorders that fall under the major heading of anxiety disorders – phobias are the most common of all anxiety disorders. Many of the anxiety disorders develop in childhood and tend to persist if not treated. Most occur more frequently in females than in males (approximately 2:1 ratio).

6.8 CHECK YOUR UNDERSTANDING >>

1 Which of the following symptoms are often experienced by people suffering from anxiety disorder?
   - A Anxiety, fear and uneasiness
   - B Anxiety, hallucinations and fear
   - C Fear, delusions and uneasiness
   - D Anxiety, stress and control

2 The difference between pathological gambling and social gambling is that social gambling:
   - A occurs with friends and family.
   - B has acceptable losses.
   - C lasts for a limited time period.
   - D All of the above

3 What similarities are there between a gambling disorder and other addictive disorders such as substance abuse?

4 How is the anxiety that everyone experiences different from a diagnosable anxiety disorder?

5 Gambling is often perceived as a 'socially acceptable' activity. How can this contribute to developing an addictive disorder?

MOOD DISORDERS

Psychologists have come to realise that mood disorders are among the most serious disorders of all. This is largely attributed to the fact that mood disorders are one of the most common types of disorders in our society. Mood disorders are defined as a group of mental disorders that involve major disturbances in emotion (mood), such as depression or mania.

The *DSM-5* has two major categories of mood disorders: depressive disorders and bipolar disorders. The previous *DSM* categorised both of these together. Now there is a separate category for bipolar disorders

anxiety Feelings of apprehension, dread or uneasiness as a response to an unclear or ambiguous threat

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and it is placed between the schizophrenia spectrum and other psychotic disorders and depressive disorders because bipolar disorders share some common symptoms, family history and genetics.

Depressive disorder: Major depression

It is normal for depression to follow events such as disappointment, loss, a setback or the death of a loved one; depression and feeling sad is a normal part of the grieving process. Sometimes, depressive types of mood disorder follow a specific event; however, these reactive depressions last longer and are more severe than the event would seem to warrant (Gorman, 1996). In this case, people get stuck in the grief process and are unable to accept their loss. But depressive mood disorders can also appear for no obvious reason – they can have a life of their own.

Major depression is a depressive disorder marked by lasting and extreme low emotions. For the person with major depression, everything looks bleak and hopeless, and their suffering is intense. Symptoms include feelings of hopelessness and worthlessness, loss of appetite, difficulty sleeping, withdrawal from social relationships, difficulties in concentrating, diminished interest in pleasurable activities or general everyday activities, neglect of appearance and lack of energy and motivation (see Figure 6.21). The person becomes extremely subdued or withdrawn, and may be suicidal. Depressive reactions pose a serious threat to survival. Suicide attempted during a major depression is rarely a simple 'cry for help' – usually, the person intends to succeed and may give no prior warning.



ISTOCKPHOTO.COM/LATHURIC

FIGURE 6.21 People with major depression experience intense negative emotions and feelings of total despair. Their depression causes them to be extremely subdued and withdrawn.

In Australia, about 26 per cent of people admitted to psychiatric wards in hospitals suffer from major mood disorders (AIHW, 2008). Studies have found that 5 to 12 per cent of men and 15 to 25 per cent of women will at some time in their lives experience major depression (Blazer, 2000). These figures reveal the lifetime risk of experiencing the disorder, but definitive (actual) figures also show a higher rate of depression in women that in men. The 2007 Australian Bureau of Statistics (ABS) National Survey of Mental Health and Wellbeing found that 8 to 10 per cent of men and 15 per cent of women surveyed had suffered major depression at some stage in their lives. The key causes of depression in women were problems with relationships, loneliness, financial problems or stress (ABS, 2007) (see Figure 6.22). Many of these women cope with depression on their own and do not receive adequate treatment.

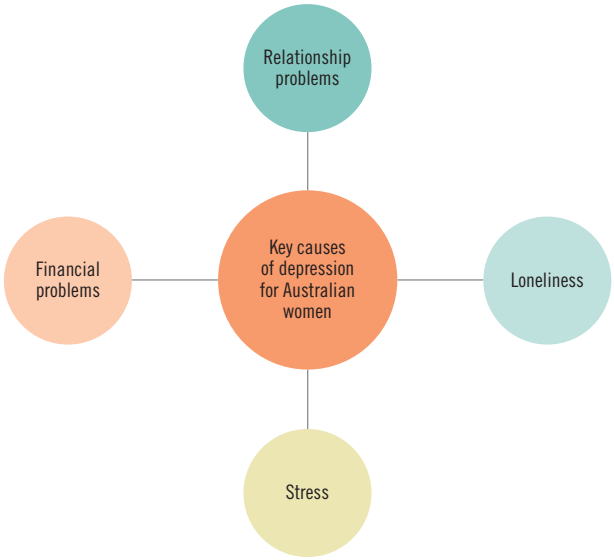


FIGURE 6.22 The key causes of depression in Australian women.

Authorities believe that social and environmental conditions are the main reasons that more women than men suffer from depression. Factors that contribute to women's greater risk of depression include reproductive stresses, conflicts between work and parenting, and the strain of providing emotional support for others. Marital troubles, sexual and physical abuse, and poverty are also factors (Russo, 1990).

PERSONALITY DISORDERS

The *DSM-5* characterises a personality disorder as 'an enduring pattern of inner experience and behaviour that deviates markedly from the expectations of the

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individual's culture, is pervasive and inflexible, has an onset in adolescence or early adulthood, is stable over time, and leads to distress or impairment' (American Psychiatric Association [APA], 2013). There are 10 types of personality disorders listed in the *DSM-5* (see Table 6.6).

SCHIZOPHRENIA SPECTRUM AND OTHER PSYCHOTIC DISORDERS

Schizophrenia spectrum and other psychotic disorders are characterised by abnormal functioning in one or more of five domains. The *DSM-IV-TR* listed schizophrenia and a number of subtypes of schizophrenia, such as paranoid, disorganised and catatonic schizophrenia; however, the *DSM-5* has changed this so the disorder is now viewed as a spectrum consisting of five domains, a person needing to have symptoms of two or more of the domains as well as other criteria to be diagnosed with schizophrenia.

The five domains are delusions, hallucinations, disorganised thinking (speech), grossly disorganised or abnormal motor behaviour (including catatonia) and negative symptoms (APA, 2013).

Delusions

A delusion is a fixed belief that cannot be changed; even with conflicting evidence the individual will still hold their belief. There are a variety of themes, but some common delusions include persecutory delusions (the belief that the individual is being harmed and/or harassed by others) and grandiose delusions (the belief that the individual has exceptional abilities, wealth or fame).

Hallucinations

Hallucinations occur when no real external stimulus exists, but an individual has a perceptual experience. These experiences are not under voluntary control; such as seeing or hearing things that are not really there. Hallucinations can be the perception of any of the senses, but auditory hallucinations are the most common in schizophrenia and related disorders.

Disorganised thinking (speech)

Disorganised thinking is usually inferred from the individual's speech; when an individual shows signs of switching topics without any real association between topics or when asked a question the individual may give an answer that is unrelated.

Grossly disorganised or abnormal motor behaviour (including catatonia)

Symptoms of this domain include a variety of behaviours such as unpredictable agitation, problems performing everyday activities, catatonia (decreased reactivity to the environment) and excessive motor activity without obvious cause.

TABLE 6.6 Subtypes of personality disorders

PERSONALITY DISORDERS	KEY CHARACTERISTICS
Paranoid personality disorder	Suspicion, distrust, 'paranoia' – the belief that the motives of others are malicious
Schizoid personality disorder	Social detachment, little to no emotion
Schizotypal personality disorder	Distortions in perception and cognition, odd behaviour, unease in relationships
Antisocial personality disorder	Non-conformity, weak conscience, reckless disregard for others, lack of remorse
Borderline personality disorder	Disturbed sense of identity, impulsive behaviour, unstable relationships
Histrionic personality disorder	High emotions, attention seeking, excessive need for approval
Narcissistic personality disorder	Preoccupation with vanity and prestige, grandiosity, impaired ability to empathise
Avoidant personality disorder	Avoidance of social interaction, extreme fear of being ridiculed or rejected, anxiety in social situations
Dependent personality disorder	Pervasive dependence on others, fear of separation, inability to meet own emotional needs
Obsessive-compulsive personality disorder	Concern with perfectionism and neatness, excessive attention to detail, enduring need for control

Negative symptoms

Some negative symptoms include reduced emotional expression such as eye contact, fewer facial emotions, decreases in motivation and involvement in purposeful activities.

Negative symptoms are more common in schizophrenia spectrum disorders than psychotic disorders.

LABELLING AND STIGMA

Labelling occurs when a certain characteristic an individual possesses is used as a name or brand to describe them. For example, some people are labelled based on physical characteristics – such as 'tall', 'short', 'thin' or 'fat' – or characteristics of personality, such as 'arrogant', 'reliable', 'caring' or 'selfish'. Some of these labels have a negative connotation, while some may be seen as positive. For people suffering from mental illness, however, labels are generally derogatory, and may include 'psycho', 'nuts', 'schizo' or 'crazy'. Of course, when we have a broken leg we are not automatically labelled as 'limpy', so why should mental illness carry such labels?

The reason that mental illness and physical illness are treated differently is because mental illness has a social stigma attached to it. Stigma refers to social disapproval of an individual's personal characteristics or beliefs, or social disapproval of a type of behaviour. Stigma arises because people are often uncomfortable or embarrassed by behaviour that is different, and often the mentally ill are seen as violent, unpredictable or scary. People who have been labelled mentally ill are less likely to be hired for a new job, tend to be denied housing and are more likely to be falsely accused of crime (Hocking, 2003).

A community consultation of carers and mental health consumers in Australia in 2000 (SANE Australia's *Have Your Say* report) identified a reduction in stigma and an increase in awareness and understanding as having the greatest potential to improve the lives of people affected by mental illness (Hocking, 2000). Respondents also considered it important to have better-trained health professionals and more available information and education for people with mental illness and their carers. Respondents wanted healthcare workers to 'treat them more respectfully' and the community to understand that they are not 'lazy' or 'weak' (Hocking, 2000).

The consequences of negative and unhelpful stereotypes are profound for people with a mental illness. They not only impair help-seeking behaviours, but affect medication adherence, overall recovery and, most importantly, impair self-esteem of the sufferer (Stuart, 2006).

FOCUS ON RESEARCH 6.3

THE EFFECTS OF LABELLING

A fascinating study undertaken by David Rosenhan and his colleagues of Stanford University illustrates the impact of psychiatric labelling. Rosenhan and several colleagues had themselves committed to mental hospitals with a diagnosis of 'schizophrenia' (Rosenhan, 1973). After being admitted, each of these pseudo-patients dropped all pretence of mental illness. Yet, even though they acted completely normally, none of the researchers was ever recognised by hospital staff as a phoney patient. Real patients were not so easily fooled. It was not unusual for a patient to say to one of the researchers, 'You're not crazy, you're checking up on the hospital!' or 'You're a journalist'.

To record their observations, Rosenhan and his colleagues took notes by carefully jotting things on small pieces of paper hidden in their hands. However, they soon learned that secrecy was totally unnecessary – they then simply walked around with a clipboard, recording observations and collecting data. No one questioned this behaviour. The note-taking was just regarded as a symptom of the 'illness' the psuedo-patients allegedly had. This observation clarifies why staff members failed to detect the fake patients. Because they were in a mental ward, and because they had been labelled schizophrenic, anything the pseudo-patients did was seen as a symptom of psychopathology.

As Rosenhan's study shows, it is far better to label problems than to label people. Think of the difference in impact between saying 'You are experiencing a serious psychological disorder' and saying 'You are a schizophrenic'.

QUESTIONS

1 Write a possible hypothesis that Rosenhan may have been testing.

2 What sort of sampling technique was used in this study?

3 What is one advantage and one disadvantage of this sampling technique?

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Stigma about mental illnesses has an important role to play in the belief systems of society. Stereotypical views of mental illness begin in childhood and intensify in adulthood. Researchers believe that children learn from a very early age that mental problems are seen as a failure of character, and admitting such problems is looked down upon by their peers. Thus, people who are grappling with mental illness can be harmed as much by social stigma as they are by their immediate psychological problems (Corrigan & Penn, 1999).

Dealing with social stigma

In recent years, our understanding of how to improve community attitudes has become more sophisticated. There is now awareness that we need long-term strategies to combat stigma by disengaging mental illness from associated fears and anxieties and by improving knowledge and attitudes. Two important ways of doing this are improving mental-health literacy (knowledge and awareness about mental health) and stopping the constant reinforcement of negative stigma by the media (Jorm et al., 1997).

A website called Headspace was launched in 2006 by the Commonwealth Government (see Figure 6.23). Part of the National Youth Mental Health Foundation, the initiative aims to provide important information and services to young people and their families across Australia, and also reduce stigma surrounding mental illness by raising community awareness. It provides support for mental health and wellbeing, and information that young people may not seek elsewhere because they feel intimidated or uncomfortable. Headspace employs a range of youth-friendly health professionals who can help young people with general health, mental health and counselling, education, employment services, and alcohol and other drug services. Headspace workers reinforce the fact that getting help early is the key to resolving mental health issues quickly (Headspace, 2006).

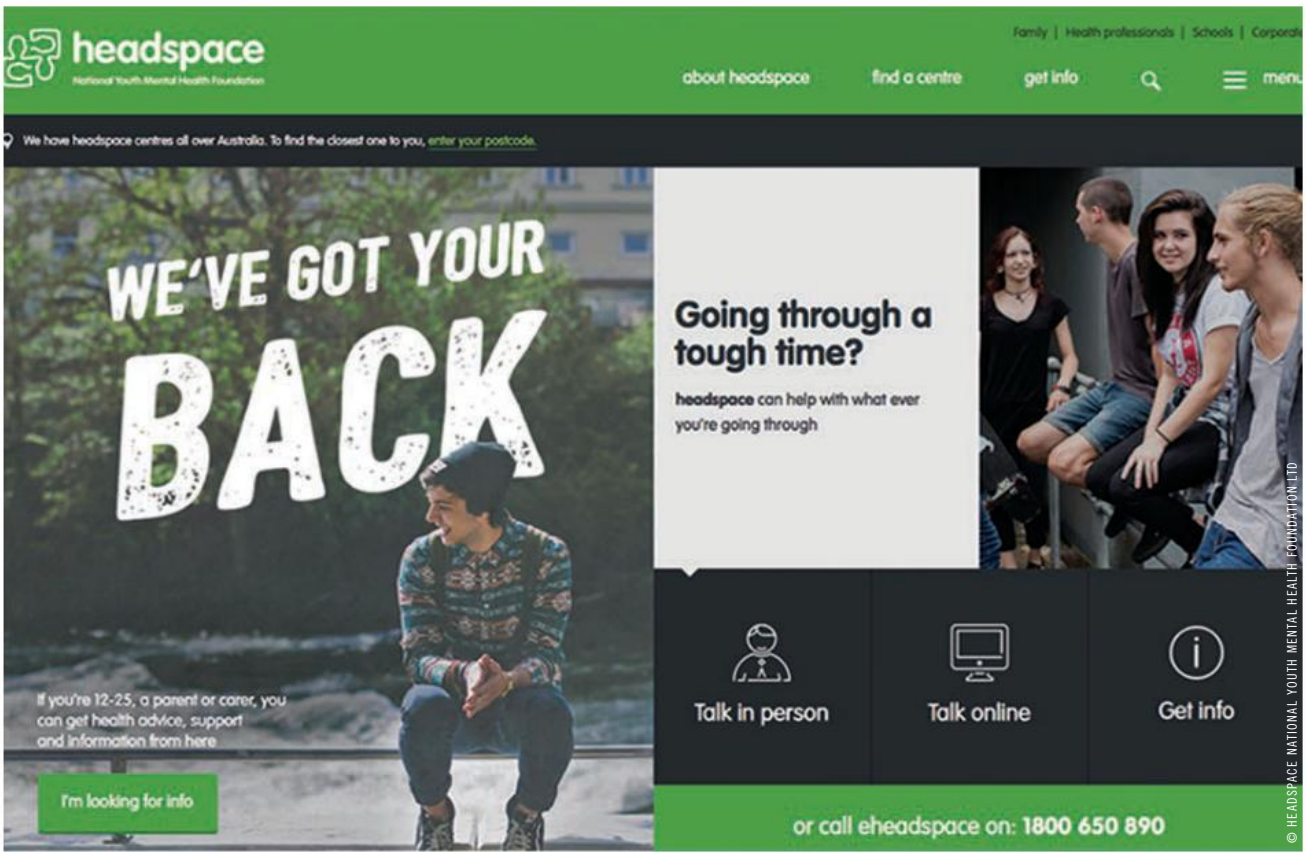


FIGURE 6.23 Organisations such as Headspace raise awareness and provide support and assistance to individuals experiencing a range of mental health issues.

labelling When a certain characteristic of an individual is used as a name or brand to describe them

stigma Social disapproval of an individual's personal characteristics or beliefs, or social disapproval of a type of behaviour

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6.3 TRY IT YOURSELF >>

THE CUNNINGHAM DAX COLLECTION

The Cunningham Dax Collection is a collection of artwork that contains more than 10000 pieces that have been made by people experiencing mental illness. It is one of the largest collections of its kind in the world and the only such collection in the southern hemisphere. The aim of the collection is to promote a greater understanding of people experiencing psychological trauma and/or mental illness, and to foster an appreciation of their creativity. The collection is currently in Parkville (Melbourne) under the auspices of the Mental Health Research Institute of Victoria. There is a permanent display of more than 150 works at the collection and some works may be seen on the collection's website.

In 1946, as the superintendent of a major psychiatric hospital in England, Dr Dax was one of the first to introduce art and other recreational therapies as therapeutic tools in the treatment of mental illness.

Go to the Cunningham Dax collection website at www.daxcentre.org. Look at the different pieces of art displayed on the website and discuss the following questions with your classmates.

QUESTIONS

1. Why do you think artwork is used as a treatment tool for mental illness?
2. How does the art make you feel?
3. Do you feel you gain insight into the thoughts of people with mental illness by looking at the art?
4. Do you think the artwork helps to reduce social stigma associated with mental illness?

6.9 CHECK YOUR UNDERSTANDING >>

1. What is a typical symptom of schizophrenia?
   - A Heart palpitations
   - B Obsessive cleanliness
   - C Nightmares
   - D Hallucinations
2. What major category of mental health disorders does major depression fall under?
   - A Anxiety disorders
   - B Psychotic disorders
   - C Bipolar disorders
   - D Mood disorders
3. Symptoms of major depression include:
   - A feelings of hopefulness and increased appetite.
   - B withdrawal from social relationships and improved concentration.
   - C diminished ability to find enjoyment in everyday activities.
   - D neglect of appearance and increased energy.
4. What are some benefits and disadvantages of labelling people with mental disorders?
5. There are 10 types of personality disorder in the *DSM-5*. What do they have in common?

THE TWO-HIT HYPOTHESIS

Some psychological disorders are reasonably straightforward to diagnose; however, the causes of the disorders are not easily identified. In some cases the difficulty in finding a cause is in part due to the variety of possibilities that contribute to the disorder. When the cause of a disorder or disease is not clear, alternative models are used to identify possible causes. The two-hit hypothesis is one such model that is used to explain the development of particular psychological disorders, including schizophrenia, as well as other diseases such as cancer, where there appear to be a number of possible causes.

The two-hit hypothesis proposes that people suffering from psychological disorders such as schizophrenia have generally had some genetic or prenatal environmental factor disrupt early brain development. This accounts for the first 'hit', so to speak. This then sets the individual up for long-term vulnerability to a second 'hit' that then leads to the onset of symptoms of a psychological disorder such as schizophrenia. The two-hit hypothesis generally refers to a genetic vulnerability (first hit) that is triggered by something in the environment (second hit). Both 'hits' are required for symptoms of a disorder to become apparent, as each of the 'hits' by themselves would not be sufficient to cause schizophrenia or another mental disorder (Maynard et al., 2001).

As there has not been one clear cause of disorders such as schizophrenia, the first hit is proposed to involve disruption of some sort of brain mechanism that is susceptible to numerous genetic and environmental agitations, and capable of producing long-term significant changes. The second hit, on the other hand, would most likely have no impact on an individual's brain if it were not already vulnerable or 'primed' to respond to certain environmental stimuli such as some drugs, stress and so forth (Maynard et al., 2001).

The two-hit hypothesis may account for the late adolescent and early adulthood onset of schizophrenia. Symptoms are rarely produced earlier in life, and it may be at least in part due to when the 'second hit' impacts on the vulnerable person that the 'primed' individual starts to show signs of the disorder. The adolescent brain in particular is more vulnerable to some environmental stressors.

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The two-hit hypothesis has been used as a model to explain diseases such as cancer. Cancer is a complex disease that has been linked to many genetic and environmental factors, with no single cause that can account for all cases. A genetic mutation, for example, may make some cells vulnerable to change, and when exposed to a particular cancer-causing agent or carcinogen, the formation of a tumour (cancer) may be the result. Genetic risk factors may be present at birth (first hit), and if a second hit never eventuates, the person may never get cancer. However, if a second hit does occur to a person with the genetic risk factors, this makes cancer more likely. People with genetic risk factors often do not present with cancer for many years, similar to disorders such as schizophrenia, when the vulnerability appears to lie dormant until a second hit occurs.

POSSIBLE CAUSES OF SCHIZOPHRENIA

Schizophrenia is marked by delusions (thoughts or beliefs that are not real), hallucinations (sensations that are not real), apathy, a split between thought and emotion, disorganisation of behaviour, cognitive impairment, disturbances of interpersonal communication, and social and functional impairment. The most basic functions that give us the feeling of being a unique and self-directed individual are disturbed in this disorder (Treatment Protocol Project, 2004).

One Australian in 100 will suffer from schizophrenia during their lifetime, and roughly half of all the people admitted to psychiatric wards in hospitals have schizophrenia. The psychotic symptoms of schizophrenia typically emerge between the late teens and the mid-30s. Onset before adolescence is rare. The peak age for the first psychotic episode is in the early to mid-20s for males and in the late 20s for females. The first symptoms may be abrupt, but for most individuals the symptoms are slow to develop. Though men and women are affected by schizophrenia in approximately equal numbers, women tend to experience later onset, fewer periods of illness and better recovery (Devilly, 2004; Queensland Centre for Mental Research, 2009).

Some of the factors that are believed to contribute to the onset of schizophrenia are:

- *environment* – the season of birth has been linked to the incidence of schizophrenia as well as a higher incidence for children growing up in an urban environment and for some minority ethnic groups
- *genetic and physiological factors* – genetic factors make a strong contribution in determining risk for schizophrenia. There are a number of genes that have been found to contribute to schizophrenia, as well as other mental disorders such as bipolar, depression and autism spectrum disorder. Interestingly, studies of identical twins show that if one twin has schizophrenia, then the other has a 50 per cent chance of also being diagnosed with the disorder, showing that genetics alone do not predict development of schizophrenia (see Figure 6.24)
- *pregnancy and birth complications* – lack of oxygen at birth and greater paternal age are associated with a higher risk of schizophrenia. In addition, stress, infection, malnutrition, maternal diabetes and other medical conditions have been linked with schizophrenia.

However, the majority of children with these risk factors do not develop schizophrenia. As schizophrenia is a relatively prevalent psychological disorder with an estimated one in 100 people having the disorder, this may suggest that there might be a number of causes for it to be so prevalent, or that the cause is common. More research into risk factors and protective factors is needed in the future to ensure those members of the community with some of the first hit or risk factors may be able to minimise or reduce the likelihood of being affected by a second hit.

two-hit hypothesis A model used to explain the multiple causes of disorders such as schizophrenia

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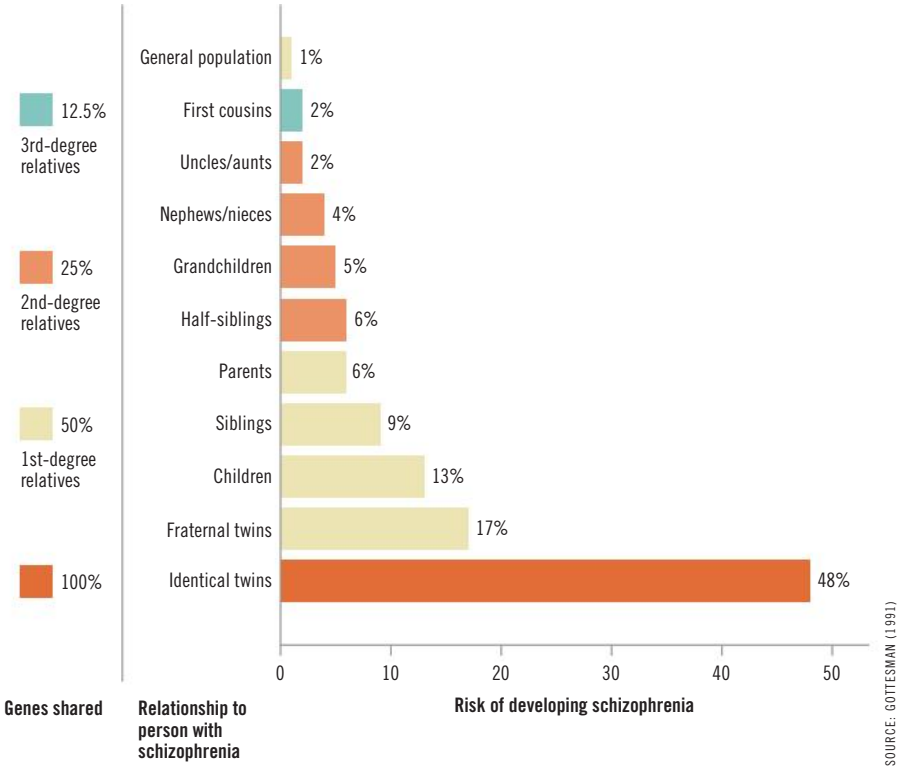


FIGURE 6.24 After a person has been diagnosed with schizophrenia, the chance for a sibling to also be diagnosed with schizophrenia is 7 to 9 per cent. If a parent has schizophrenia, the chance for a child to have the disorder is 10 to 15 per cent. Risks increase with multiple affected family members.

6.10 CHECK YOUR UNDERSTANDING >>

1 Schizophrenia is believed to be caused by:
   - A genetics.
   - B environmental factors.
   - C both genetic and environmental factors.
   - D None of the above

2 The risk of developing schizophrenia:
   - A increases if a family member has the disorder.
   - B decreases if a family member has the disorder.
   - C is no more likely if a family member has the disorder.
   - D is not influenced by genetics.

3 How is the two-hit hypothesis model used to explain schizophrenia?

4 Why is this model necessary?

5 What other disorders or diseases can be explained by the two-hit hypothesis?

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CHAPTER SUMMARY

Normality

- Normality is defined as patterns of behaviour, or personality traits, that are typical or that conform to some standard of proper and acceptable ways of behaving. Adaptive behaviour allows an individual to cope with change and develop, while maladaptive behaviour prevents an individual from achieving competence in everyday activities that promote good mental health.
- Approaches to defining normality include the statistical approach, the sociocultural approach, the functional approach, the historical approach, the situational approach and the medical approach.

Mental health and mental disorder

- All people have elements of mental health, even those with mental disorders. The mental health and mental disorder continuum shows the degrees of these concepts on a scale. One dimension shows the mental health of an individual, the other dimension shows mental disorder.

Stress

- Stress is a state of mental or physical tension that occurs when an individual must adjust or adapt to the environment. The experience of stress may be positive (eustress) or negative (distress).
- Internal factors that assist an individual to cope with stress include biological and psychological factors such as genetics, hormones, being physically healthy, the way stressors are appraised and personality characteristics.
- External factors that assist an individual to cope with stress include social factors such as family, friends, environment and culture.

Psychological disorders

- Major categories of psychological disorder include addiction disorders, anxiety disorders, mood disorders, personality disorders and psychotic disorders.
- A mental disorder can be diagnosed using the categorical approach, whereby common symptoms are grouped. The *DSM-5* uses a categorical approach and is a manual widely used by health professionals to diagnose and treat mental disorder.

Social stigma

- Social stigma and being labelled as having a mental health disorder are factors that discourage individuals from seeking treatment.

Two-hit hypothesis

- The two-hit hypothesis is a model used to explain the cause of psychological disorders such as schizophrenia that appear to have more than one cause.
- The first 'hit' is generally a genetic predisposition, or biological disruption caused early in development, that makes some people's brains vulnerable to disorder.
- The second 'hit' may be some environmental stimuli that would not produce symptoms of schizophrenia by itself, but given the vulnerability caused by the first 'hit', symptoms become apparent.

APPLY YOUR KNOWLEDGE AND SKILLS

SECTION A: MULTIPLE-CHOICE QUESTIONS

Answer the following questions by writing the correct letter in your workbook. Only one answer is correct for each question.

1 Mental health is often defined as:
- **A** the psychological state of someone who is functioning at an unsatisfactory level of emotional and behavioural adjustment.
- **B** the psychological state of someone who is functioning at a satisfactory level of emotional and behavioural adjustment.
- **C** the physical state of someone who is functioning at an unsatisfactory level of bodily and behavioural adjustment.
- **D** the physical state of someone who is functioning at a satisfactory level of bodily and behavioural adjustment.

2 Health is a state of complete:
- **A** cultural wellbeing.
- **B** spiritual wellbeing.
- **C** physical, mental and social wellbeing.
- **D** environmental wellbeing.

3 If John's parents both have diabetes, but neither of Sam's parents have diabetes, John's risk of developing diabetes is higher than Sam's. Which of the determinants of health does this represent?
- **A** Biological
- **B** Cognitive
- **C** Social
- **D** Psychological

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4 The difference between maladaptive behaviour and adaptive behaviour is that:

- **A** maladaptive behaviour promotes good mental health.
- **B** adaptive behaviour promotes good mental health.
- **C** maladaptive behaviour is positively viewed by society and adaptive behaviour is not.
- **D** adaptive behaviour cannot be learned.

5 The _____ is a judgment of normality that depends on the situation or the context in which the behaviour occurs. This takes into consideration the popular standards of behaviour in a particular situation.

- **A** statistical approach
- **B** medical approach
- **C** sociocultural approach
- **D** situational approach

6 In some countries it is unacceptable to be married to more than one person at a time. In Australia, this practice would be defined as abnormal in the _____ approach to normality.

- **A** sociocultural
- **B** statistical
- **C** situational
- **D** functional

7 Tom was walking to the bus stop one morning. When he reached the bus stop, he met a man dressed as a clown. This man wore a red nose and a bright curly wig, as well as a coloured jumpsuit and big red shoes. Which approach to normality would best classify this man's behaviour as abnormal?

- **A** The functional approach
- **B** The medical approach
- **C** The historical approach
- **D** The situational approach

8 An example of a stressor is:

- **A** learning to relax from a trained professional.
- **B** an examination.
- **C** meditation.
- **D** regular exercise.

9 Schizophrenia is:

- **A** an addictive disorder.
- **B** only developed as a result of biological factors.
- **C** characterised by disorganised thought patterns and emotions.
- **D** the same thing as severe depression.

10 A phobia is a type of _____ disorder.

- **A** mood
- **B** psychotic
- **C** addictive
- **D** anxiety

11 Two psychological coping strategies a person may use to overcome a stressor are:

- **A** problem focused and biologic focused.
- **B** problem focused and emotion focused.
- **C** problem focused and the historical approach.
- **D** emotion focused and integration.

12 Stigma:

- **A** refers to a mark of shame or negative view of something.
- **B** refers to an eye problem commonly seen in people with poor nutrition.
- **C** refers to the positive image created when a person is labelled with a mental disorder.
- **D** encourages people to seek help when they are unable to cope with a stressor.

13 In Australia the percentage of people who will suffer from a mental disorder at some point in their lives is:

- **A** 20 to 30 per cent.
- **B** 45 per cent.
- **C** 65 per cent.
- **D** 100 per cent.

14 Symptoms of schizophrenia include:

- **A** delusions, disorganised thinking and hallucinations.
- **B** delusions, depression and anxiety.
- **C** hallucinations, fear and violence.
- **D** hallucinations, disorganised thinking and depression.

15 The key cause(s) of depression in women in Australia include:

- **A** loneliness.
- **B** financial stress.
- **C** relationship problems.
- **D** All of the above

SECTION B: SHORT-ANSWER QUESTIONS

1 Explain how the biopsychosocial approach seeks to explain mental health.

2 What is the statistical approach to defining normality? Provide an example to support your answer.

3 Explain the difference between a stressor and stress.

4 Explain what the term 'eustress' means and provide an example.

5 What is an advantage of classifying mental disorders using a categorical approach?

6 What is the difference between protective and risk factors in relation to mental health?

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7 Name and explain two reasons that may prevent people from seeking treatment for mental disorders.

8 Explain the concept of the mental health and mental disorder continuum.

9 Susan is referred to a psychologist by her local doctor because she has begun rambling incoherently when she is stressed. An example of Susan's speech includes, 'Come and take my hand, you evil being. I can't have it on my head any longer. I want an apple for tomorrow.' Susan often also grimaces and frowns when she speaks in this manner. What sort of mental disorder is Susan likely to be diagnosed with?

10 Using an example, describe the model of the two-hit hypothesis.

SECTION C: EXTENDED-RESPONSE QUESTION

AVATARS HELP SILENCE SCHIZOPHRENIA'S VOICES

LONDON: People with schizophrenia who didn't respond to medication learned to control hallucinatory voices with the aid of a computer program that used an avatar of their imagined persecutor, in a study by British researchers.

The Wellcome Trust, the world's second-largest biomedical charity, said on Wednesday that it is giving scientists at University College London and King's College London £1.3 million pounds ($2.04 million) to test the avatar therapy in more patients.

Schizophrenia is a condition that affects thinking, feeling and behaviour in about one in every 100 people. A quarter of them aren't helped by drugs. The avatar therapy reduced the frequency and intensity of auditory hallucinations in patients in the British study. It also diminished the disruption to patients' lives and the delusions they developed about the voices. Three patients stopped hearing voices altogether.

The computer software uses gaming technology. One of Professor Leff's colleagues combined FaceGen, three-dimensional facial construction software from Toronto-based Singular Inversions, and animation software from Annosoft of Richardson, Texas, to enable the patients to create a face and voice representing their tormentor. Professor Leff then spoke to them through the modified voice until the patient gained control.

The researchers also recorded the sessions on MP3 players so that the patients could replay them as reminders of their capacity to overcome the bullying voices.

Twenty-six patients between the ages of 14 and 74 who hadn't been helped by anti-psychotic drugs such as AstraZeneca's Seroquel and Bristol-Myers Squibb's Abilify participated in the trial. They received either treatment as usual or as many as seven sessions of therapy lasting as long as 30 minutes.

Those in the control group were offered the treatment at the end. After the therapy, patients were evaluated by a psychiatrist with commonly used rating scales for psychotic symptoms, their beliefs about the voices, and depression.

Avatar therapy's overall effect was at least twice that of the only other non-pharmaceutical treatment for schizophrenia, cognitive behavioral therapy, Professor Leff said.

Professor Leff and his colleagues had difficulty recruiting enough people for the £55 000 pilot study because he said other doctors were reluctant to refer patients for an unproven treatment.

Only 16 of the 26 participants completed the trial, he said. Some were deterred by voices they heard threatening to harm them if they participated.

He said the therapy wasn't the answer for everyone with schizophrenia. Those who heard more than one voice had difficulty concentrating when other voices interrupted. Some patients enjoy their auditory hallucinations, such as a young man Professor Leff didn't treat in the trial because the voice he heard was of a broadcaster commenting on his favourite soccer team.

Source: Adapted from Associated Press. (2013, May 30). Avatars help silence schizophrenia's voices. *The Age*.

QUESTIONS

1 Is this an example of an experiment? Why or why not?

2 Describe the method involved in the research.

3 What were the results of the study?

4 Can a conclusion be made after this research?

5 Do you think the researcher acted ethically by offering the participants in the control group the opportunity to undergo the treatment after the research? Why or why not?

This question is worth 10 marks.

SECTION D: ASSESSMENT TASK

CATEGORIES OF MENTAL DISORDER

Present research on one of the major categories of mental disorder.

In your presentation include the following:

- a definition of the disorder
- symptoms, behaviours and attitudes that are present in someone with the disorder
- possible causes for the disorder
- a possible treatment
- other interesting information about the disorder
- a case study of someone with the disorder
- a bibliography or reference list.

CHAPTER 07

RESEARCH INVESTIGATION



KEY KNOWLEDGE INCLUDES:

- the characteristics of effective science communication: accuracy of psychological information; clarity of explanation of psychological concepts, ideas and models; contextual clarity in terms of importance and implications of findings; conciseness and coherence; and appropriateness for purpose and audience
- the psychological concepts specific to the investigation: definitions of key terms; use of appropriate psychological terminology, conventions and representations
- the use of data representations, models and theories in organising and explaining observed phenomena and psychological concepts, and their limitations
- the nature of evidence and information: distinction between opinion, anecdote and evidence, weak and strong evidence, and scientific and non-scientific ideas; validity and reliability of data including sources of possible errors or bias
- the influence of social, economic, cultural and ethical factors relevant to the selected psychological investigation.

Psychology Area of Study Key knowledge points derived from *VCE Psychology Study Design 2016*, p.18; © The Victorian Curriculum and Assessment Authority (VCAA). Used with permission.

Refer to the VCAA VCE Psychology Study Design (Unit 1, Area of Study 3) for research topics, or you may develop your own research question related to Units 1 and 2 in conjunction with your teacher.

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RESEARCH INVESTIGATION

This chapter covers everything you need to prepare yourself for Unit 1, Area of Study 3, Outcome 3: the student-directed research investigation. The research investigation is a formal scientific report that explores and presents information on a topic of interest; in this investigation you will explore brain function and/or development. You are to draw on your knowledge of the topics covered throughout Unit 1 to conduct your investigation. Your report can take the form of a digital, oral or written report, and the research question you choose comes from one of six topics: Biopsychology; Brain and the use of technology; Cognition; Psychological development; Mental health and disorder; and Changing thoughts, feelings and behaviour.

WHY DO WE WRITE SCIENTIFIC REPORTS?

Imagine that you are sitting at home chatting to friends and you start to wonder about all sorts of random questions: Did they ever make a seventh M&M's colour? What would happen if you didn't sleep for a week? What is the highest pitch you can hear? These kinds of questions used to keep people puzzling for hours, or even years, but with the introduction of the Internet more than 25 years ago, society has spent a lot less time wondering and a lot more time finding out! So, what do you want to find out about? Complete Try it yourself 7.1 to research your burning questions. The Internet does not provide answers to every question you may have. However, it does present an abundance of information on topics you might like to know about and this may help you answer any of those random or more obtuse questions you may have. Of course, this information did not just appear on the Internet overnight. This abundance of information exists because of the research that has occurred worldwide and then been shared globally.

7.1 TRY IT YOURSELF >>

UNANSWERED QUESTIONS

So, what are your unanswered questions? Have you been meaning to look up those lyrics to that Taylor Swift song you just can't work out? Or the definition to some word your friend uses that you don't understand? Or are you just keen to explore the Guinness World Record for the longest fingernails?

Write down three of your burning questions and look them up on the Internet.

- What do you notice about the responses?
- Are there lots of hits? Have people wanted to know the same thing as you?
- Are your answers sourced from scientific research, or are they a matter of opinion?
- What does that mean for what you are searching for?
- Do you believe the accuracy of your answers?
- What other questions arise from what you found?

For centuries, researchers have been systematically manipulating one variable in order to measure its effect on another variable. This forms the basis of an experiment because a cause-and-effect relationship between two variables is sought. If you change one thing, what happens to another? If you eat more chocolate, do you get more energy? If you listen to a recording of your Psychology material while asleep (Figure 7.1), will you remember more of it in the morning? Changing one thing to measure an effect on another and other things associated with experimental research is explored in detail in Chapter 1.

What is absolutely critical to research and research questions alike is what we do with that research after it has been collated. For an individual to conduct research just for the benefit of their own team, students or

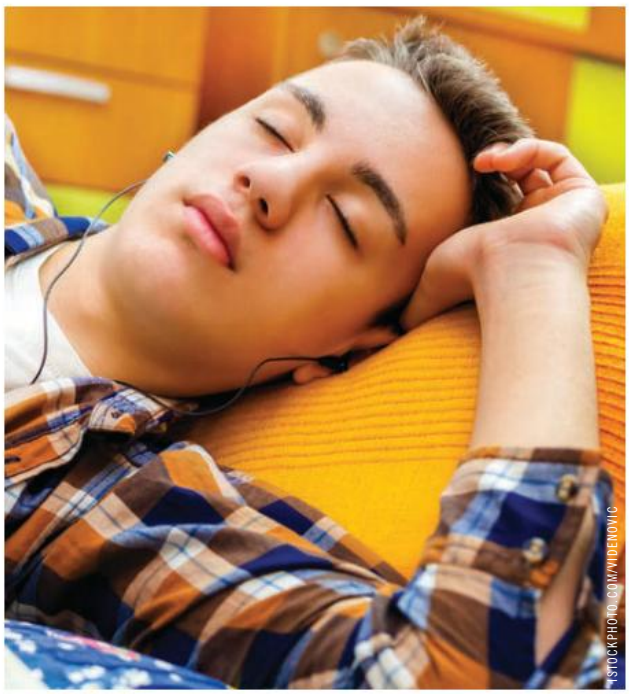


FIGURE 7.1 Do you ever wonder if you can learn your Psychology content while you sleep?

research investigation A formal scientific report that explores and presents information on a topic of interest

experiment A process by which we seek to find a cause-and-effect relationship between two variables

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corporation does nothing to advance research, science, psychology or any field under investigation. If scientists are going to add to the body of scientific knowledge, their research and its findings must be published.

There are many forms of research publication, such as journals, articles or even theses (Figure 7.2), but if this research is to be shared, it must follow certain rules of publication that are largely associated with making sure that the research has validity, reliability and integrity. Research that does not have these elements can be useless because the errors or biases that occur in the research can produce false or misleading results. So how do we protect research from these research flaws? First, research must have validity; that is, it must be conducted and shared in such a way that it measures what it claims to have measured. For example, if research claims to measure intelligence, it cannot actually be testing memory; if it claims to investigate teenagers' driving ability, it cannot only measure that of 18-year-old females. Second, research presented should have reliability so that it can be replicated by others. Research is important for advancing scientific fields and knowledge, so being able to replicate, or repeat, the same findings strengthens the original findings and enables further investigation (validity and reliability are covered in Chapter 1). Third, research must be conducted and shared with integrity. This means that all ethical considerations and standards relating to scientific research must be upheld in every way. Research is designed to help and not hinder. So if research leads to harm, or lends favour to those involved in research that is unfair to others, or leads to an abuse of power or influence, it does not follow the guidelines of scientific research.



FIGURE 7.2 It is important to publish research, for example in the form of a thesis.

When research is published, not only does it help to advance our knowledge, it also allows other researchers to learn from mistakes made by previous researchers. As a result, future researchers are able to build on previous work done and add to the general body of scientific knowledge. Next, we explore some of the ways you can present the research findings that result from your own research investigation.

SECTIONS OF THE RESEARCH INVESTIGATION

There are many different ways research can be presented; from informal to formal, from discussion-based exploration to methodically scientific. The approaches we will focus on explore main points for you to consider that will assist with your understanding, exploration and presentation of your research investigation.

The research investigation you conduct will take the form of a publication. You can choose a digital presentation, oral presentation or written report, but the areas for consideration will all be the same. So, what do you need to include in a research investigation?

What is the research question?

The most important component of any research investigation lies in an understanding of what it is you want to explore. This is sometimes known as an aim, where you consider the purpose of the study. You must therefore first decide what it is that you want to know about. Then you need to consider many other factors, such as which population you are interested in investigating, how you will research this, what problems you might encounter, and how you can prevent them from occurring.

The research question can be used in your research investigation as the title. It will also need to be addressed in both the introduction and the conclusion of your piece of work. Your research question determines which psychological concepts and evidence you need to explore.

Research is a very exciting journey that begins with a single question.

Who is the audience?

In all forms of writing or presenting, it is crucial to be aware of your intended audience. Knowing who your audience is guides your writing and presentation style. This knowledge allows you to present your information

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in a more compelling or persuasive way. For example, you might adopt a story-like approach when trying to teach children not to bully others (Figure 7.3), but when trying to warn adults of the dangers of drink-driving it may be more appropriate to use scare tactics and graphic images. Adjusting your style of presentation to suit your audience is a powerful tool to get your message across in a way that has the most impact. Try it yourself 7.2 allows you to consider how differently messages can be conveyed to different audiences.



FIGURE 7.3 Changing your presentation style to suit your audience can help you to be more persuasive.

Identifying your audience also allows you to explore why you are asking the question in the first place. Who will benefit from, or be interested in, your research? What is the likely impact of your research on others? Where may the knowledge you hold be most valuable?

So, who will your audience be? Who will you address your presentation to? What style will you adopt to maximise the impact you may have on your audience? It is important to note that there is no need to write about the audience specifically in your investigation. Who your target audience is should be clear through your style and the development of your piece of work.

7.2 TRY IT YOURSELF >>

WHO IS THE AUDIENCE?

When conveying a message, especially a persuasive one that tries to convince people to form an opinion or belief on something, it is very important to know your audience. When you know the audience you are trying to appeal to, you can adjust the way your message is delivered so that it has maximum impact.

Your task is to watch a series ofTV ads during an ad break. Select one of the ads and answer the following questions.

- Can you pick the target audience for this ad?
- What hints were you given about who the target audience is?
- What persuasive techniques did the ad use to appeal to this audience?
- What other features in the ad, such as language and visuals, were used to appeal to the audience?

How do I introduce the psychological concepts?

Once you have established your research question and decided on your audience, you can commence writing your research investigation. It should begin with an introduction that covers all the relevant background theories, definitions and concepts that are important for the audience to know about.

You should approach this section by considering the following questions: What is it important for the audience to know? (You should consider any background theory or knowledge relating to the area you are investigating and relay that information to your audience.) What do the terms you are going to use mean? How do they all fit together?

Your introduction must be cohesive and take the reader on a journey from general understandings to specific detail. Think of this section as a funnel (Figure 7.4) – start from a broad base by introducing the topic area and then, as you progress, become increasingly specific so that you finish at a precise point. The final concept you explore at the end of your introduction also serves as the point from which the next section of your investigation – the research (evidence) component – begins.

validity Research must actually measure what it claims to measure

reliability Research must be able to be replicated and the same results found

integrity Upholding ethical considerations and research standards

aim The purpose of the study; what you intend to investigate

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FIGURE 7.4 An introduction should be written like a funnel, starting from a broad base and ending at a specific point.

The introductory section of your research investigation should be factual, and hence free from bias. It is not an opportunity to present your personal opinion on the topic – you are merely presenting the facts or theories that exist. In this section you should also ensure that you present any limitations to the theories and concepts you present. These limitations may become important considerations as your investigation unfolds. In addition, acknowledging them is integral to providing a well-rounded and balanced view of the concepts and understandings of the background material.

How do I present contemporary research to help answer the research question?

The background information and relevant concepts have now funnelled their way to a specific point. It is time to present sourced research or scientific evidence. When sourcing evidence, you may choose from a variety of sources of secondary data. For example, you may use scientific journals or statistics in a newspaper article. You may even use research discussed throughout the textbook. In this section it is essential that you make sure that what you are presenting are findings from research and not a repeat of definitions and theories discussed previously.

When you present sourced research it is also important to give it context. To do this, you may like to present the research with three main points in mind:

1 What were the researchers aiming to do?
2 What did they do?
3 What did they find?

These general guidelines will ensure that the audience forms an understanding of where the research or evidence fits in a broader context. You must also ensure that the evidence you are presenting is linked to the background information and the concepts you have discussed. You are not merely stating what someone has done; you are searching for parallels or conflicts between your evidence and the theory. You must also state whether the evidence supports or refutes the theory.

When presenting the research or evidence, ensure that you discuss the validity and reliability of what you have presented (Figure 7.5). Earlier, we discussed that validity in relation to research refers to whether or not the research measures what it intended to measure. As a researcher, you should be aware that many errors can occur in research that can affect the validity of the findings, and while some are unable to be controlled, others can be controlled. In order to determine whether your research was valid, you must determine whether there were large errors in its execution. Were there major flaws in the research design that meant that the findings may not be valid? If the answer is yes, then the validity of the research can be questioned.



FIGURE 7.5 When you present research, make sure you discuss its validity and reliability.

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We also noted earlier that the reliability of the research refers to whether or not the findings of the research can be replicated. Were the circumstances of the research such that the findings were only achieved on a singular day, at a singular point or at a precise moment? If this is the case, the findings are not truly reflective of actual findings on a given topic. For research to be reliable the results need to occur again and again, and with similar samples. If this is unlikely, the reliability of the research could be brought into question.

The validity and reliability of the sourced research or evidence should be discussed. If the research has questionable validity or reliability, it does not mean you should not present the research or data. On the contrary, the research should still be presented, but you must acknowledge its flaws.

How do I analyse and synthesise the evidence presented?

The research question you asked at the beginning of the research investigation now needs to be addressed. What have you learned through your journey? This is the point where you bring the information together – from theory to practice to synthesis.

You might start by briefly revisiting the theory and then briefly revising the evidence. Then it is time to evaluate what you have found. Was it all as expected? Did the theory and the evidence match, or support, one another? If so, what might this tell us for future research? Maybe the theory and evidence did not match. What might this tell us? Why might this have occurred? What might this tell us for future research?

The answers to some of these questions may lie in social, economic or cultural factors that may influence your research. These influences can act as extraneous variables in your study, but also can help to explain why results occurred in the manner in which they did. This may also be the case with ethical considerations that may have been relevant to your research question. Ethical considerations refer to a set of moral standards and guidelines that govern research (Figure 7.6). You can read about these in more detail in Chapter 1. You may have already done this in relation to the limitations of the sourced research or evidence you have provided, or it may be important to mention now the ethical considerations guiding any future research that may be conducted in the field you have begun investigating.

In order to complete your research investigation, it is important to include concluding remarks. Concluding remarks address the initial question posed. At this point it is essential to remember that your investigation of your topic is not conclusive. It is not an extensive or exhaustive investigation, so you need to be careful with your choice of words so that you do not give this impression. You may like to say that 'it is suggested' or 'preliminary research indicates'. However you decide to present your concluding remarks, you should view them as an opportunity to briefly answer the question you posed and suggest the direction of future research. You should not view the concluding remarks as an opportunity to provide a definitive answer to the question.



FIGURE 7.6 Ethical considerations are a set of moral standards and guidelines that govern research.

ethical considerations Moral standards and guidelines that govern research

How do I reference any material I have sourced or referred to?

Any time you use a concept, definition or idea taken from another source you must reference it. This is important because it gives credibility to your work, but it also acknowledges the work of others.

In psychology, the APA style of referencing is widely used. For a detailed explanation of how to cite and reference other sources using APA style, please see Chapter 1 (page 26).

You should ensure that you closely follow the required referencing format because this aspect of scientific report writing will become increasingly important to your research journey as you continue into tertiary studies.

What are the important points for my writing style?

Your research investigation needs to be written in a scientific manner. It should include relevant psychological terminology at all times.

When writing a scientific report it is important not to personalise it. Do not use words such as 'I' or 'we', or 'my class' or 'my teacher' (Figure 7.7). Take on the persona of a researcher presenting findings to the population. To avoid personalising, you may like to use phrases such as 'it has been demonstrated' or 'research suggests'.



FIGURE 7.7 Always write in a scientific manner. Take on the persona of a researcher; don't acknowledge that you are a student in a class.

It is also important that your writing is cohesive and comprehensive. Your thoughts should be presented in a logical sequence, not just a collection of facts stated one after the other. You should demonstrate how one concept or fact relates to the next.

For ideas on how scientific writing works, you should search journal articles online. Take note of the way these articles incorporate terminology, how ideas are presented so they flow, and the use of third-person perspective.

SUBHEADINGS OF THE RESEARCH INVESTIGATION

To help guide your writing, Table 7.1 provides a summary of sections or subheadings you might like to use in your research investigation report, with a brief description of what you could include in each section. More detail can be found under the previous section, 'Sections of the research investigation'.

CHOOSING A PRESENTATION STYLE

When presenting academic research, the style of presentation you submit, the headings you can use and even the font type you can select can be very limited. However, the research investigation you are completing is designed to allow you to showcase your natural talents. You should choose a style that suits your strengths. Ask yourself whether you enjoy public speaking. Do you like writing or are pictures and visual representations more your style? After considering your strengths, remember to consider how the question you choose could best be answered. Would your question be better framed by arguing two cases against each other, or would it be better to present it through pictures or a written evaluation? No presentation style is superior to another; each will have its own strengths and limitations. Now it is time for you to consider which presentation style might be best for you and your question. You can choose from a digital presentation, an oral presentation or a written presentation. Once you have read about all the options, complete Try it yourself 7.3 to weigh up each option before you make your choice.

Digital presentation

A digital presentation could be a very exciting way to present your findings and it could provide great flexibility in terms of presentation style. Presenting your findings digitally could be the most effective

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TABLE 7.1 Sections of the research investigation and what you should include

SECTION	WHAT TO INCLUDE
Title	» Use the research question.
Introduction	» Flesh out the research question from broad beginnings to specific detail (What does it mean? What do we know? Who does it impact? Why is it important?) » Define and explain key terms needed to understand the research question. » Include any limitations to the theories you have presented.
Scientific evidence	» Present at least two pieces of contemporary research that provide evidence related to your research question (include what they aimed to do, what they did and what they found). » Discuss whether the evidence you have provided is valid and reliable (were there any research flaws that should be highlighted?)
Analysis	» Discuss whether the evidence you have supports or refutes the theory. (Why might that have occurred? What does that mean for future research?) » Include any social, economic, cultural or ethical considerations that need to be accounted for in your field of research.
Conclusion	» Include a concluding remark that addresses the research question. What might be the future direction of this area of research?
References	» Ensure that you reference all sources referred to in your research investigation according to APA standard.

option if your topic is best illustrated by the use of images or videos. If you choose a digital presentation, you need to be careful to provide the necessary detail throughout the presentation. This will ensure that your concepts are fully explained rather than just briefly mentioned and will avoid you relying on the images to do the explaining for you.

Oral presentation

An oral presentation allows for a lot of discussion so it provides an opportunity to add depth to the arguments you may wish to present (Figure 7.8). An oral presentation may be particularly appropriate if you are dealing with a fairly contentious topic. If this is the case, it is wise to outline the two different sides of the topic to your audience. An oral presentation is an ideal way to do this because it allows you to choose how strongly you deliver both arguments. When presenting orally, you must be careful to ensure that there is ample time for you to present the arguments. You must also ensure that you don't brush over less exciting components in order to focus on the evidence you wish to present. Cue cards are an effective way to keep you on track and well-planned PowerPoint slides will always enhance your presentation style.



FIGURE 7.8 An oral presentation allows for discussion, which adds depth to the arguments you are presenting.

Written presentation

A written presentation has the advantage of being one of the best ways of preparing for assessment tasks that you will complete later in the year. It is also serves as effective preparation for the examination because a written presentation helps you to plan and organise how you are going to attempt questions in the written form. This presentation style allows you to draft quite easily too. If you are someone who likes to plan your work, and get feedback on it as you progress, then this style will work well or you. Because a written presentation will include a lot of sourced material, you must ensure that you follow the correct referencing format throughout.

reference To acknowledge a concept, definition or idea taken from another source

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7.3 TRY IT YOURSELF >>

COMPARISON TABLE

Now that you have read about each of the presentation styles, draw up a table that compares the three styles. Write the name of each style down the side of your page and then draw two columns, one titled 'Pros' and one titled 'Cons'. Fill in the pros and cons for each presentation style and then use this table to help make your final decision.

CHOOSING A QUESTION AND TOPIC

There are six broad topics drawn from information you have already learned about this year in Psychology:

- Biopsychology
- Brain and the use of technology
- Cognition
- Psychological development
- Mental health and disorder
- Changing thoughts, feelings and behaviour.

For each of these topics there are a variety of research questions you can choose from. Your task is to pick only one question from one area. The following 'Exploration' sections provide an overview of each of the six broad topics and highlight one question drawn from each of the topics. Each of the questions explored is designed to provide a starting point for you, if you were to choose that question for your research investigation. Some background theory, research or interesting facts will be presented, along with some points to consider if you were to select that question.

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EXPLORATION 1: BIOPSYCHOLOGY

WHAT IS BIOPSYCHOLOGY?

Biopsychology is a field of psychology that examines how the brain and neural processes (our biology) influence our behaviour, thoughts and feelings (psychology). It is the study of how our biology and our behaviour impact on one another. For example, when you are feeling stressed, your psychological state can cause a biological reaction that results in you getting the flu. Biology and psychology are so closely intertwined that it can, at times, be difficult to determine whether a behaviour has a biological or a psychological cause, whether a biological reaction led to a psychological state, or whether a psychological state led to a biological reaction. For example, being stressed about upcoming examinations can often lead to a cold. Did the cold cause the stress, or did the stress cause the cold? This fine line is what makes the field of biopsychology so fascinating, and at the same time crucial to understand.

We learn much about biopsychology through the use of brain imaging and other technological advances. As we saw in Chapter 2, neuroimaging techniques allow scientists to take pictures of the brain's structure and function so they can see what the brain looks like as well as which areas of the brain are active at any given moment. These techniques allow the brain's activity to be measured while someone performs a specific task, such as listening to music, remembering a holiday or counting to 100. By viewing the brain at work, scientists are able to determine which brain areas are used during specific tasks and how much they are used during each activity. This ability has helped researchers understand how the brains of individuals with enhanced abilities work, as well as how brain damage affects behaviour. Brain injury cannot always be physically seen, but by looking at brain activity, changes to brain function can be detected. Of course, not all of the effects of brain injury happen immediately. Some effects can show up years later, but continued advancements in technology will enable brain researchers to improve their understanding of the brain and what it can do.

HOW CAN BRAIN TRAUMA IN SPORTING INJURIES AFFECT COGNITIVE FUNCTION?

The Australian cricket world was shocked and saddened in November 2014 when cricketer Phillip Hughes received a fatal blow to the head from a bounced ball. Although this was a rare occurrence in professional cricket, for many sports the reality of brain trauma occurring while playing is a lot more common (Figure 7.9). Competitors in sports such as boxing and American football wear helmets for protection, but this does not prevent all forms of brain trauma. In fact, American football is known for a high level of brain trauma incurred while on the sporting field (American Association of Neurological Surgeons [AANS], 2014). In other contact sports, helmets are not compulsory, such as in Australian Rules football, but even sporting organisations such as the Australian Football League (AFL) widely debate the risks associated with rough play and the possibility of brain trauma (AFL, 2014).



FIGURE 7.9 In many sports, players are at risk of brain trauma.

The AFL's 2013 Injury Report stated, 'Concussion has been a major injury concern for all sports in recent years with further understanding that there is a possible link between concussions suffered in sport and neurodegenerative conditions in later life. Reflecting these concerns, the AFL and AFLDA introduced revised Concussion Management Guidelines at the beginning of the 2011 and 2013 seasons that reinforced a more conservative approach to concussion management' (AFL, 2014).

biopsychology A field of psychology that examines how the brain and neural processes influence our behaviour, thoughts and feelings

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Concussion is one of the most common types of brain trauma and results from a sudden blow to the head or violent shaking. The symptoms of concussion are varied and many, ranging from loss of consciousness to dizziness and disorientation, to nausea and vomiting, memory loss and confusion. So, which sports have the highest number of incidents of brain trauma in the US? Focus on research 7.1 lists 20 sports and recreational activities that contributed to the highest number of estimated head injuries treated in US hospital emergency rooms in 2009.

FOCUS ON RESEARCH 7.1

HEAD INJURIES IN US SPORT

TABLE 7.2 Number of head injuries by sport

SPORT/RECREATIONAL ACTIVITY	NUMBER OF HEAD INJURIES TREATED IN US HOSPITAL EMERGENCY ROOMS (2009)
Cycling	85389
Football	46948
Baseball and softball	38394
Basketball	34692
Water sports (diving, scuba diving, surfing, swimming, water polo, water skiing, water tubing)	28716
Powered recreational vehicles (ATVs, dune buggies, go-carts, mini bikes, off-road)	26606
Soccer	24184
Skateboards/scooters	23114
Fitness/exercise/ health club	18012
Winter sports (skiing, sledding, snowboarding, snowmobiling)	16948
Horseback riding	14466
Gymnastics/dance/ cheerleading	10223
Golf	10035
Hockey	8145
Other ball sports and balls, unspecified	6883
Trampolines	5919
Rugby/lacrosse	5794
Ice skating	4608
Roller and inline skating	3320

Source: AANS (2014)

We have started to see the dangers associated, in terms of brain trauma, in a variety of sports, but why are brain traumas such as concussion widely studied and so important to manage correctly when playing sport? In 2013, ex-NFL players sued the US National Football League (NFL) for poor handling of concussion-based injuries, in what is now a world-famous case. Three cognitive disorders were identified as being linked to brain trauma when playing sport (Figure 7.10). The development of these disorders was linked to brain trauma sustained by the ex-players involved in the case. The three disorders noted were Alzheimer's disease, dementia and chronic traumatic encephalography. To discover more on the possible effects of concussion, read the full article in Focus on research 7.2.

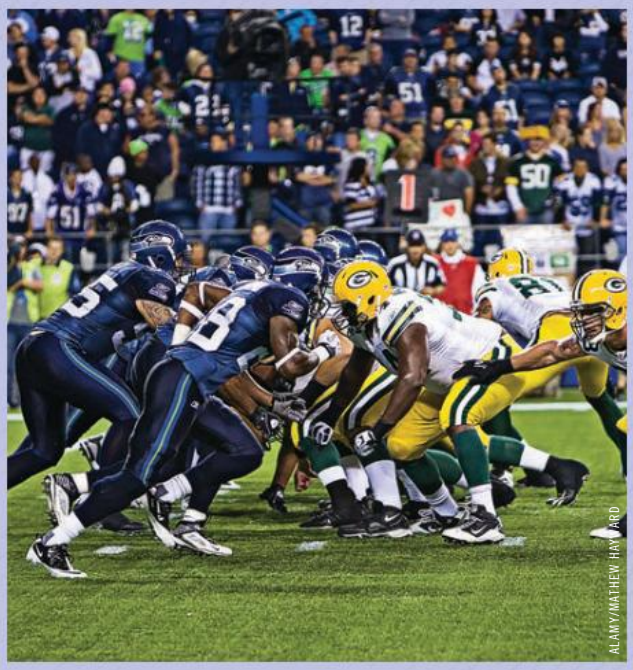


FIGURE 7.10 Although NFL players wear helmets, recent findings show that cognitive damage can still occur from concussions incurred while playing.

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FOCUS ON RESEARCH 7.2

NFL, EX-PLAYERS AGREE TO $765 MILLION SETTLEMENT IN CONCUSSIONS SUIT

PHILADELPHIA – The NFL has reached a tentative $765 million settlement over concussion-related brain injuries among its 18 000 retired players, agreeing to compensate victims, pay for medical exams and underwrite research.

A federal judge announced the agreement on Thursday after months of court-ordered mediation. It came just days before the start of the 2013 season.

More than 4500 former athletes – some suffering from dementia, depression or Alzheimer's that they blamed on blows to the head – had sued the league, accusing it of concealing the dangers of concussions and rushing injured players back onto the field while glorifying and profiting from the kind of bone-jarring hits that make for spectacular highlight-reel footage.

The NFL long has denied any wrongdoing and insisted that safety always has been a top priority. But the NFL said on Thursday that Commissioner Roger Goodell told pro football's lawyers to 'do the right thing for the game and the men who played it.'

The plaintiffs included Hall of Famer Tony Dorsett, Super Bowl-winning quarterback Jim McMahon and the family of Pro Bowl linebacker Junior Seau, who committed suicide last year.

Under the settlement, individual awards would be capped at $5 million for men with Alzheimer's disease; $4 million for those diagnosed after their deaths with a brain condition called chronic traumatic encephalopathy; and $3 million for players with dementia, said lead plaintiffs' lawyer Christopher Seeger.

Any of the approximately 18000 former NFL players would be eligible.

Senior US District Judge Anita Brody in Philadelphia announced the proposed agreement and will consider approving it at a later date.

The settlement most likely means the NFL won't have to disclose internal files about what it knew, and when, about concussion-linked brain problems. Lawyers had been eager to learn, for instance, about the workings of the league's Mild Traumatic Brain Injury Committee, which was led for more than a decade by a rheumatologist.

In recent years, a string of former NFL players and other concussed athletes have been diagnosed after their deaths with chronic traumatic encephalopathy, or CTE. Those ex-players included Seau and lead plaintiff Ray Easterling, who filed the first lawsuit in Philadelphia in August 2011 but later committed suicide.

About one-third of the league's 12000 former players eventually joined the litigation. They include a few hundred 'gap' players, who played during years when there was no labour contract in place, and were therefore considered likely to win the right to sue.

Source: Associated Press. (2013, August 29). NFL, ex-players agree to $765 million settlement in concussions suit. *NFL News*. Reproduced with permission.

There are a range of symptoms that can occur from brain injury or trauma and many of these are related to cognitive functioning. These cognitive effects may be as mild as temporary memory loss or disorientation, or as discussed in Focus on research 7.2, they can be as serious, chronic and debilitating as Alzheimer's disease or dementia. Advanced research conducted by utilising findings from neuroimaging techniques have allowed many sporting organisations and players to be able to understand more about the effect of brain trauma. This information in turn has improved management of brain injuries, such as concussion, which should lead to improved outcomes for all both in the short and long term.

IMPORTANT THINGS TO CONSIDER IF CHOOSING THIS RESEARCH QUESTION

If you choose 'How can brain trauma in sporting injuries affect cognitive function?' for your research investigation, the following suggestions provide a guide for your approach:

- The background theory/content discussed should include information on the brain and nervous system, as well as discussing critical and sensitive periods for neural development, and neural development in general.
- You should explore a range of critical functions affected through brain trauma in sporting injuries and draw parallels to the areas of the brain most likely affected.
- Remember to think about your data. For example, is cycling the most dangerous sport for head injuries or is there another factor driving these numbers higher?

EXPLORATION 2: BRAIN AND THE USE OF TECHNOLOGY

HOW DO WE USE TECHNOLOGY TO STUDY THE BRAIN?

The brain has been studied for centuries in many different ways, from primitive methods such as phrenology, to modern-day neuroimaging techniques. We have learned much about the brain through brain imaging and the mysteries continue to unfold. Advances in neuroimaging continue to help us understand more about brain structure and function. For example, neuroimaging techniques such as PET and fMRI can track blood flow and glucose and oxygen use in certain parts of the brain so that we can determine which parts of the brain are being used during a specific task. Neuroimaging techniques provide structural images of the brain, so we can see what the brain looks like, and functional images of the brain, so we can see what the brain can do, and fMRI machines can perform both these functions at the same time.

These neuroimaging machines continue to generate improved images, so this technology is at the point where we can almost 'see' a working brain in real time. Advancements such as this will allow for an infinite number of possibilities in terms of understanding how we use our brains, explaining amazing abilities, exploring how our brain regenerates and recovers, and many more unexplained phenomena. This kind of understanding is possible because neuroimaging allows objective data to be gathered; that is, data that is directly measurable or observable. This means that research into improving reading speed, or facial recognition, or the best time of day to study, or the development of mental health problems can now be observed through measuring the changes that occur in the brain. Technological advances have also enabled changes in the brain to be mapped. As a result of this ability, the number of things that can be better understood through neuroimaging is virtually limitless.

ARE 'BRAIN-TRAINING' PROGRAMS EFFECTIVE?

If we can map the brain through neuroimaging then it is possible to see the effect that different stimuli have on its growth and development. Much research has focused on brain damage, but we can also use neuroimaging to explore enhanced brain functionality as well. So how do we enhance the abilities of our brain? As we age, we experience a decrease in neurological abilities, which in turn leads to slower processing of information and a decrease in certain memory abilities. But what if we could change that? What if we could train our brain?

Ever since Nintendo released *Brain Age*, the market has been flooded with games and apps that claim to help 'train your brain', and even Mensa has released technology that allows individuals to do this (Worcester, 2014). Brain training works on the same premise as exercise. If you use a muscle consistently, then over time this muscle will strengthen. Brain training involves practising different tasks that 'work out' the brain and hence strengthen the brain through its use. The question remains though, does this theory hold true?

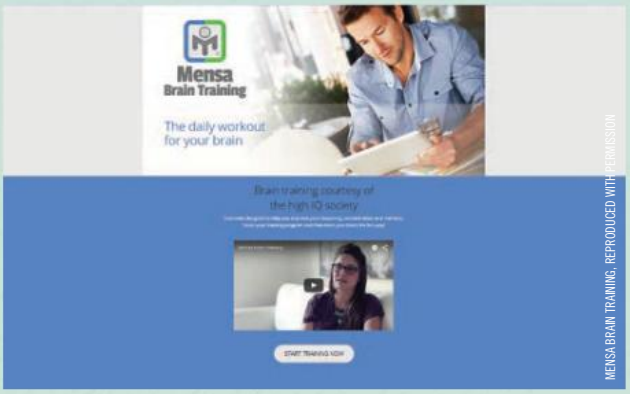


FIGURE 7.11 Mensa has released its own 'brain training' app.

Lumosity, a well-known brain-training application, has a website that features journals and research that supports the notion that brain training is effective in enhancing the brain's capabilities. One such study showed that '1204 students from 40 different schools participated in a semester-long study of the effects of Lumosity in the classroom. The results of the study showed that those students who supplemented their regular curricula with Lumosity training experienced greater changes in their scores on our battery of cognitive assessments than a control group of students who did not complete Lumosity training' (Ng, Sternberg, Katz, Hardy, & Scanlon, 2013).

Another study showed increased parietal lobe activity in children with maths disability following Lumosity training. The parietal lobe controls higher-order functions such as attention, visual–spatial

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processing and number sense. Dr Shelli Kesler and colleagues from the Stanford University School of Medicine published this study in the journal *Neuropsychological Rehabilitation*, reporting changes in behavioural and brain-based measures of cognitive and maths function in these children following Lumosity training (Kesler, Sheau, Koovakkattu, & Reiss, 2011). Figure 7.12 displays in red the parietal cortex activity described in the study. On brain imaging, these areas were more active during a maths task after Lumosity training than before the training.

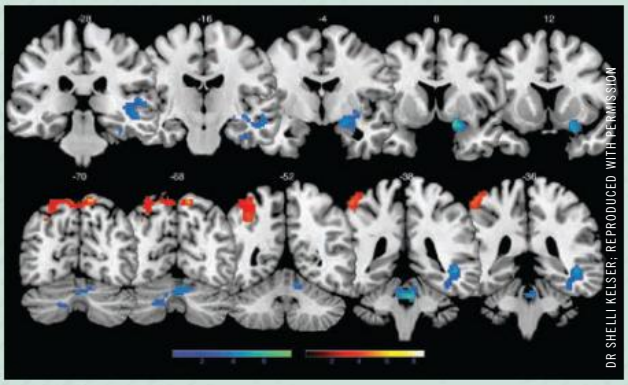


FIGURE 7.12 Increased cognitive function shows up in red in children with maths disability following Lumosity training.

However, reviews of 'brain training' programs over recent years (Kueider et al., 2012; Melby-Lervåg & Hulme, 2013) show that, in general, brain training seems to show that a person undertaking training will get better at the task they are performing, but that it doesn't make a person smarter overall. Steven Novella, clinical neurologist and editor of the blog *Science-Based Medicine* argues that brain training seems to have the same effect on brain plasticity as does regular learning of a task (Novella, 2013). Brain plasticity refers to the brain's ability to modify its structure and function as a result of experience. If a tennis player practises a particular shot enough times, the brain will change to allow that shot to be played with less neural effort. Novella argues that practising anything changes the brain and that brain training itself is little more than practice.

Novella (2013) concludes that brain-training is simply learning; that it is effective, though it is effective in the specific tasks being trained and may not be generalised to other cognitive functions or skills; that it is good to engage in any cognitively demanding tasks, and these do not need to be computer-based; that people should not believe the hype nor spend lots of money on brain-training programs; and that further research is required.

So, who do you believe? Are brain-training games effective, or are they based on a great placebo effect? A placebo effect is where we see a change in a person's behaviour that is due to their expectation that they have been exposed to something that will cause a particular effect. This could be seen in people who play brain-training games because they expect to feel smarter or more able and hence may be more motivated to use their brain, which in turn leads to improved cognitive results. However, if we decide to 'work out' our brain by playing brain-training games, doing crossword puzzles or simply recounting stories, there is certainly merit in the belief that practice will lead to improved cognitive results, so get working!

IMPORTANT THINGS TO CONSIDER IF CHOOSING THIS RESEARCH QUESTION

If you choose 'Are brain-training programs effective?' for your research investigation, the following suggestions provide a guide for your approach:

- The question will need to cover what 'effective' means. How would you measure a brain-training tool's effectiveness? How does research measure effectiveness of a brain-training game?
- Your background theory or content should include information on the brain and on neural development, as well as discuss critical and sensitive periods of neural development and brain plasticity.
- Think carefully about the data you present and remember to discuss the validity and reliability of the data. Remember, companies such as Lumosity are trying to sell a product. Look carefully at who is conducting their research and whether they have a vested interest in the results they produce.

objective data Data that can be directly observed or measured

brain plasticity The brain's ability to modify its structure and function as a result of experience

placebo effect A change in a person's behaviour due to their expectation that they have been exposed to something that will cause a particular effect

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EXPLORATION 3: COGNITION

WHAT IS COGNITION?

Cognition refers to the mental processes that allow us to acquire and understand knowledge through thought and experience. Our ability to think, and the way in which we are able to think, separates us from many other species. Our thought processes allow us to plan, reason, make judgments and conclusions, and even allow us to conceptualise things that cannot be seen or do not exist. As we age, we develop new cognitive capabilities. For example, a baby believes that only what they see exists and hence when their mother leaves the room they get distressed because to them their mother now no longer exists. As they age and progress into childhood, they establish object permanence and understand that something still exists even though it cannot be seen.

Our cognitive development is thought to be relatively stable and predictable in terms of a sequence of events that occur across the lifespan. Early cognitive development is documented by theorists such as Jean Piaget, who describe significant developmental stages that children go through at approximately the same age. The order of these developmental stages is important to allow children to understand the world around them. For example, a young child only understands their own perspective of the world, which is important for them to learn to communicate what they want. As they age they develop the ability to understand perspectives other than their own. The cognitive development described by Piaget is largely unable to be taught, but is learned through a cognitive understanding that emerges as a child interacts with their environment.

DOES EXTRASENSORY PERCEPTION EXIST?

The development of cognition is something that can be mapped or measured over time but, as with many things in the study of psychology, there can be abnormal cognitive patterns as well. Sufferers of schizophrenia can experience thoughts and sensations that are not real, yet they feel real to the sufferers. In obsessive-compulsive disorder, the obsessive thoughts a person experiences are irrational but constant and persistent, and interfere with their ability to conduct daily tasks. In both of these mental health disorders the irregular and abnormal thought patterns experienced can be largely explained by biological, psychological or social factors, but what about thoughts or experiences that cannot be explained by any of these measures?

ESP, or extrasensory perception, has fascinated people for generations. ESP involves an individual receiving sensory information outside of the ordinary five senses of sight, hearing, smell, taste and touch, and can provide the individual with information of the present, past and future. ESP can involve people reporting premonitions of future events, reading the mind of someone they are speaking to, or even being able to communicate with people who have died (Figure 7.13).



FIGURE 7.13 ESP can involve the ability to read other people's minds.

So does ESP really exist and, if so, what evidence is there to support its existence? Much of people's belief in ESP comes through stories that cannot be explained in any logical way through science. Stories such as 'A little girl's dream' create a mystery for believers and sceptics alike as the experience is difficult to rationalise.

A little girl's dream

In October 1966 in Wales, a mountain of black coal waste was destabilised by rain and slid down onto the mining village of Aberfan. The debris destroyed many houses and covered the classrooms of Pantglas Junior School. In total, 116 children and 28 adults died in the disaster from impact or from suffocation.

It is said that one of the children who died – a 10-year-old girl named Eryl Mai Jones – foretold the tragedy. According to the *Daily Mail*, in the days preceding the collapse Jones had told her mother that she was 'not afraid to die' and 'I shall be with Peter and June' (Chalmers, 2009). The day before the collapse, she had told her mother about a dream she had had, in which she had gone to school but found that it was covered by something black. Jones was buried next to her classmates Peter and June.

Apart from stories and tales such as these to support ESP, there is research that explores the existence of ESP. As with all research, it is important to ensure that results are interpreted correctly. All research aims to be free from error and bias through controlling any anticipated extraneous variables that may occur before research is conducted; however,

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interpreting the data can still be subjective. Read Focus on research 7.3 to see the types of studies that have been conducted into ESP. This article also illustrates how differently results can be interpreted because of your own beliefs. See how differently the same results can be interpreted by believers and by sceptics.

Though some psychologists and natural scientists remain sceptical, many agree telepathic abilities and related phenomena exist (MacIsaac, 2013). In one survey that featured more than 500 scientists, 56 per cent reported that ESP is an established fact or a likely possibility, whereas in another survey conducted among more than 1000 scientists, 67 per cent said it is an established fact or likely possibility (MacIsaac, 2013).

Figures 7.14 and 7.15 show some of the differences in belief in ESP among different groups of people. So, do *you* believe?

FOCUS ON RESEARCH 7.3

ESP IS PUT TO THE TEST – CAN YOU FORETELL THE RESULTS?

It's just hokum, say researchers, who offer a new experiment as proof.

The phone rings; you see the caller ID, pick it up and say, 'Wow! I was just heading to the phone to call you.' Or ... you close your eyes and wish as hard as you can as the batter swings, and then he hits it out of the park. Or ... you have an uneasy feeling all day about your son; he comes home with a broken thumb, and you say, 'Thank goodness. I thought you were going to break your arm.'

Did you telepathically signal your friend to call? Did your thoughts generate a home run? Did you get a glimpse of your son's future pain? Do you have extrasensory perception? Does anyone?

Not that anyone who believes in ESP will believe it, but a study published January 13 in *PLOS ONE*, an online peer-reviewed journal, came up with an answer – a resounding 'No.'

Piers Howe and Margaret Webb, both of the University of Melbourne in Australia, showed 48 volunteers pairs of photographs of people, a split second apart, some of which had minor changes (e.g. a haircut, the addition of red lipstick) and some of which were identical. The volunteers consistently detected that there was a change but could not say what the change was.

'From their perspective, they were able to sense changes they could not see. We had induced the impression of a sixth sense,' says Howe. But the sixth sense doesn't exist: It's simply a matter of detecting a change we are unable to verbalize. For decades, others have attempted to examine ESP – a term that embraces phenomena from telepathy to clairvoyance. Here is one of the earliest and one of the most recent of these experiments:

→

The study: Can people use ESP to figure out what's on the face of a card? Probably the earliest attempt to prove the existence of a sixth sense was undertaken by Joseph Banks Rhine at Duke University and published by the Boston Society for Psychic Research in 1934.

Methodology: Research subjects were presented with shuffled decks of cards; each card pictured one of five symbols: a cross, a circle, a wavy line, a square, or a star. Each deck had 25 cards, and chance alone would predict five correct answers. In one experiment, 2400 guesses were made, 489 of which were correct – more than twice as many as would be correct by mere chance.

What skeptics think: Some claimed cheating by subjects and sloppiness by researchers.

What ESP believers think: The statistical probability of this result is roughly a million to one, so something unknown is going on.

The study: Does precognition exist? Can we 'feel' the future? A report by Daryl Bem of Cornell University published in 2011 in the *Journal of Personality and Social Psychology* triggered outrage in the psychological community.

Methodology: Bem conducted nine experiments involving 1000 subjects. In some, subjects were shown two computer images of curtains and told that behind one of the curtains was an image, behind the other, a blank screen. They were to click on the curtain that they believed covered the image. In some tests, the images were soft-core pornography. (Volunteers were warned ahead of time that if they objected to such images, they should not participate in the study.) In other tests, the images were non-erotic. For each click, they had a 50–50 chance of being correct. When the images were non-erotic, the results were close to chance: 49.8 per cent. But the subjects correctly located the pornographic images 53.1 per cent of the time. Other tests checked the volunteers' memories of lists of words, showing that they could anticipate which words they'd be asked to recall. Overall, although the effect was small, it was statistically significant.

What skeptics think: So far, other researchers have been unable to reproduce Bem's results.

What ESP believers think: Some people will agree with Bem's statement at the conclusion of his paper, where he said he wished that psychologists would be more open to considering 'impossible things.'

Researchers will continue to attempt to use scientific methods to prove or disprove reincarnation, crop circles, or whether anyone can predict the future. A 2005 Gallup poll found that about three out of four Americans subscribe to at least one paranormal belief, such as ESP, haunted houses, or telepathy.

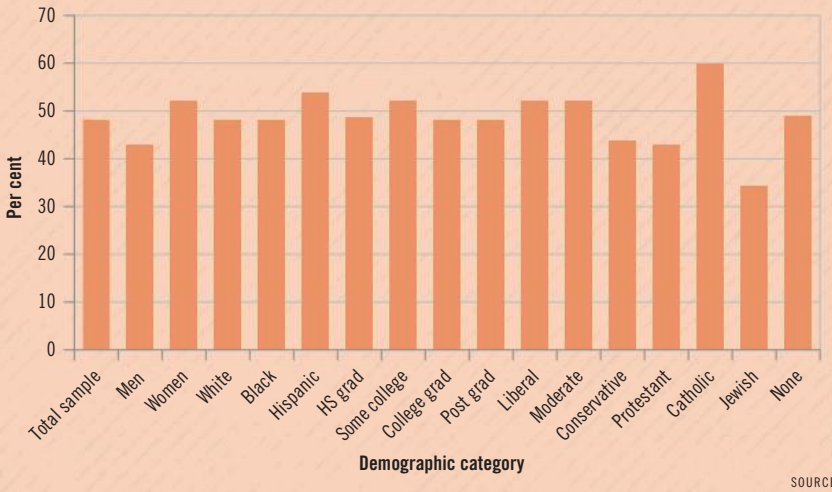
It seems that when it comes to a sixth sense, what we know for sure is that people will believe exactly what they want to believe.

Source: Brink, S. (2014). ESP is put to the test – can you foretell the results? *National Geographic Creative.*

cognition Our mental processes that allow us to acquire and understand knowledge through thought and experience

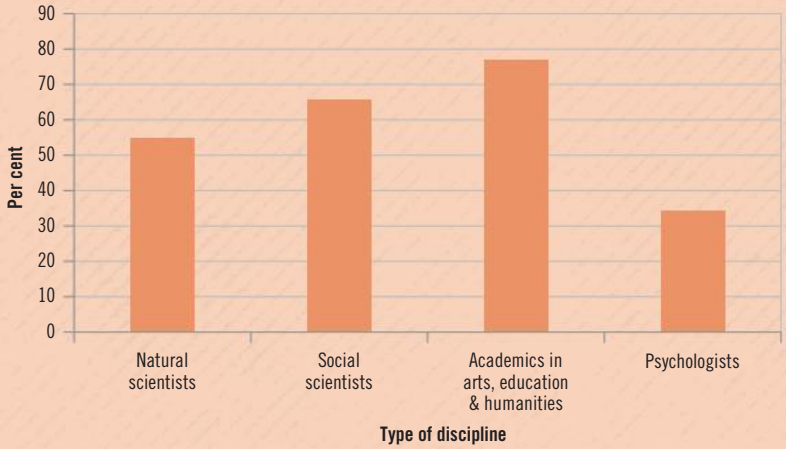
extrasensory perception Sensory information that comes from outside the normal five senses and provides an individual with information from the past, present or future

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SOURCE: 1996 GALLUP POLL, IN NISBET (2000)

FIGURE 7.14 Belief in ESP among the general public



SOURCE: WAGNER & MONNET (1979), IN NISBET (2000)

FIGURE 7.15 Belief in ESP among college professors, according to discipline

IMPORTANT THINGS TO CONSIDER IF CHOOSING THIS RESEARCH QUESTION

If you choose 'Does extrasensory perception exist?' for your research investigation, the following suggestions provide a guide for your approach:

- Your background theory will need to be drawn from work on cognition, but ESP will be a more difficult topic as we are talking about what cognitive theory cannot explain.
- You need to remember this is not an opinion piece but a research investigation, so you must present the research from a scientific point of view, not a personal one.
- You need to consider the element of bias in the research you present. Ask yourself the following questions: What interest does the researcher or publisher have in the findings? Are they trying to justify their own field of work or employment?

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EXPLORATION 4: PSYCHOLOGICAL DEVELOPMENT

WHAT INFLUENCES PSYCHOLOGICAL DEVELOPMENT?

Psychological development includes an individual's emotional, cognitive, social and intellectual development over time. It determines how we respond to situations, as well as our moral development in terms of how we respond to others. Psychological development also encompasses our personality and temperament, as well as the development of our understanding of the world and others. All of these things are just a very small percentage of the abilities and characteristics that make up our psychological development, but are they the result of our genetics, determined at birth, or are they the result of our environment or our experiences?

The 'nature-versus-nurture debate' is a phrase you will hear a lot in psychological studies. So what does it mean and why is it so important? As we saw in Chapter 4, nature versus nurture refers to the integrated relationship between someone's nature (their genetics) and how they have been nurtured (the environment they are exposed to). When we look at any trait an individual possesses, it is difficult to determine whether genetics or the environment were responsible for that trait. For example, some children love to perform and will grab any opportunity to sing in front of a crowd, while others hate the attention. Were those children born with that confidence or did they watch someone else with the confidence and decide they wanted to try it too? In most cases it is argued that it is a combination of genetics and environment that guides our psychological development.

The quest to discover whether nature or nurture has a larger impact on our psychological development is widely studied for many reasons. One important reason for researching the complex interplay between genetics and the environment is to learn more about abnormality and dysfunction. If there are genetic or environmental reasons for psychological dysfunction, then discovering why they have occurred is important for helping to ensure the dysfunction doesn't occur in the future or for helping those affected to better understand their unique characteristics or traits.

HOW DOES LEARNING TO PLAY A MUSICAL INSTRUMENT AFFECT PSYCHOLOGICAL DEVELOPMENT?

Understanding the influence of nature or nurture on psychological development is not only of interest to those studying abnormality and dysfunction. Studying the influence of different environmental factors is also of great interest to those trying to maximise an individual's psychological development. Questions that are often asked include: What can we do to become more in tune with others? What can we do to improve our temperament, become more motivated or more easygoing? And the question many parents ask: What can we do to make our children more intelligent?

The term 'tiger mum' is a modern-day phrase that is gaining popularity in exploring the advanced cognitive development of some children over others. The Macmillan Dictionary (2012) defines a tiger mum as 'a very strict mother who makes her children work particularly hard and restricts their free time so that they continually achieve the highest grades'. Tiger mums typically involve their children in extracurricular pursuits as well, such as music and sport, and demand the same high levels of performance in all of these pursuits. Of course there are many factors at play for the high academic performance of 'tiger cubs', which includes high expectations from their parents and hard work. But their belief in the importance of learning music may have some substance, and many psychologists believe that playing a musical instrument has a number of beneficial effects for an individual, including improved mood and creativity (Figure 7.16). Some of the reported benefits that occur through learning a musical instrument are included in Figure 7.17.



FIGURE 7.16 Playing a musical instrument has many beneficial effects on an individual.

psychological development An individual's emotional, cognitive, social and intellectual development over time

nature versus nurture The integrated relationship between someone's genetics (nature) and the environment they're exposed to (nurture)

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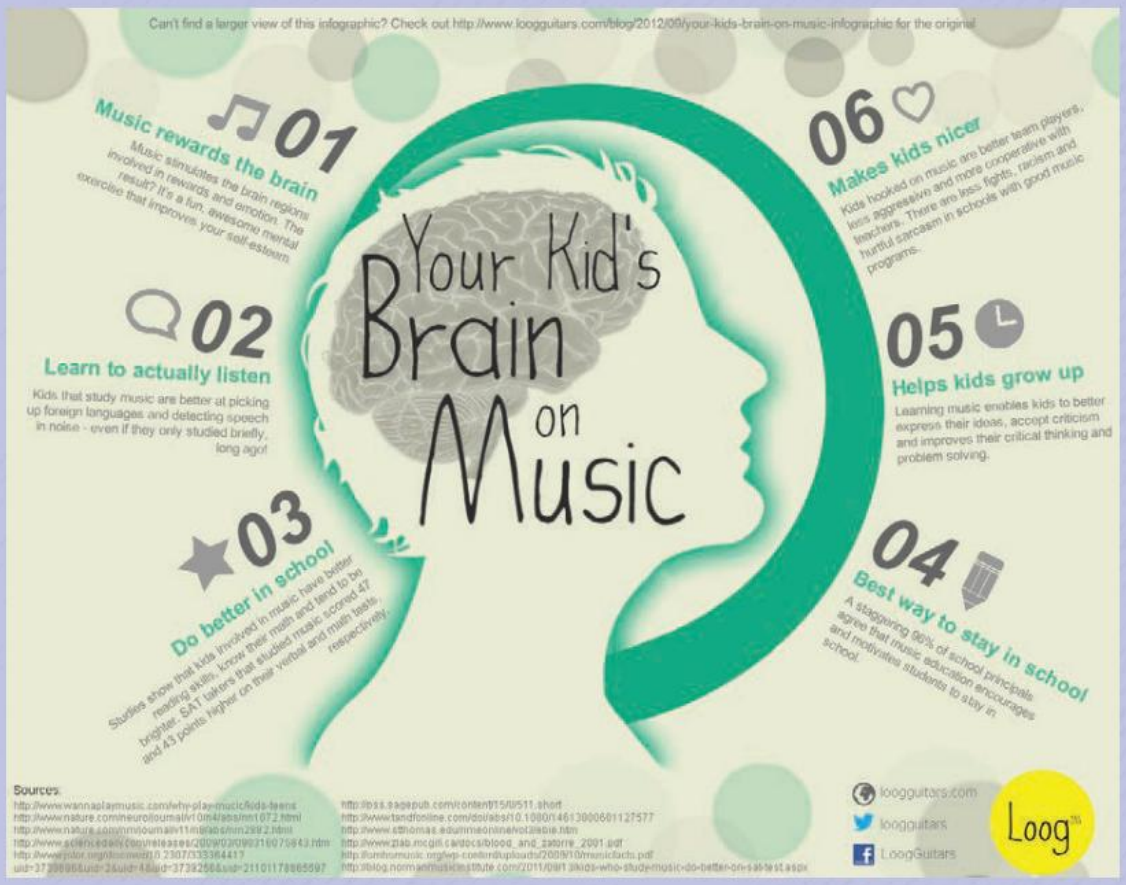


FIGURE 7.17 This infographic shows some of the reported benefits from playing music.

So why do these benefits occur? Read Focus on research 7.4 to find out about some of the effects of playing a musical instrument on the development of the brain.

FOCUS ON RESEARCH 7.4

LEARNING A MUSICAL INSTRUMENT BOOSTS KIDS' BRAINS

Learning a musical instrument is a terrific opportunity for children to express themselves creatively while picking up a new skill. It could be much more than this though, according to researchers, who suggest that musical training could also serve to hone their mental energies. In a new study, published in the *Journal of the American Academy of Child & Adolescent Psychiatry*, a child psychiatry team has found that learning a musical instrument could help children to reduce feelings of anxiety, gain a greater control of their emotions and give a stronger focus to their attention.

The authors describe the study as 'the largest investigation of the association between playing a musical instrument and brain development.'

The aim of the study was to assess any associations that may exist between playing a musical instrument and cortical thickening in the brain. As children grow up, the outer layer of the brain (cortex) changes in thickness, and certain changes have previously been found by researchers to be associated with altered mental states. …

Participants for the study were taken from National Institutes of Health (NIH) MRI Study of Normal Brain Development. A total of 232 children, aged 6–18, were analyzed by the researchers.

Each participant underwent MRI scanning and behavioral testing on up to three different occasions with a 2-year interval between each one. As well as the data from these brain scans, the researchers had access to the participants' IQ and musical training data.

The researchers observed a number of changes associated with musical training in various areas of the brain. As predicted, the motor areas were altered, as playing an instrument necessitates the control and co-ordination of movement.

Musical training was also associated with cortical thickening in areas of the brain related to executive functioning, inhibitory control and the processing of emotions. These include 'working memory, attentional control, as well as organization and planning for the future,' write the authors. …

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Unfortunately, research from the US Department of Education provided within the study reports that around three quarters of US high school students 'rarely or never' take extracurricular lessons in music or arts.

This figure represents a huge barrier to the team. 'Such statistics, when taken in the context of our present neuroimaging results, underscore the vital importance of finding new and innovative ways to make music training more widely available to youths, beginning in childhood,' state the authors.

Source: McIntosh, J. (2014, December 29). Learning a musical instrument boosts kids' brains. *Medical News Today*. MediLexicon Intl.

The physiological changes mentioned in this article included thickening of the cortex in various brain regions of the individuals investigated. This is certainly a promising finding in support of the hypothesis that playing a musical instrument does lead to improved brain development. However, although these physiological changes in the brain increase the capacity for things such as intelligence, mood and creativity, they do not necessarily lead to behavioural changes.

IMPORTANT THINGS TO CONSIDER IF CHOOSING THIS RESEARCH QUESTION

If you choose 'How does learning to play a musical instrument affect psychological development?' for your research investigation, the following suggestions provide a guide for your approach:

- The background you could write on in terms of psychological development is very broad. Maybe just choose one area of psychological development, such as cognitive development, to link your background theory to.
- This question does not ask for evidence for and against, it asks 'how' it affects development, so do not question whether it does or does not affect brain development, but look at the extent and type of development reported and the validity of the research you investigate. Who conducted the research? Did they have a vested interest in the outcome?
- Be mindful of the difference between brain development and behavioural changes; be careful of the connections you make from the research you use.

EXPLORATION 5: MENTAL HEALTH AND DISORDER

WHAT IS MENTAL HEALTH AND MENTAL ILLNESS?

Mental health is a state of psychological wellbeing. It can be characterised by one's ability to enjoy life, function in society and cope in situations that are difficult or challenging. For someone to be mentally healthy, it suggests the absence of a mental disorder. Mental disorders, or mental illness, affects one in five Australians each year (SANE, 2014).

There are many different types of mental disorders that fit under many different categories. Of the most common disorders, anxiety disorders affect approximately 14 per cent of the adult population every year and depression approximately 6 per cent (SANE, 2014). The remainder of sufferers of mental illness are affected by substance abuse disorders, psychotic illnesses such as schizophrenia, personality disorders, and many other conditions.

The recognition, diagnosis and treatment of mental illness has undergone significant changes over the past century. Mental illness was not well understood 100 years ago, which led to fear and confusion for sufferers, as well as their families. Fortunately today we have a better understanding of the complex interplay between biological, psychological and social influences in developing, treating and understanding mental illness. This is known as the biopsychosocial approach. The biopsychosocial approach recognises that it is not just one factor that leads to development of a mental disorder.

WHY ISN'T CAFFEINE ADDICTION IDENTIFIED AS A MENTAL DISORDER?

Mental disorders can be classified through a categorical approach or a dimensional approach. A categorical approach involves an individual presenting with a set number of symptoms for classification, whereas a dimensional approach involves looking at the severity or intensity of symptoms. Each approach to categorising mental disorders has criteria that determine when behaviours are considered healthy and when they are considered maladaptive. When an individual suffers from a series of maladaptive behaviours, they may be classified as having a mental disorder.

Not all maladaptive behaviours are related to mental illness. Mental illness takes many forms, and classification systems, such as the *DSM-5*, are always redefining disorders to ensure they are truly representative of current trends in mental health and illness. One problem recently debated for its appropriateness to be classified as a mental disorder is caffeine addiction. See Focus on research 7.5 to learn more.

FOCUS ON RESEARCH 7.5

CAFFEINE ADDICTION A MENTAL DISORDER?

Caffeine addiction has not yet been classified as a mental disorder by the *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)*. Despite a lot of pressure from groups of doctors and health advocates, the latest version was released this year without the caffeine addiction disorder diagnosis. However, this doesn't mean that caffeine-related problems were eliminated from the *DSM-5* entirely. A couple of disorders related to caffeine consumption were placed in the manual by the American Psychiatric Association.

Both caffeine withdrawal and caffeine overdose did make it into the latest diagnostic manual. The official caffeine overdose diagnosis can be made as long as five of these overdose symptoms are present:

- restlessness
- nervousness
- excitement
- insomnia
- flushed face
- frequent urination
- upset stomach, diarrhoea
- muscle spasms
- fast and incoherent speech
- irregular heartbeat
- periods of inexhaustibility
- psychomotor agitation.

Those withdrawing from caffeine can also be classified if they exhibit caffeine withdrawal symptoms such as headaches, constipation, lethargy, inability to concentrate, depression and muscle stiffness.

So why isn't caffeine addiction listed? There are pretty strict criteria for what makes it into the *DSM-5*, and caffeine addiction was most likely debated extensively. Based on what we know about caffeine, in the end, it probably wasn't placed in the *DSM-5* for the following reasons:

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- Caffeine is consumed daily by billions of people worldwide with very little to no health consequences for the vast majority. We would estimate that less than a tenth of one per cent of the world's population have any adverse reactions to this drug.
- There is little to no evidence that caffeine is harmful to the human body when consumed in moderation or that it interferes with normal mental functioning and productivity.
- While caffeine does have addictive properties, it doesn't foster deep psychological and physiological dependency as do controlled addictive substances. People can generally detox from caffeine and function normally in a couple days without professional intervention.

This issue has been debated as far back as 2007 and most likely will continue to be debated by the American Psychiatric Association as they begin work on the *DSM-6*. For now, caffeine addiction isn't yet classified as a mental disorder, although many health professionals feel that it should be.

Caffeine addiction is more about people's need to increase their dosage as the body builds up tolerance to the chemical. Therefore, it takes more and more caffeine to produce the desired effects. In any event, caffeine addicts can't be officially labelled just yet.

Source: Adapted from Caffeine Informer (2014, January 31). Caffeine addiction a mental disorder?

You can see from Focus on research 7.5 that the effects of caffeine on health can be negligible. There are also reportedly positive effects that result from caffeine consumption, such as increases to memory and stimulating hair growth, and caffeine consumption has even been linked to reducing the risks of several sorts of cancer (Caffeine Informer, 2014).

Figure 7.18 depicts webs spun by spiders under the influence of different substances, including caffeine. This would suggest that the consumption of caffeine is still not a decision to be made lightly.

IMPORTANT THINGS TO CONSIDER IF CHOOSING THIS RESEARCH QUESTION

If you choose 'Why isn't caffeine addiction identified as a mental disorder?' for your research investigation, the following suggestions provide a guide for your approach:

- Make sure your background research discusses classification systems. Maybe pick one classification system and use it to show how another disorder is classified using this system.
- This question would be best discussed by looking at arguments for and against its classification to help form an argument before giving evidence.
- This topic will certainly lend itself to you discussing social influences on its classification, and should therefore feature heavily in your discussions.

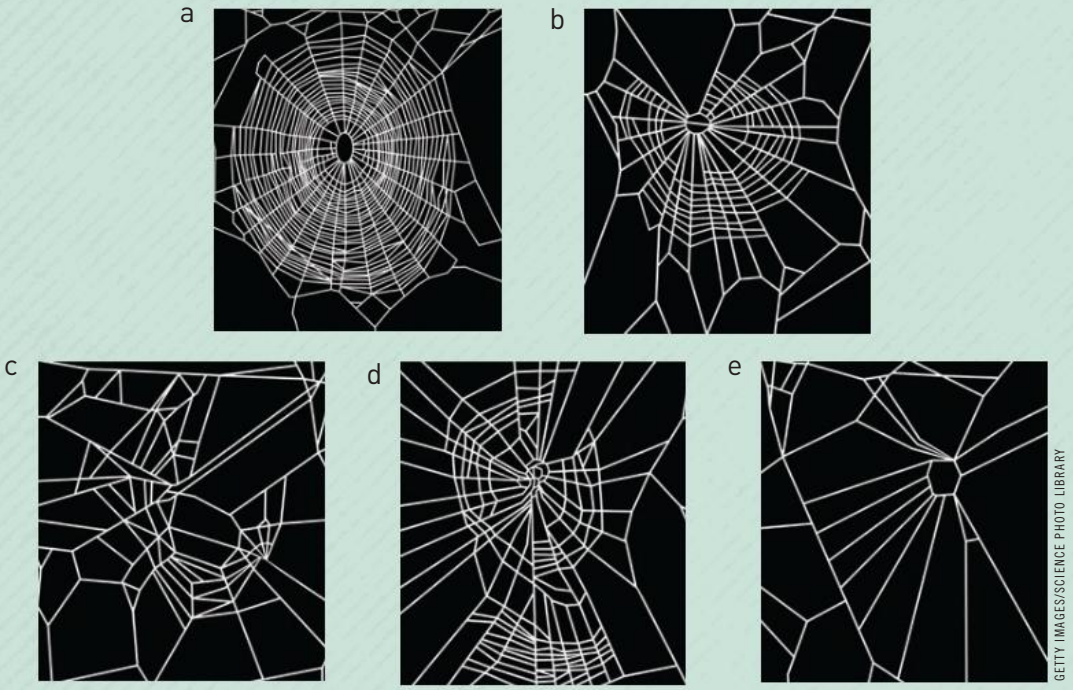


FIGURE 7.18 Spider webs spun by spiders under the influence of different substances: (a) normal web, (b) marijuana, (c) caffeine, (d) benzedrine and (e) chloral hydrate

EXPLORATION 6: CHANGING THOUGHTS, FEELINGS AND BEHAVIOUR

WHY DO WE STUDY OUR THOUGHTS, FEELINGS AND BEHAVIOURS?

Psychology is the systematic study of thoughts, feelings and behaviours. The reason these things are so interesting to study is because there is an element of the unknown, the unseen or the unexplained. Our thoughts have been studied for many years, with changing perspectives in understanding human thoughts emerging throughout history. US psychologist William James (1842–1910) believed our consciousness was like a stream, ever flowing and changing, while Austrian psychoanalyst Sigmund Freud (1856–1939) was well known for his belief that our thoughts and dreams were manifestations of desires buried deep in our subconscious. Whatever the theory, thought and human emotion have long been studied with regard to how they change and influence behaviour.

Psychologists are not so interested in thoughts and emotions that 'match' the behaviour, such as people who don't like needles avoiding doctors, or people who love the feeling of adrenalin wanting to skydive. These thoughts and emotions are in sync with the demonstrated behaviours. What is more interesting, however, is when our thoughts and emotions do not match our behaviour. Why do we do things we know are wrong? For example, why do we stay in friendships that make us unhappy? Learning more about our thoughts and emotions will certainly help us to explain behaviour, but it may never help us to predict it entirely.

ARE EMOTIONS CONTAGIOUS?

So what is an emotion? An emotion is a feeling or mood that an individual experiences. There are many types of emotions, such as happiness, fear, anger, sadness, disgust, surprise and contempt. These seven emotions are known as universal emotions because they can be recognised across different cultures. Can you recognise these emotions in Figure 7.19?



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FIGURE 7.19 There are thought to be seven universal emotions that all humans can recognise.

The interesting thing about human emotions is that you don't have to experience an event to feel an emotion. You can feel the emotions someone else feels just by watching them. You may feel empathy towards someone having a difficult time, or you may feel happy when looking at the joy on someone else's face. So can you can 'catch' an emotion? Psychologists believe that, yes, emotions are contagious. Read Focus on research 7.6 to find out more.

FOCUS ON RESEARCH 7.6

WHY ARE EMOTIONS CONTAGIOUS?

When someone smiles at you, you smile back. Why is this?

We all share emotions, and we're all affected by the emotions others share with us. We spread our emotions through face-to-face conversations, phone calls, emails, Facebook posts, tweets, or in wordless expressions :-)

These all influence the moods of others. When someone smiles at you, you smile back. This is known as imitation. If someone cries, you experience more or less sadness and/or urge to help. In small children, such contagion is

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irresistible. Any preschool teacher will confirm times when one crying kid has led to all the kids being in tears.

Why is this? Is there some kind of benefit underlying the emotional contagion between human beings?

According to an article published by Elaine Hatfield, John T. Cacioppo and Richard L. Rapson, emotional contagion is 'the tendency to automatically mimic and synchronize expressions, vocalizations, postures, and movements with those of another person and, consequently, to converge emotionally.'

From an evolutionary perspective, emotional contagion is essential for survival. For example, when threatened by a predator, emotional arousal spreads within a prey group and enables more of the animals to escape from danger. Researchers at the University of Chicago observed that rats became distressed when they saw other rats in distress, and they displayed pain behavior if they saw other rats in pain, suggesting that the most principal form of empathy is well known to other species. Emotional contagion serves human beings as well, it was helpful to our ancestors, enabling them to understand each other in a time before verbal communication was possible.

Although we tend to believe that, as adults, we're adept at emotional management and control, even the most stoic among us is susceptible to emotional contagion. (Howell, 2012)

Source: Howell, R. T. (2012). Why are emotions contagious? *Psychology Today*. Reproduced with permission.

In a well-known American podcast called 'Invisibilia', the hosts explore a range of thoughts, emotions and experiences that are unable to be seen. One woman featured in an episode of the podcast has an extreme form of emotional contagion and can actually physically feel the pain and emotions of others. So much so that she finds it difficult to distinguish between her own emotions and those of others.

The way in which we communicate has changed drastically over the past 20 years, with much communication between individuals happening through email, text messaging and instant messaging. So can we experience emotional contagion through these media as well? Is there merit to including emoticons at the end of text messages? Do they actually help the receiver to feel the emotion?

In a study conducted into emotional contagion in social media in January 2012, researchers manipulated the number of positive or negative posts people saw in their news feeds. They found that when a percentage of positive words were removed from an individual's news feed, their personal posts reflected this and fewer positive words were used by the individual. Likewise, when negative words were removed from an individual's news feed, their personal posts featured fewer negative words. Along with this omission, the participants also frequently displayed the opposite emotion more readily (Lewis & LiveScience, 2014).

It seems the answer is clear, if we want to be happy we need to surround ourselves with happy people. Lifting our mood on low days may be as simple as finding someone to 'share the love'.

IMPORTANT THINGS TO CONSIDER IF CHOOSING THIS RESEARCH QUESTION

If you choose 'Are emotions contagious?' for your research investigation, the following suggestions provide a guide for your approach:

- Make sure your background research discusses emotions and how they are developed in individuals.
- This question would be best presented by looking at evidence that refutes emotional contagion as well.
- To show a biological understanding of this topic, read about mirror neurons – they will be strong supportive evidence for your argument.

TIME TO START YOUR RESEARCH INVESTIGATION

By now you should have a thorough understanding of what goes into a formal research investigation report – possible subheadings, items for inclusion, format and writing style. You should also have chosen a question for investigation from one of the 10 to 12 questions listed under each exploration topic in the VCE Psychology Study Design. It is time to start your research investigation. Figure 7.20 is a criteria sheet that can help as a guide when conducting your research investigation to ensure you have included all necessary components. Good luck.

Research investigation rubric (UNIT 1)

Student: _____

Question investigated: _____

Mark allocated: _____

	CRITERIA	COMMENT	NOT SHOWN (0)	LOW (1)	MEDIUM (2)	HIGH (3)	SCORE (30 MARKS)
Knowledge of key psychological concepts	Appropriate definitions of key terms						
	Use of appropriate scientific language and conventions						
	Discussion of social, economic, cultural and ethical considerations relevant to the research question						
Understanding of appropriate scientific evidence	Strong evidence to support the questions discussed						
	Relevant links between theory and evidence						
	Consideration of validity and reliability of evidence						
Evaluation of scientific research	Evaluation of issues/ evidence/concepts and appropriate conclusions						
Knowledge of effective scientific communication	Accuracy of scientific information presented						
	Clarity of the ideas expressed in terms of importance and implications for future research						
	Appropriateness for purpose and audience						
Total mark							/30
General comments:							

FIGURE 7.20 A research investigation rubric (a set of instructions or guidelines)

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CHAPTER SUMMARY

What is the research investigation?

- The research investigation is a task that you will complete in the form of a digital, oral or written presentation. The research investigation will explore brain function and/or development and will draw on your knowledge from topics covered throughout Unit 1. The question to be researched is to be drawn from one of six topics: Biopsychology; Brain and the use of technology; Cognition; Psychological development; Mental health and disorder; and Changing thoughts, feelings and behaviour.

Why do we write scientific reports?

- Researchers systematically change one variable to measure the effect on another. This is known as an experiment where we seek to find a cause-and-effect relationship between two variables.
- Publishing research helps to advance our knowledge of science; it allows other researchers to learn from past mistakes and to build on previous work done.
- When publishing research, the researcher must ensure that the research is valid; it must be conducted and shared in such a way that it has measured what it claims to have measured. It should also be reliable so that it can be replicated by others. Research must uphold all ethical considerations and standards in every way so that it can be shared with integrity.

What sections are in a research investigation report?

- Title: The title will be the research question you are investigating. You will need to address this question in the introduction and conclusion of your piece of work. Your research question determines which psychological concepts and evidence you need to explore.
- Introduction: The introduction should develop the research question from broad beginnings to specific detail. It should address what the question means and what is already known on the topic. To do this you will need to define and explain key terms needed to understand the research question, as well as including any limitations to the theories you have presented.
- Scientific evidence: This section includes the presentation of at least two pieces of contemporary research that provide evidence related to the research question. When research is presented, you need to include what the researchers aimed to do, what they did and what they found. Ensure that you discuss the validity and reliability of the evidence you present.
- Analysis: This is the section in which you bring all of the findings together and analyse and synthesise them. You can discuss whether the theory and evidence presented were congruent (in accord) and why that might have occurred. You should also include any social, economic, cultural or ethical considerations that need to be accounted for in your field of research.
- Conclusion: This section addresses the research question that you opened with. This section may also include suggestions as to where future research in this field may be heading next.

What do I need to remember when writing my research investigation?

- Your research investigation needs to be written in a scientific manner. It should include relevant psychological terminology at all times. When writing a scientific report it is important not to personalise it.
- Your writing style should be cohesive and comprehensive. There should be a logical sequence and flow to the writing style, and you need to demonstrate how one concept or fact relates to the next.
- Any time you use a concept, definition or idea taken from another source you must reference it. This is important because it gives credibility to your work and also acknowledges the work of others.
- When choosing a presentation style, remember to select one that suits your strengths and one that best suits your topic; you can choose a digital presentation, an oral presentation or a written presentation.
- Choose one question from one of six different topics studied this year in Psychology: Biopsychology; Brain and the use of technology; Cognition; Psychological development; Mental health and disorder; and Changing thoughts, feelings and behaviour.
- Use a criteria sheet to guide the amount of detail and depth of investigation you need when writing your research investigation.

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UNIT 2

HOW DO EXTERNAL FACTORS INFLUENCE BEHAVIOUR AND MENTAL PROCESSES?

AREA OF STUDY 1:
WHAT INFLUENCES A PERSON'S PERCEPTION OF THE WORLD?

AREA OF STUDY 2:
HOW ARE PEOPLE INFLUENCED TO BEHAVE IN PARTICULAR WAYS?

AREA OF STUDY 3:
STUDENT-DIRECTED PRACTICAL INVESTIGATION

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CHAPTER 08

SENSATION AND PERCEPTION



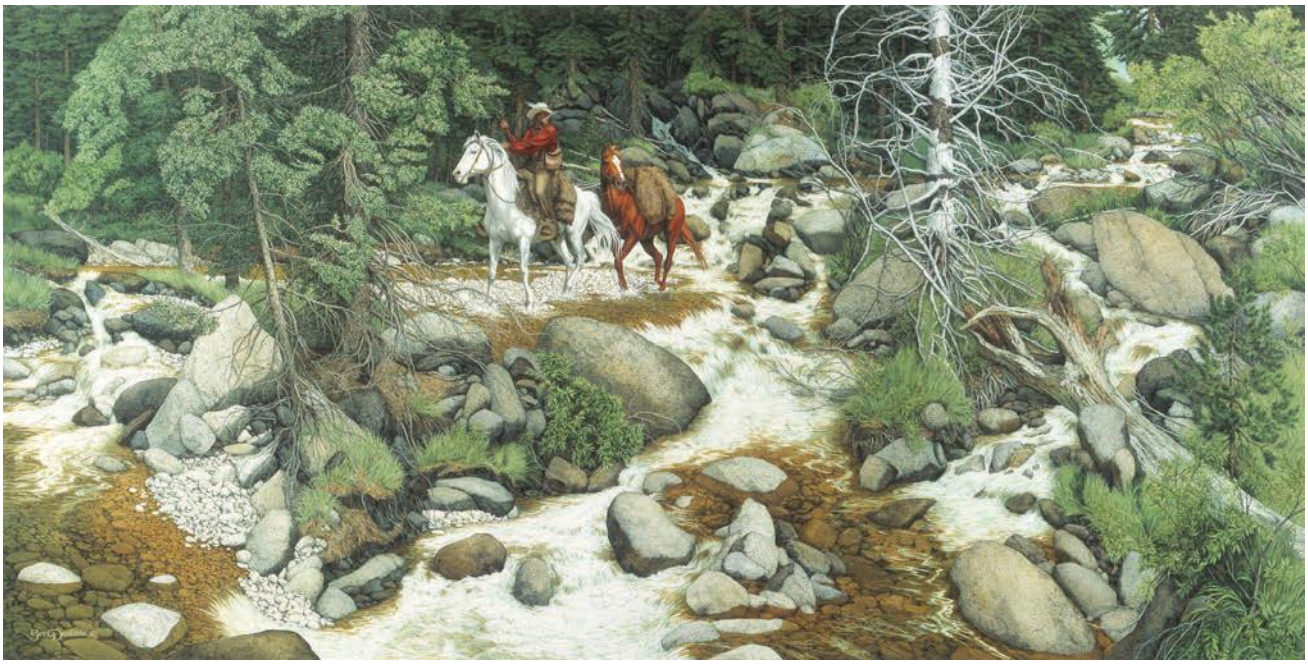
KEY KNOWLEDGE INCLUDES:

- sensation and perception as two complementary but distinct roles in the reception, processing and interpretation of sensory information
- taste and vision as two examples of human sensory systems, including the roles of sensory receptors and receptive fields, transmission of sensory information to the brain, and representation of sensory information in the cerebral cortex
- the influence of biological, psychological and social factors on visual perception, including depth cues, visual perception principles and perceptual set
- the influence of biological, psychological and social factors on gustatory perception, including age, genetics, perceptual set (including food packaging and appearance) and culture.

Psychology Area of Study Key knowledge points derived from *VCE Psychology Study Design 2016*, p.20; © The Victorian Curriculum and Assessment Authority (VCAA). Used with permission.

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THE FOREST HAS EYES, ©1984 BEV DOOLITTLE, THE GREENWICH WORKSHOP, INC.

FIGURE 8.1 Our eyes and our brain work together so we can identify the hidden images in this painting. Can you find 13 faces in this painting?

As students of psychology we are interested in human behaviour. We want to understand why we respond to our world in the way we do. In order to achieve this understanding, we need to know how we take in information from the outside world and make sense of it. In other words, we need to examine the relationship between our physical (external) environment, our body (specifically our sensory systems) and our brain. Our body interacts with the external environment through our senses: vision, hearing, smell, taste and touch (see Table 8.1).

TABLE 8.1 Types of stimulus energy and the senses and sensory organs used to detect it

STIMULUS ENERGY	SENSE	SENSORY ORGAN
Electromagnetic radiation (visible light)	Sight (vision)	Eye
Sound waves	Hearing (audition)	Ear
Chemical energy (molecules)	Smell (olfaction)	Nose
Chemical energy (molecules)	Taste (gustation)	Tongue
Mechanical and thermal energy	Skin (touch, pressure, pain, cold and warmth)	Skin

Our external environment constantly bombards us with an array of physical energies (such as light waves and chemical molecules) that we take in and give meaning to. Initially, our response to this energy is an automatic physical (bodily) response that does not involve the brain. The body's initial detection and processing of stimulus energy is referred to as sensation. Sensation translates various kinds of external energy into neural impulses that can be processed by the brain and because it is a purely physical process, we all sense information in the same way.

At this point, however, we still do not understand what the energy represents about the outside world. For this to occur, our brain must assign meaning to the stimulus. To do this, the brain applies a range of psychological processes to the information it receives. This psychological response to a sensation is referred to as perception. The psychological processes involved in perception are also influenced by a number of factors that are subjective, or unique to the individual, such as memory and emotions. The result is that although we may have sensed a common stimulus in the same way as other individuals, our perception of it, and therefore our response to it, can be quite different from someone else's.

Our sensory systems all operate in a similar way, but each receives different information and sends it to a specialised region in the brain. Therefore, different sensations occur because each sense activates a different part of the brain. To find out more about the complex and interactive nature of sensation and

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perception, let's begin by looking at how information from the outside world gets through to us.

STAGES IN SENSATION

If we assume that the body's physiology is alike for all humans who do not have some form of physical defect, then we can say that most humans, when shown a common stimulus, will initially respond to it and process it in the same way. So, sensation is described as a purely automatic, physical reaction that is the same for us all. The process of sensation involves three stages: reception, transduction and transmission. Sensation occurs in the body's sense organs and neural pathways, and does not involve the brain.

Reception: Taking the stimulus in

Sensation begins with reception when the stimulus is detected by sensory neurons. Sensory receptors are groups of neurons located in receptor sites in our various sense organs. These receptor cells are specialised to detect and respond to a specific type and level of stimulus energy (see Table 8.1). For example, sensory receptors in your eye's retina only respond to a light stimulus and sensory receptors in your tongue only respond to specific chemical molecules.

Although the stimulus may strike the sensory receptor, it may not be intense enough to activate a response. If this happens, no further processing occurs. If the stimulus is strong enough to activate a response, the second stage of sensation – transduction – begins.

Transduction: Converting the stimulus

The human sense organs take in five different forms of energy (see Table 8.1) at any one time. However, the human nervous system and brain can only process one form of energy, electrochemical energy. Therefore, sensory receptors must convert, or transduce, the original energy into impulses of electrochemical energy before it can be sent through to the brain for further processing. This conversion is known as transduction.

During transduction, sensory receptors code information about the various features of the stimulus into an electrochemical neural impulse. Now it is ready to leave the receptor site, so the final stage of sensation – transmission – occurs.

Transmission: From receptor site to brain

Transmission begins when electrochemically charged neural impulses leave their receptor site and travel along specific nerve fibres (neural pathways) that connect to a particular location in the brain specialised to receive them. For example, auditory information detected by sensory receptors in our ears is registered in the brain's temporal lobe, but visual information detected by our eyes is registered in the occipital lobe.

When this stage of transmission finishes, so does the purely physical process of sensation. However, we still do not know what the energy represents in our external environment. To know this, our brain must engage in perception.

8.1 CHECK YOUR UNDERSTANDING >>

1 Which of the following statements is incorrect?
   - A Perception and sensation involve the same processes.
   - B Perception depends on sensation.
   - C Perception has a biological basis.
   - D The brain can only form a perception of information contained in electrochemical energy.

2 Which of the following statements about sensory receptors is incorrect?
   - A Sensory receptors give meaning to sensory stimuli.
   - B Sensory receptors are located in all sense organs.
   - C Sensory receptors are the first point of bodily contact with sensory stimuli.
   - D Sensory receptors convert physical stimuli into impulses of electrochemical energy.

3 During the transduction stage of sensation:
   - A sensory receptors change the original energy stimulus into impulses of electromagnetic energy.
   - B sensory receptors receive the energy stimulus from the external environment.
   - C sensory receptors change the original energy stimulus into impulses of electrochemical energy.
   - D sensory receptors send the stimulus to sensory neurons higher in the nervous system hierarchy.

4 Explain the role of photoreceptors in visual perception.

5 Explain why transduction of stimulus energy into impulses of electrochemical energy is necessary.

sensation A physiological process involving sensory receptors detecting and responding to the presence of stimuli

perception The mental process of organising and interpreting sensory stimuli sent from the senses so it achieves a meaningful mental representation or form

reception The process of sensory receptors detecting the presence of a stimulus or changes to a stimulus

sensory receptors Specialised neurons located in sense organs that detect and respond to physical energy (stimuli)

electrochemical energy An energy form where minute electrical charges travel through and between neurons with the help of neurotransmitters (chemical substances)

transduction The process of sensory receptors converting stimulus energy into impulses of electrochemical energy

transmission The process whereby neural impulses leave sensory receptor sites and travel to the areas in the brain that are specialised to receive them

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STAGES IN PERCEPTION: HOW WE CREATE MEANING

Perception allows us to understand our world because it gives meaning to the stimuli we take in. Although it involves the body because it occurs in the brain, it also involves a number of psychological processes such as thinking, learning, memory and emotions. In order to perceive a stimulus, the new information is integrated with information from past experiences already stored in our memory. Perception, by its very nature, is unique to the individual, and this is why the same sensory information can be interpreted by individuals in a number of different ways. When we perceive a stimulus, we become aware of our environment. We do this by selecting, organising and interpreting the stimuli sent from our senses.

Selection: Filtering information

Once the information reaches the brain, a range of psychological processes select certain features of the stimuli and organise them into meaningful patterns that can be interpreted. The brain cannot possibly process all the varied and constantly changing information it receives, so it pays attention to only the most important pieces and ignores the rest. Stimuli that are ignored receive no further processing. By using selective attention, the brain directs our focus towards a particular stimulus at the expense of others. This helps the brain to quickly organise the most important information into a whole that can be given meaning.

Selection involves specialised neurons, known as feature detectors, detecting and filtering the neural impulses sent from the receptor site. The nerve pathways from the sense organs to the brain, and the sensory areas of the brain itself, contain a great number of feature detectors that are only activated by specific features of the stimuli. The further along the nerve pathway information travels, the more complex these cells become, and the features of the stimuli they respond to become more and more specific. When activated, feature detectors filter the information by selecting the most important features of the stimuli for further processing. Selection begins in the neural pathway that connects the receptor site to the brain, but the bulk of selection occurs in the brain.

Organisation and interpretation: Creating a whole and understanding the stimuli

The selected stimuli contain important information about the original stimulus energy. Because the information now exists in the form of separate impulses, and also because some features have been ignored, individually they have no meaning. Before the brain can interpret the stimuli and know what they represent, they must be organised (or reassembled) into a meaningful pattern or whole.

Organisation refers to the grouping of elements or features of stimuli to form a whole that can be given meaning. How these features are organised depends on a range of mental processes. Some processes are shared by us all and others may vary between individuals. When the information has been organised, we need to know what it represents. In other words, we need to interpret it.

Interpretation is the final stage of perception. It involves giving meaning to the stimuli so we understand what they represent about the external world. When the brain is attempting to organise and interpret stimuli, it is working with information that is incomplete and inconsistent. So, at times we have to make an initial guess, or perceptual hypothesis, as to what the stimuli represent. Sometimes our guess is correct, but it also accounts for why our first impression of a stimulus is sometimes wrong.

Assigning meaning to stimuli is a complex process. Interpretation is influenced by which features were selected for further processing and by a range of psychological factors such as past experience, expectations, culture, emotional state and motivation. As these factors are unique to the individual, they influence the unique perceptions we have of stimuli. Interpretation completes the perception process – and perception forms the basis of our behaviour.

Are sensation and perception separate processes? As we have seen, during sensation we respond to stimuli in a different way to the way we respond to them during perception. The psychological process of perception depends on the physical process of sensation, and although they are distinct processes, sensation and perception are also complementary processes. The stages involved in physically sensing and mentally interpreting sensory stimuli blend into one continuous process. To demonstrate this, close your eyes and then look at Figure 8.2. The light image of the picture is taken in by your eyes, converted to neural impulses and sent to your brain. Now your brain needs to make sense of this sensation. At first you will probably notice only a number of black blotches on a white background,

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so your brain automatically starts organising the stimuli into something you can understand. When you recognise some of the randomly arranged blotches as a dog sniffing the ground, you have formed a mental representation of the information you sensed (Plotnik & Mollenauer, 1986). Now the perception process is complete. Table 8.2 provides a summary overview of the stages in sensation and perception.

TABLE 8.2 The stages in sensation and perception

STAGE	DESCRIPTION
1 Reception	Sensory receptors absorb raw energy (the stimulus) from the external environment.
2 Transduction	Sensory receptors convert the stimulus energy into impulses of electrochemical energy that have information about the original stimulus coded into them.
3 Transmission	Stimuli are transmitted via specialised neural pathways to the area of the brain specialised to receive and process them.
4 Selection	» The brain filters the stimuli. » Important features are selected for further processing. Unimportant features are ignored and receive no further processing.
5 Organisation	Individual impulses of electrochemical energy are organised into meaningful patterns or wholes.
6 Interpretation	The brain interprets these patterns or wholes and gives them meaning so we know what they represent in the external world.



FIGURE 8.2 What do you see?

In order to understand the sensation and perception process, we must understand the psychological processes involved. We must also consider how our physiological structures operate so we understand what they contribute to behaviour. This means we also need to look at behaviour from a biological perspective.

8.2 CHECK YOUR UNDERSTANDING >>

1 Feature detector cells:
   - A are the body's first point of contact with an external stimulus.
   - B transduce the original energy into impulses of electrochemical energy.
   - C are only activated by specific parts of stimulus energy.
   - D are specialised cells located in the sense organ.

2 Which of the following sequences shows the correct sequence for stages in perception?
   - A Selection, interpretation, organisation
   - B Reception, transduction, transmission
   - C Selection, organisation, interpretation
   - D Transmission, selection, interpretation

3 Perception is based on a complex sequence of:
   - A receiving, transmitting, converting and interpreting stimuli.
   - B receiving, converting, transmitting and interpreting stimuli.
   - C detecting, converting, interpreting and organising stimuli.
   - D detecting, organising, converting and interpreting stimuli.

4 Describe the relationship between sensation and perception.

5 Explain why feature detector cells filter stimuli during selection.

VISION: OUR 'SEEING' EXPERIENCE

Vision refers to the sense that detects objects by the light reflected from them into our eyes. Vision allows us to identify objects in our environment, determine

selective attention A voluntary or involuntary tendency to focus on a particular stimulus (or part of a stimulus) and ignore other stimuli

selection The process of feature detector cells responding to specific features of a stimulus pattern and ignoring the rest

feature detectors Neurons specialised to respond to specific features of a stimulus pattern and ignore other features of the pattern

organisation The process of reassembling the features of sensory stimuli in a meaningful manner

interpretation The process of assigning meaning to sensory stimuli so we understand what they represent about the external world

perceptual hypothesis An educated guess about the correct meaning to be assigned to a particular pattern of sensory stimulation

vision The sense that detects objects by the light reflected from them into our eyes

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their location and how far away they are, and identify if they are threatening or not. Without the ability to see, we would be dependent on others in most of our daily activities.

VISUAL SENSATION AND PERCEPTION

Reception: Catching some rays

To experience vision, we must have a healthy, functioning visual system. In addition, light must exist – it is the energy stimulus that activates the visual sensory system. Light is part of the electromagnetic spectrum, the full range of electrical and magnetic wavelengths that exist in the external environment. The range of wavelengths of light that human eyes are sensitive to is called the visible light spectrum, and its approximate range is 380 to 750 nanometres.

Visual sensation begins when light enters the eye (the sense organ for vision – Figure 8.3) and passes through various structures until it strikes the back of the eye. Light first passes through the cornea, then the aqueous humour, pupil, lens and vitreous humour before striking the receptor cells located in the retina. The retina is a light-sensitive membrane composed of a number of layers of specialised neurons at the back of the eye.

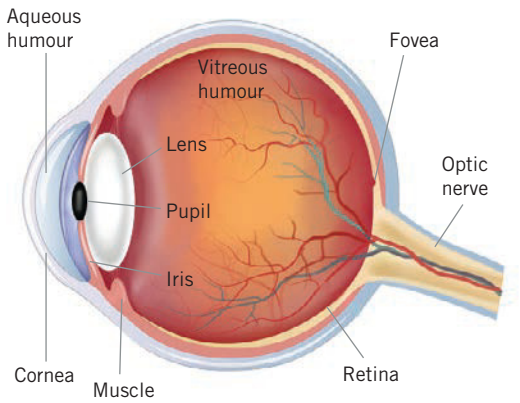


FIGURE 8.3 The major components of the human eye

Transduction: Sensory receptors and receptive fields

PHOTORECEPTORS (RODS AND CONES)

The retina's very back layer consists of photoreceptors, the body's receptor cells specialised to detect and respond to specific features of light. Photoreceptors consist of two specialised types of light sensitive cells known as cones and rods.

Cones are specialised photoreceptors that detect longer wavelengths of light. There are approximately 6.5 million cones in each eye and they are found mainly at the centre of the retina. Cones function best in bright light and they are responsible for day vision, colour vision and visual acuity (sharpness of vision and ability to detect fine detail). Visual acuity is greatest in the fovea, a small, cup-shaped area near the middle of the retina that contains only cones – about 50 000 of them, tightly packed. As there are fewer cones outside the fovea, visual acuity steadily decreases towards the outer edge of the retina.

Rods are specialised to detect shorter wavelengths of light. Rods are more sensitive than cones, so they are stimulated by lower levels of light. There are approximately 100 million rods in each eye, the majority of which are located on the outer edges of the retina, about 20 degrees from the retina's centre. Rods are responsible for black-and-white vision and peripheral vision, which refers to vision at the sides of the visual field (all the area of the external environment that can be seen when your head is still). When peripheral vision is combined with another rod feature, sensitivity to movement, the result is that the eye maintains a radar-like scan for movement in side vision. We depend on this ability to 'see out of the corner of our eyes' to effectively move around our environment such as when we play sport or drive a car. Rods are also responsible for night vision. Their greater sensitivity to light, together with their location on the retina, means that if you are to experience the best night vision possible, you should look to the side of the object you wish to see (Figure 8.4).



FIGURE 8.4 The Mona Lisa's smile is more obvious when you look into her eyes or at the painting's background, compared with when you look directly at her mouth. The shadows around her mouth and jaw are best seen by peripheral vision. (Australian Broadcasting Corporation, 2003)

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Table 8.3 summarises the differences between cones and rods.

TABLE 8.3 Summary of the differences between cones and rods

CHARACTERISTIC	CONES	RODS
Location	Mainly in the centre of the retina – fovea is cones only	Mainly on the outer edges of the retina (none in fovea)
Number	Approximately 6.5 million in each retina	Approximately 100 million in each retina
Visual acuity	High visual acuity	Low visual acuity
Light sensitivity	Functions best in bright light	Functions best in dim light
Colour vision	Responsible for colour vision	Responsible for black-and-white vision
Peripheral vision		Responsible for peripheral vision
Movement		Responsible for detecting movement

periphery. In addition to single photoreceptors having their own receptive field, the light that enters the eye may strike a cluster of photoreceptors, and each cluster of photoreceptors has its own receptive field.

Each photoreceptor is connected to a bipolar cell, and bipolar cells feed their information into ganglion cells (see Figure 8.5). The receptive field for a single ganglion cell is composed of input from all the photoreceptors that synapse with it; and a group of ganglion cells forms the receptive field of a neuron it is synapsed with further up the neural pathway. The size of the receptive field for one ganglion cell will therefore be determined by the amount of bipolar cells (and photoreceptors) it is connected to.

Because the nervous system is hierarchical in nature, all photoreceptors form synapses with other neurons further up the hierarchy. So, the deeper into the neural pathway for vision, the larger and

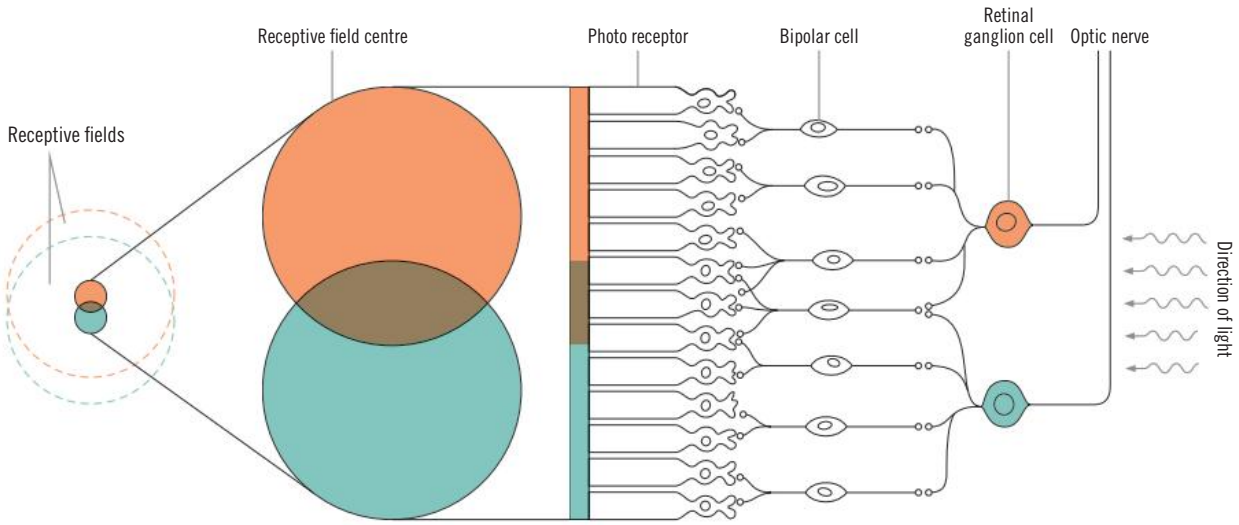


FIGURE 8.5 Two neighbouring retinal ganglion cells receive input over the direct path from two overlapping groups of receptors. The areas of retina occupied by these receptors make up their receptive-field centres, shown face on by the large overlapping circles.

RECEPTIVE FIELDS

When light strikes a photoreceptor, the portion of its surface receiving the stimulus, which triggers the receptor to fire, is known as a receptive field. Each photoreceptor has its own receptive field, but its response to stimulation depends on what type of photoreceptor it is and what part of its receptive field is stimulated. An 'on-centre' receptor is stimulated by light falling in the centre of its receptive field and inhibited by light falling on the periphery. An 'off-centre' receptor reacts in exactly the opposite way; that is, it is inhibited by light falling in the centre of its receptive field and stimulated by light falling on its

visible light spectrum The range of wavelengths on the electromagnetic specrum of light to which the human eye is sensitive

retina A light-sensitive membrane composed of a number of layers of specialised neurons at the back of the eye

photoreceptors Receptor cells located at the back of the retina and specialised to detect and respond to light

cones A group of photoreceptors, located mainly in the centre of the retina, specialised to detect and respond to bright light; responsible for day vision, colour vision and visual acuity

rods A group of photoreceptors located mainly in the outer ends of the retina specialised to detect and respond to dim light; responsible for night vision, black-and-white vision and peripheral vision

receptive field The portion of a neuron's surface receiving the stimulus that triggers the neuron to fire

bipolar cells The layer of cells in the retina that receive information from photoreceptors and transmit it to ganglion cells

ganglion cells The layer of cells in the retina that receive information from bipolar cells and transmit it to the optic nerve

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more complex the receptive field becomes because the number of synapses for the original information increases, and therefore the receptive field for that information increases.

Although the light stimulus may strike the photoreceptors, if it is not intense enough to activate the receptor, no further processing occurs. If the light is approximately 380 nanometres or more in intensity, the photoreceptors will be activated and the reception stage of visual sensation begins.

8.3 CHECK YOUR UNDERSTANDING >>

1 The range of wavelengths for visible light is approximately:
   - A 380–750 nanometres.
   - B 350–570 nanometres.
   - C 300–600 nanometres.
   - D 450–750 nanometres.

2 Which of the following statements about photoreceptors is incorrect?
   - A Photoreceptors are specialised light-sensitive sensory receptor cells.
   - B Photoreceptors focus the light image on the retina.
   - C The majority of photoreceptors are rods.
   - D Photoreceptors receive the focused light image.

3 Explain the relationship between photoreceptors, bipolar cells and ganglion cells.

4 In terms of the visual neural pathway, what is a receptive field?

5 Explain whether cones or rods are more sensitive to light. Give a reason or reasons for your answer.

Transmission: From photoreceptor to visual cortex

Photoreceptors also transduce the light stimulus into coded impulses of electrochemical energy. These impulses contain information about various features of the original stimulus that are decoded and interpreted by the brain. Transmission begins once the light stimulus has been transduced and is sent to bipolar cells the receptors are connected to (see Figure 8.6).

Bipolar cells form synapses with either rods or cones so they can receive information. This means they are designated rod bipolar or cone bipolar. When bipolar cells receive an impulse, they transmit it to ganglion cells located at the front of the retina that they are synapsed to. It is estimated that a single ganglion cell receives signals originally sent from approximately 126 receptors (Goldstein, 1996).

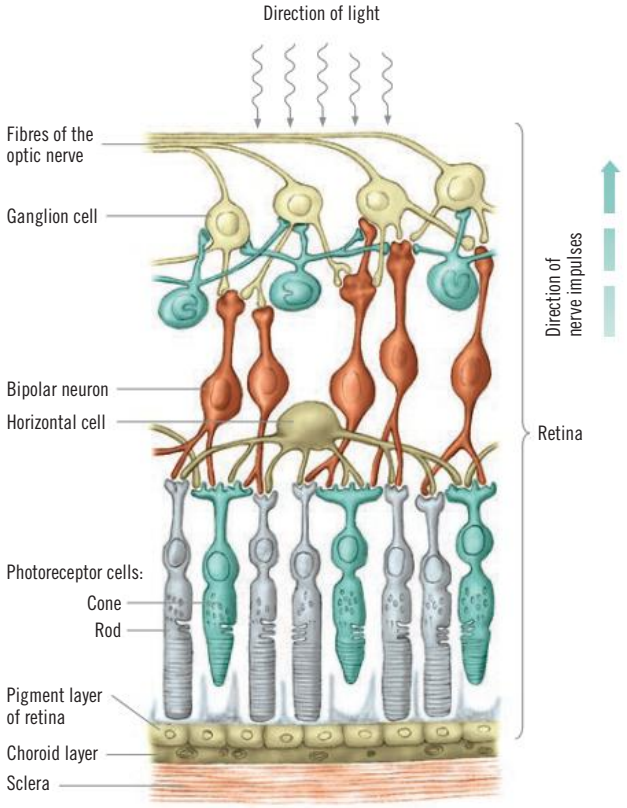


FIGURE 8.6 The anatomy of the human retina

Once ganglion cells are activated, they transmit the impulses to the optic nerve, the nerve that carries visual information from your retina to your brain. The optic nerve is formed from bundles of axons from the network of ganglion cells. Nearly a million messages can be sent by the optic nerve at once, through nearly one million ganglion fibres. The optic nerve exits the brain through an opening in the retina (known as the blind spot) and ends in the brain's occipital lobe.

Selection: Feature detectors at work

When the information reaches the brain, it is registered in the occipital lobe's primary visual cortex (see Figure 8.7). Selection occurs and the process of visual perception begins. Selection at a very basic level starts at the retina because photoreceptors respond only to specific wavelengths of light. When visual stimuli are registered in the primary visual cortex, where the majority of the visual system's feature detector cells are located, further higher-level selection occurs.

The primary visual cortex contains feature detector cells specialised to respond to specific features of the visual stimuli, for example lines, edges, spots, colour, shape or motion. Once the information has been processed, it is sent to other areas of the occipital lobe and to other brain areas for further processing.

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8.1

FOCUS ON RESEARCH

HUBEL AND WIESEL'S FEATURE DETECTOR THEORY

Thanks to the Nobel Prize-winning work of biopsychologists David Hubel and Torsten Wiesel, we now know that vision acts more like a computer than a camera.

Hubel and Wiesel (1979) directly recorded the activities of single cells in the occipital lobe of cats and monkeys. As they did, they matched the area of the retina to which each neuron responded. Then they shone lights of various sizes and shapes on the retina and recorded how often the corresponding brain cell 'fired' nerve impulses. The results were fascinating. Many neurons responded only to lines of a certain width or orientation. These same neurons did not get the least bit 'excited' over a dot or light or about overall illumination. Other neurons responded only to lines of certain angles, lines of certain lengths or lines moving in a particular direction.

Such findings indicate that neurons act as feature detectors, in that the brain seems first to organise incoming information into lines, angles, shading, movement and other basic features. Other brain areas then combine these features into meaningful visual experiences. Understanding the letters on this page is a direct result of such feature analysis.

QUESTIONS

1. Identify the independent variable (IV) and dependent variable (DV) in Hubel and Wiesel's 1979 experiment.
2. What conclusions did Hubel and Wiesel draw from their results?
3. Is feature detection a process of sensation or one of perception?
4. What are some of the ethical issues raised by their research?

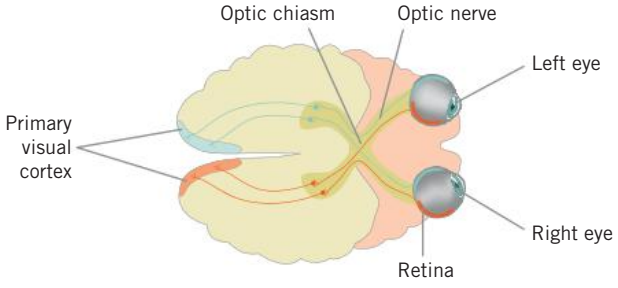


FIGURE 8.7 The basic nerve pathways of vision from the retina to the visual cortex, by way of the optic nerve. Notice that the left portion of each eye's retina (which receives information from the right visual field) connects to the primary visual cortex in the left occipital lobe; likewise, the right portion of each eye's retina (which receives information from the left visual field) connects to the brain's right occipital lobe. The crossover point is the chiasm. The layout of this neural pathway results in each eye supplying visual information to both your left and right occipital lobes.

Organisation and interpretation

By this stage the original light stimulus in the form of an image on the retina has been transduced and separated into individual impulses of electrochemical energy. During selection, the impulses have been filtered, so some of the original stimulus has been ignored. Because the visual information we take in is constantly changing, the brain needs to quickly and efficiently organise the impulses into some form or pattern that can be interpreted.

In the visual system, organisation relies on the application of visual perception principles. Visual perception principles are rules our brain automatically uses to help organise and interpret the constantly changing stream of visual stimuli it receives. In doing this, these principles help us perceive our environment in a consistent and meaningful way. Visual perception principles are discussed in detail later in the chapter.

Once organised, the newly assembled stimulus pattern is now ready for interpretation. Because information has been filtered during selection, when the brain is trying to interpret the information, it is working with incomplete information. So, in order to quickly give meaning to these stimuli, we make a perceptual hypothesis about what they represent in the external environment. Assigning meaning is a complex process that can be influenced by a range of biological, psychological and social factors. As these psychological factors are unique to the individual, they influence the unique perceptions we have of the visual stimuli we are sensing.

8.4 CHECK YOUR UNDERSTANDING >>

1 The optic nerve receives visual stimuli directly from:
   - A feature detector cells.
   - B ganglion cells.
   - C bipolar cells.
   - D photoreceptor cells.

→

optic nerve The nerve that connects the light receptor cells in the retina to the brain

blind spot The opening in the retina through which the optic nerve exits the brain and hence there are no light receptor cells

visual perception principles Rules our brain automatically applies to visual stimuli to help organise and interpret them in a consistent and meaningful way

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2 During the transmission stage of visual perception:
   - A the original energy source is converted into impulses of electrochemical energy so it can be processed by the brain.
   - B photoreceptors pass information to ganglion cells, which pass the information to bipolar cells.
   - C visual information is transferred from the retina to the brain's occipital lobe.
   - D visual information is transferred from the retina to the brain's frontal lobe for interpretation.

3 If you are driving a car during the day, your brain will not receive any information about the part of the light stimulus that falls on your retina's blind spot because:
   - A the blind spot is made up of rods only, and rods do not operate in bright light conditions.
   - B there are no ganglion cells in the blind spot to feed into the optic nerve.
   - C there are no photoreceptors in the blind spot.
   - D the blind spot's receptive field is too small to activate connecting neurons.

4 Describe what happens to stimuli during the selection stage of perception and explain why it happens.

5 Explain why the brain uses a set of visual perception principles during the organisation state of visual perception.

INFLUENCE OF BIOLOGICAL, PSYCHOLOGICAL AND SOCIAL FACTORS ON VISUAL PERCEPTION

When we experience vision we are in fact only taking in a limited area of our visual environment. This area is referred to as our visual field (see Figure 8.8). A visual field is the area of the external environment that can be seen when your head is still. Because the visual stimuli in our visual field are so varied, we are selective in what we pay attention to. Therefore, selective attention determines what visual information will be processed into a perception and what information will be ignored. The way we process this information is the same for us all, but there is much variation in what individuals pay attention to. So, selective attention is one reason why our perception of visual information is unique. However, other biological, psychological and social factors also cause perceptions of visual stimuli to vary.

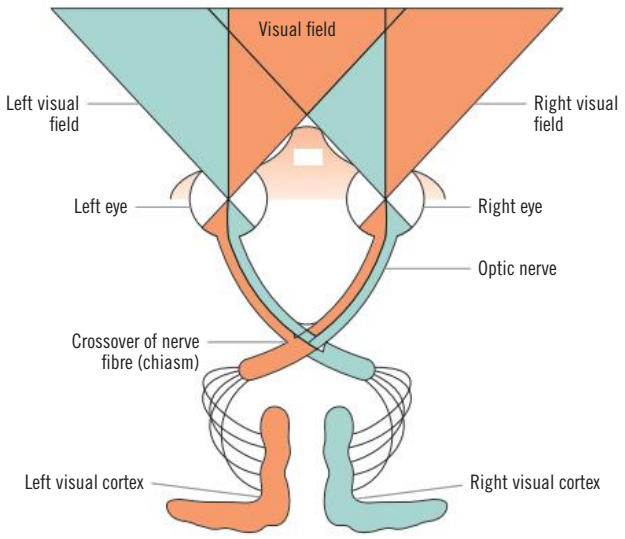


FIGURE 8.8 Our total visual field consists of all the area we can see when our head is still. Each eye also has its own visual field. Images in these two fields are merged by the brain so we have the perception of one continuous visual field.

BIOLOGICAL INFLUENCES ON VISUAL PERCEPTION

Individual physiological make-up

If some form of malformation of any part of our visual system occurs during foetal development, we will experience some form of visual impairment. Any abnormality that occurs during the development of our eyes, optic nerves or areas of our brain responsible for processing visual information will negatively impact on our ability to sense and perceive our world.

Some common problems associated with our ability to focus clearly on objects occur as a result of physical abnormalities associated with the shape and size of the eye. Eye shape is primarily achieved through the vitreous humour, a jelly-like fluid that cleans and nourishes the eye, keeps it firm and maintains an appropriate interior pressure level. So, if the vitreous humour is infected or leaks as a result of damage, eye shape will be affected. If the other main liquid in the eye – the aqueous humour – is damaged, pressure can build up, leading to retinal damage or damage to the optic nerve that ultimately results in vision loss. If the eye is too short, nearby objects cannot be focused on, but distant objects are seen clearly. This is called hyperopia, or farsightedness. If the eyeball is too long, the image falls short of the retina, and distant objects cannot be focused on. This results in myopia, or being nearsighted. If the cornea or lens is misshapen, part of the visual field will be focused and part will be fuzzy. In this case, the eye has more than one focal point. This problem is called astigmatism. If detected early in life, these defects can often be corrected by wearing glasses or contact lenses.

Malformation or damage to the eye's iris and pupil will affect the eye's ability to regulate the amount of light that is let in, causing distortions in vision. If the retina is damaged, particularly the photoreceptors, visual impairment may result because of an inability to detect the light stimulus. We may have difficulty

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perceiving colour, seeing clearly in bright light or dull light, or detecting movement.

Malformation of or damage to the optic nerve may also affect visual perception, because information sensed by our photoreceptors may not be able to be delivered to our brain. Also, if brain areas involved in visual perception, particularly the occipital lobe, are damaged or we are born with some form of structural abnormality, we may be able to sense the visual information and transmit it to the brain efficiently, but our ability to analyse and interpret it may be impaired.

Ageing

While many people maintain good eyesight well into old age, others experience some type of visual impairment. This is because, as we age, our eyes change. For example, when many people reach middle age their lens becomes less elastic, and this impacts on how well they can focus on objects at close range. In addition, cells may clump, causing tiny spots or cobweb-like specks, known as floaters, to drift across the field of vision. Many people also develop cataracts as they age. Cataracts form when protein builds up in the lens, causing it to become cloudy and making it difficult for light to easily pass through the lens (see Figure 8.9).

Other common age-related visual impairments include glaucoma and age-related macular degeneration (AMD). According to Glaucoma Australia (2014), more than 300 000 Australians have glaucoma, and one in eight Australians over the age of 80 will develop the disease. Glaucoma is the name given to a group of eye diseases that slowly destroy the optic nerve. In most people this damage is due to an increased pressure inside the eye. It can be due to fluid accumulating in the eye, or by poor blood supply to the optic nerve fibres. Age-related macular degeneration is a progressive disease that typically strikes people around the age of 60 and eventually leads to blindness (see Figure 8.10). The macula is a part of the retina that contains the fovea, a concentrated cluster of cones that processes central vision. If blood vessels in the eye start to leak, metabolic waste accumulates around the centre of the retina and attacks the macula and fovea, which diminishes central vision and visual acuity.



FIGURE 8.9 Cataracts are painless but they cause loss of vision as they cause the lens to become cloudy.

Genetics

Visual disorders may also be passed on genetically. Eye diseases such as congenital (present at birth) cataracts, congenital glaucoma, retinal degeneration and eye malformations have all been shown to have a genetic link. Recent research findings suggest that glaucoma, age-related macular degeneration and retinitis pigmentosa also have a genetic link. Retinitis pigmentosa is a degenerative disease of the retina that causes night blindness and gradual vision loss. It starts with a degeneration of rod receptors in the retina's periphery, then gradually attacks the cone receptors, and in its final stages causes complete blindness.

Genetic links have also long been established to colour blindness, or an inability to detect colour. A colour-blind person either lacks cones or has cones that do not function normally. (Hsia & Graham, 1997). Colour blindness is caused by changes in the genes that control red, green and blue pigments in the cones (Nathans, Piantandia, Eddy, Shows & Hogness, 1986). Red-green colour blindness is a recessive, sex-linked trait carried on the X chromosome – the female chromosome. Women have two X chromosomes, so if they only receive one defective colour gene on one chromosome, they still have normal colour vision.

visual field All the area of the external environment that can be seen when your head is still

hyperopia A visual impairment that results in an inability to focus on nearby objects

myopia A visual impairment that results in an inability to focus on distant objects

astigmatism A visual impairment that results in distorted vision because the eye has two focal points

glaucoma An eye condition that causes gradual loss of sight due to increased pressure within the eyeball, which results in damage to the optic nerve

age-related macular degeneration An eye condition associated with ageing that causes gradual loss of sight in which the macula in the middle of the retina breaks down or becomes damaged as a result of leaking blood vessels

retinitis pigmentosa A genetically related degenerative retinal disease that causes night blindness and gradual vision loss

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GETTY IMAGES/CORDELIA MOLLOY/SPL

FIGURE 8.10 The impact of age-related macular degeneration. The left image shows normal vision; the right shows what a person suffering from macular degeneration would see.

Colour-blind men, however, have only one X chromosome so they can inherit the defect from their mothers. The Y chromosome that pairs with the X in males contains no gene to mask the defective gene.

8.5 CHECK YOUR UNDERSTANDING >>

1 Age-related macular degeneration is associated with:
   - A loss of rods.
   - B loss of cones.
   - C loss of pressure in the eyeball.
   - D loss of optic nerve fibres.

2 Abnormal pressure within the eye causes:
   - A myopia.
   - B glaucoma.
   - C age-related macular degeneration.
   - D farsightedness.

3 A fault in the functioning of the _____ results in colour blindness.
   - A rods
   - B cones
   - C lens
   - D optic nerve

4 Explain the difference between a visual field and a receptive field.

5 Why can damage to the optic nerve cause problems with vision?

PSYCHOLOGICAL INFLUENCES ON VISUAL PERCEPTION

During the interpretation stage of perception, a number of psychological factors unique to the individual affect the final perception of sensory stimuli. Not only does the effect of these factors vary between individuals, an individual may be affected differently by them from day to day.

Perceptual set (expectancy)

A set of psychological factors helps shape perception by creating an expectancy about what the incoming stimuli will represent – this is known as a perceptual set. Psychologists define perceptual set (also known as 'expectancy') as a readiness or predisposition to perceive stimuli in a particular way according to expectation. The perceptual set affects which elements of a stimulus we attend to and select for further processing, as well as the way we organise and interpret them.

Some of the factors that contribute to creating a perceptual set originate with the individual. They include past experience, motivation and emotional state. Others, such as context, originate in the external environment.

PAST EXPERIENCE

Imagine you are a runner in the starting blocks just before a race. You have raced many times before so you are primed to respond in a certain way. For example, the words 'On your marks, get set …' leave you waiting for the word 'go' and for the sound of a starting gun. At this

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moment, if you suddenly hear a car backfiring, you may leap out of the starting blocks and make a false start. In this case, your past experience of racing has led to an expectancy about what the next sound you hear will be, and it causes you to misperceive this stimulus and 'jump the gun'.

Our perceptual set often leads us to see what we expect to see based on past experience – our prior exposure to stimuli and previous life experiences. Past experience creates a tendency to interpret new stimuli in the same way we have interpreted similar stimuli in the past.

8.1 TRY IT YOURSELF >>

PAST EXPERIENCE AND EXPECTANCY

As an interesting demonstration of perceptual expectancy, show some of your friends image a and some image b in Figure 8.11 – but make sure you cover the other two views each time. Next, show your friends image c and ask them what they see. Those who viewed image a should see an old woman in image c, whereas those who viewed image b should see a young woman in image c. Can you see both? (Adapted from Leeper, 1935)

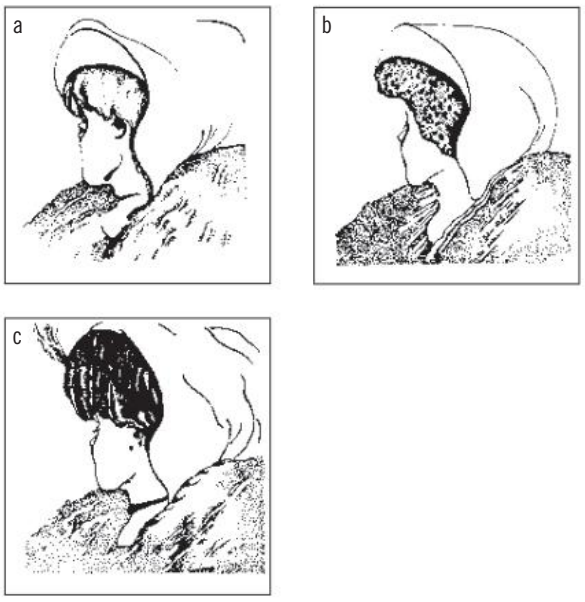


FIGURE 8.11 'Young woman, old woman' illustrations

CONTEXT

The external context within which a stimulus is viewed also affects the perception of that stimulus. Context refers to information that surrounds a stimulus and contributes to perceptual set. For example, a man with a height of 180 centimetres will look 'tall' when surrounded by others of average height, and 'short' among a group of professional basketball players. In the same way, in Figure 8.12a the centre circle is the same size in both designs, but context alters the circle's apparent size. The importance of context is also shown in Figure 8.12b. If you read across, context causes the centre figure to appear as '13'. Reading down makes it 'B'.

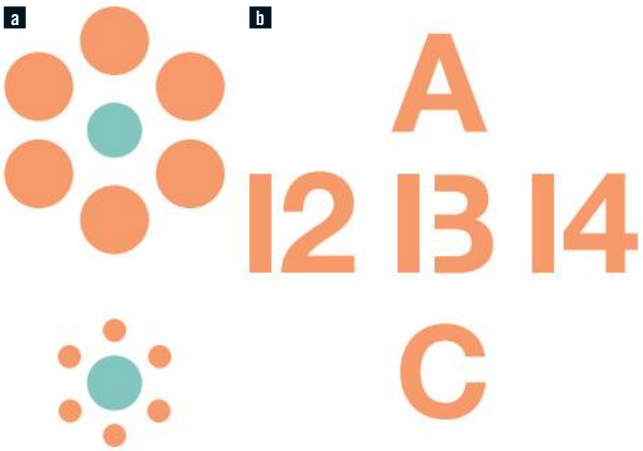


FIGURE 8.12 A Are the centre dots in both figures the same size? B Context alters the meaning of the middle. (Adapted from Bruner & Minturn, 1955)

MOTIVATION AND EMOTIONAL STATE

Imagine you are driving across the outback for the first time. You are feeling anxious because you are very low on petrol. Finally, you see a sign approaching and you read the words 'FUEL AHEAD'. But as you draw nearer, you realise the words on the sign are actually 'FOOD AHEAD'. You have never driven in the outback before, so why did you misperceive the sign? As shown by this example, and probably by some of your own experiences, motivation can influence perception.

Psychologists define motivation as an internal state that activates, directs and sustains behaviour in relation to achieving a specific goal. Motivation can play an important role in perceptual sets. It influences how we interpret the world around us and it can be influenced by a number of factors. These include physiological factors such as pain, hunger and body temperature – in other words, how you are physically feeling at the time. Psychological and emotional factors, such as what you are interested in, what your priorities are and your mood, can also influence perceptual set.

perceptual set A readiness or predisposition to perceive stimuli in a particular way according to our expectations

past experience Our prior exposure to stimuli and previous life experiences

context The information that surrounds a stimulus and contributes to perceptual set

motivation An internal psychological state that activates, directs and sustains behaviour in relation to achieving a specific goal

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8.6 CHECK YOUR UNDERSTANDING >>

1 Which of the following can influence a perceptual set?

A Being anxious
B Being hungry
C Being tired
D All of the above

2 When discussing perceptual sets, psychologists use the term 'context' in reference to:

A the memories you have of experiencing stimuli in the past.
B the way you were feeling when you experienced the stimuli.
C the patterns of behaviours and beliefs you share with other members of the groups to which you belong.
D information that surrounds a stimulus that creates an expectancy of what that stimulus will be.

3 How does the concept of perceptual set explain why one person who looked at Figure 8.13 might perceive the middle letter to be an 'H' and another person might perceive it to be an 'A'?



FIGURE 8.13 Is the middle letter an 'H' or an 'A'?

4 Explain what a perceptual set is and how it can affect visual perception.

5 How does past experience impact on perceptual set and, therefore, visual perception?

Visual perception principles

Before the visual elements selected by feature detector cells can be interpreted, the brain must reassemble them into a pattern or form that can be interpreted. Our brain must do this quickly so we can adapt our behaviour to suit the constantly changing external conditions we face and thus increase our chance of survival. The instant nature of this organisation relies heavily on visual perception principles. Visual perception principles consist of Gestalt principles, depth and distance cues, and visual constancies.

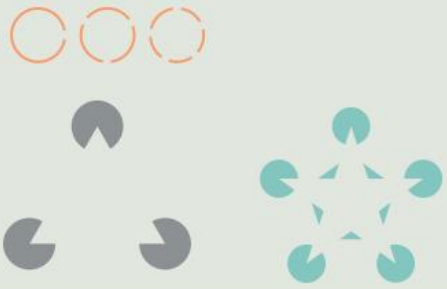
GESTALT PRINCIPLES: GROUPING AND SEPARATING

The Gestalt psychologists suggest we apply a number of rules, known as Gestalt principles, when we organise separate stimuli into meaningful patterns or wholes. These principles provide some order to our perceptions. Gestalt principles include four main categories (see Table 8.4).

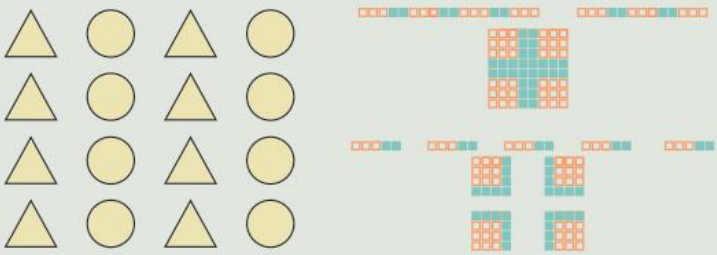
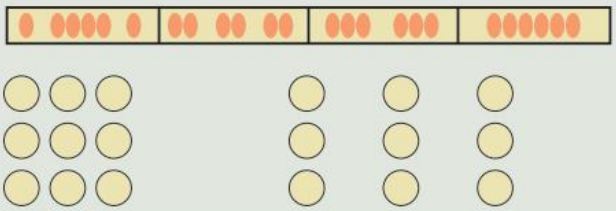
FIGURE–GROUND

The simplest Gestalt principle, figure–ground, involves the viewer using an imaginary contour line to perceptually group and separate some features of a stimulus so that a part of the stimulus appears to stand out as an object (the *figure*) against a plainer background (the *ground*). This makes it more difficult to perceptually separate the figure from the ground (see Figure 8.14).

TABLE 8.4 Gestalt principles group and separate features of a visual stimulus.

PRINCIPLE	DESCRIPTION	EXAMPLES
a Figure–ground	We see these objects as figures against the background.	
b Closure	Here, gaps are closed to make a complete figure.	

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PRINCIPLE	DESCRIPTION	EXAMPLES
c Similarity	In these examples, organisation depends on similarity of colour and/or shape.	
d Proximity	Notice how differently a group of six or nine objects can be perceptually organised, depending on their spacing.	

CLOSURE

Closure refers to the viewer's perceptual tendency to complete an incomplete figure by filling in an imaginary contour line so that the figure has a consistent overall form. For example, each drawing in Table 8.4b contains one or more gaps, yet each is perceived as indicating a recognisable and whole shape.

SIMILARITY AND PROXIMITY

Similarity helps us to perceive stimuli that have similar visual features (such as size, shape, colour or form) as belonging together and forming a meaningful single unit or group.



ISTOCKPHOTO.COM/AWAKENEDEYE

FIGURE 8.14 A challenging example of figure–ground organisation. Once the insect becomes visible, it is impossible to view the picture again without seeing the insect.

Proximity allows stimuli close together in space to be perceived as belonging together and forming a meaningful single unit or group. For example, if three people stand near one another and a fourth person stands five metres away, the three people standing near each other will be seen as a group and the distant person as an outsider.

DEPTH CUES: JUDGING DISTANCE TO CREATE A THIRD DIMENSION

One of our most remarkable perceptual abilities is our capacity to create the appearance of three dimensions – commonly called height (depth), length and width – from the flat two-dimensional images that reach our retinas. This is known as depth perception – the ability to see three-dimensional space and to accurately judge distances. Without depth perception you would be unable to effectively drive a car, ride a bicycle, or simply walk around a room.

Gestalt principles A group of principles that organise visual perceptual features and that integrate them into connected patterns or whole forms

figure–ground A Gestalt principle involving the viewer perceptually grouping and separating some features of a stimulus so that part of a stimulus appears to stand out as an object (the figure) against a plainer background (the ground)

closure A Gestalt principle involving the viewer's tendency to perceptually complete an incomplete figure by filling in an imaginary contour line so that the figure has a consistent overall form

similarity A Gestalt principle involving a viewer's tendency to perceive stimuli that have similar visual features (such as size, shape, colour or form) as belonging together and forming a meaningful single unit or group

proximity A Gestalt principle whereby stimuli that are close together in space are perceived as belonging together and forming a meaningful single unit or group

depth perception The ability to see three-dimensional space and to accurately judge distances

Depth perception relies on a number of cues known as depth cues. Depth cues are messages sent from the environment or our body that provide information about how far away objects are. Some depth cues are binocular, while others are monocular.

BINOCULAR CUES

Binocular cues require both eyes to work together to provide the brain with information about depth and distance. Binocular cues include retinal disparity and convergence.

Retinal disparity refers to small discrepancies between an image that reaches the right eye and left eye. Retinal disparity is based on our eyes being about 6.5 centimetres apart, causing each retina to receive a slightly different image. When the brain receives the separate images, it fuses (overlaps) them into one overall image and compares them. The fused image results in stereoscopic vision – or three-dimensional sight (see Figure 8.15). Any disparity (difference) between the two images provides the brain with information about the depth and distance of objects in the environment.

Convergence involves both eyes simultaneously turning inwards as an object moves closer (within approximately 7 metres) in order to maintain focus on the object. Convergence is controlled by muscles attached to the eyeball. When these muscles tense or relax, they feed information on eye position to the brain to help it judge distance. When you look at a distant object, the lines of vision from your eyes are parallel. However, when you look at something less than seven metres away, your eyes must converge (turn in) to focus on the object. You can feel convergence if you bring your fingertip towards your eyes, focusing on it until it is so close that your eyes feel like they will almost cross. At that point, you will feel sensations from the muscles controlling your eye movements.

MONOCULAR CUES

Monocular cues contain information from only one eye. Monocular cues consist of accommodation and pictorial cues.

Accommodation involves the ciliary muscles attached to the lens in each eye relaxing or contracting to alter the shape of each lens so it can focus on objects at varying distances. When an object is close (within approximately 3 metres), these muscles contract so your lens bulges and stays focused on the object. When the object is further away, the ciliary muscles relax so your lens flattens in order to stay focused on the object. Sensations from these moving muscles are channelled back to the brain and interpreted.

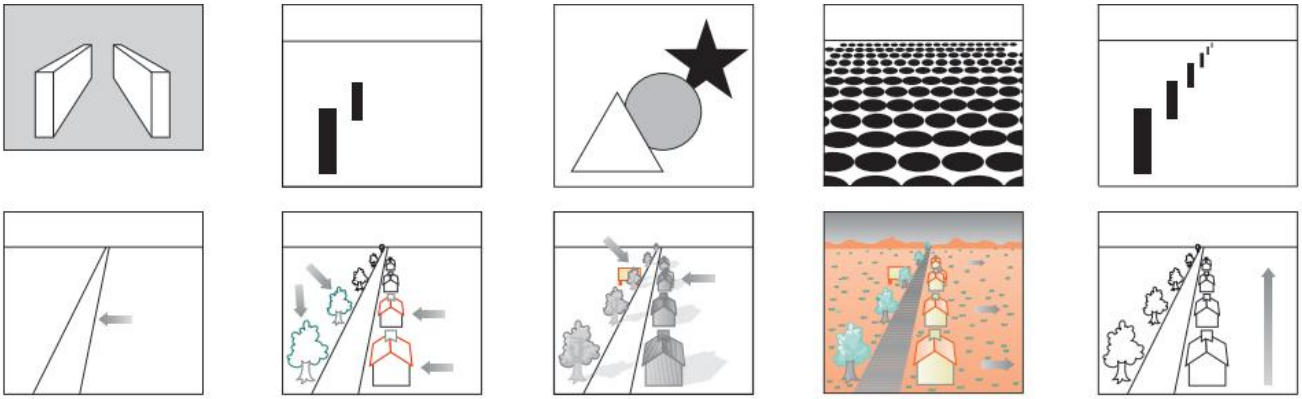
Pictorial cues are monocular cues that create an impression of depth on a flat two-dimensional surface where depth does not exist. These cues create a convincing sense of depth where none exists, and explain why a person with sight in only one eye can learn to estimate depth. They include:

- linear perspective – involves the apparent convergence of parallel lines creating the impression of increasing distance. If you look at Figure 8.16a, you will see two railway tracks. If you imagine yourself standing between the tracks, they appear to meet near the horizon. Because you know they are parallel, their convergence suggests great distance



FIGURE 8.15 Stereoscopic vision. Hold the page about 15–20 centimetres from your eyes. Focus your eyes between the two photographs, where an overlapping image of the ivy should appear. Try to merge the leaves into one image. If you are successful, you will see a third dimension appear.

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a Linear perspective **b** Relative size **c** Interposition **d** Texture gradient **e** Height in visual field

FIGURE 8.16 Pictorial cues

- **relative size** – refers to the smaller retinal image of two objects being perceived as further away, and the larger retinal image of two objects being perceived as being closer. The effect of relative size is strongest when we are familiar with the actual size of the objects (Figure 8.16b)
- **interposition** – also known as *overlap*, occurs when one object partially blocks another object and is perceived as being in front of, and therefore closer than, the object it covers (Figure 8.16c)
- **texture gradient** – refers to the surface features of an object being seen as smaller and less detailed the more distant an object becomes (Figure 8.16d)
- **height in the visual field** – relies on the height of objects in the visual field (either above or below the horizon) providing a depth cue, so that objects close to the horizon appear further away. Objects below the horizon line placed *higher* in a picture appear more distant than objects placed further below the horizon line. However, objects above the horizon line placed *lower* in a picture appear more distant than objects below, but close to, the horizon line (Figure 8.16e).

Table 8.5 summarises the depth cues that we have covered in this part of the chapter.

TABLE 8.5 Summary of visual depth cues

SITE OF CUE	BINOCULAR CUES (TWO EYES)	MONOCULAR CUES (ONE EYE)
Biological (internal) (primary)	Convergence	Accommodation
	Retinal disparity	
Pictorial (external) (secondary)		Linear perspective
		Relative size
		Interposition
		Texture gradient
		Height in the visual field

depth cues Messages that are sent from the environment or our own body and provide information to help us perceive depth or distance so that we can perceptually locate objects and perceive how far away they are

binocular cues A group of depth cues that require both eyes to work together to provide the brain with information about depth and distance

retinal disparity A binocular depth cue that refers to small discrepancies between an image that reaches the right eye and one that reaches the left eye

convergence A binocular depth cue that involves both eyes simultaneously turning inwards as an object moves closer (within approximately 7 metres) in order to maintain focus on the object

monocular cues Depth perception cues requiring information from one eye only

accommodation A monocular cue involving muscles attached to the lens in each eye altering the lenses' shape to enable the eye to focus on nearby objects

pictorial cues A group of monocular cues that create an impression of depth on a flat two-dimensional surface where depth does not exist

linear perspective A monocular pictorial depth cue where the apparent convergence of parallel lines creates the illusion of increasing distance

relative size A monocular pictorial depth cue where the smaller retinal image of two objects is perceived as being further away, and the larger retinal image of two objects is perceived as being closer

interposition A monocular pictorial cue that occurs when one object partially blocks another object and is perceived as being in front of, and therefore closer than, the object it covers

texture gradient A monocular pictorial depth cue whereby the surface features of an object become smaller and less detailed the more distant an object becomes

height in the visual field A monocular pictorial cue whereby the height of objects in the visual field (either above or below the horizon) acts as a depth cue, so that objects close to the horizon appear further away than objects located below the horizon

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VISUAL CONSTANCIES: MANAGING CHANGE

The sensory information that reaches us is constantly changing, even when it comes from the same object. This means the retinal image of the object changes constantly, yet our brain perceives the external world as fairly stable and undistorted. This phenomenon is due to visual constancies – the group of perception principles that allow us to view objects as unchanging in terms of their actual size, shape, brightness and orientation regardless of changes to the image the object casts on the retina.

SIZE CONSTANCY

Using an object's size to judge distance requires familiarity with the object's appearance. If you move your hand away from your face, you do not perceive it to be shrinking, even though the retinal image of your hand is getting smaller the further you move it from your face. Because you have seen your hand at various distances countless times in the past, your perception is that your hand is still its normal size, but that it is moving further away. This perception is due to size constancy, which is where the perceived actual size of an object remains constant despite changes in the size of the image the object casts on the retina.

SHAPE CONSTANCY

Because of shape constancy, an object's perceived shape is not affected by its changing shape on the retina. You can demonstrate shape constancy by looking at the page from a book from directly overhead and then from an angle. In reality the page is rectangular in shape, but when you view it from an angle the shape of the image that reaches your eye is different. Yet even though the image of the book's precise shape changes on your retina, your perception of its shape remains constant.

BRIGHTNESS CONSTANCY

Brightness constancy refers to the perceptual constancy whereby an object's perceived level of brightness relative to its surroundings stays the same under changing light conditions. Imagine you are outside on a sunny day. Beside you is a friend wearing a grey skirt and a bright white blouse. Suddenly a cloud shades the sun and the light levels surrounding you and your friend change. You might think that the blouse would appear dimmer than the skirt, but the blouse still appears brighter. This happens because the blouse continues to reflect a larger proportion of light than the grey skirt. However, if you shone a bright spotlight on your friend's skirt, you could make it look whiter than her shaded white blouse. You understand that, because of your brain's application of brightness constancy, the actual brightness level of the blouse compared with that of the skirt has not changed despite the change in light conditions surrounding them (see Figure 8.17).



FIGURE 8.17 Brightness constancy

ORIENTATION CONSTANCY

Suppose you are sitting on a couch or the floor watching TV. To get more comfortable, you lie on your side. Despite your head having rotated 90 degrees, causing a rotation in the retinal image of the TV, you still perceive the TV to be upright. This occurs because of orientation constancy, whereby we perceive an object's true orientation (position) as being unchanged despite changes in the orientation of the object's image on our retina.

8.7 CHECK YOUR UNDERSTANDING >>

1 Kerralie was doing some yoga while talking to Andrew. Despite standing on her head, she still perceived Andrew to be upright. This is an example of:
   - A size constancy.
   - B orientation constancy.
   - C shape constancy.
   - D brightness constancy.

2 Which is not an example of perceptual constancy?
   - A A slice of toast is perceived as square regardless of the position from which it is viewed.
   - B A white blouse is still perceived as white regardless of the change in outdoor light.
   - C A building viewed at 50 metres is perceived to be the same height as it would be if it were viewed at 100 metres.
   - D Petra would not be able to judge how far away her horse is if she lost sight in one eye.

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3 Which statement about depth cues is incorrect?
   A Depth cues can be environmental (external) or biological (internal).
   B Retinal disparity is caused by our eyes being approximately 6.5 centimetres apart.
   C Accommodation involves the ciliary muscles changing the shape of the lens.
   D Retinal disparity is a monocular cue.

4 Tourists sometimes employ trick photography to take a photo of a familiar landmark so that it appears a building is being 'held' in the palm of someone's hand. This is an example of manipulating:
   A texture gradient.
   B interposition.
   C shape constancy.
   D size constancy.

5 Explain the differences between monocular and binocular depth cues and provide an example of each type of cue.

SOCIAL INFLUENCES ON VISUAL PERCEPTION

Culture

Culture involves all the beliefs, values, customs, traditions and behaviours transmitted from one generation to the next that underpin a group's way of life.

Previously we looked at how pictorial cues help us judge depth and distance. Surprisingly, pictorial depth cues are not universal and their effect can be altered by culture.

Some cultures use only selected pictorial cues to represent depth, meaning that people from such cultures may not easily recognise other pictorial cues. For example, in 1960, researcher William Hudson tested members of remote tribes who did not use relative size to show depth in their drawings (see Figure 8.19), and found that these people perceived simplified drawings as flat designs (Deregowski, 1972). See Focus on research 8.2.

In 1972, Deregowski and others investigated whether pictures are seen and understood in the same way in different cultures (Deregowski, Muldrow, & Muldrow, 1972). His findings suggest that perceiving perspective in drawings is in fact a learned cultural skill. He found people from several cultures prefer drawings that don't show perspective, but instead are split so as to show both sides of an object at the same time. In one study he found a fairly consistent preference among African children and adults for split-type drawings over perspective drawings (see Figure 8.18). Split-type drawings show all the important features of an object that could not normally be seen at once from that perspective. Perspective drawings give just one view of an object. Deregowski argued that this split-style representation is universal and is found in European children before they are taught differently.

The cross-cultural studies seem to indicate that history and culture play an important part in how we perceive our environment. Perceptual set is concerned with the active nature of perceptual processes and clearly there may be a difference cross-culturally in the kinds of factors that affect perceptual set and the nature of the effect.

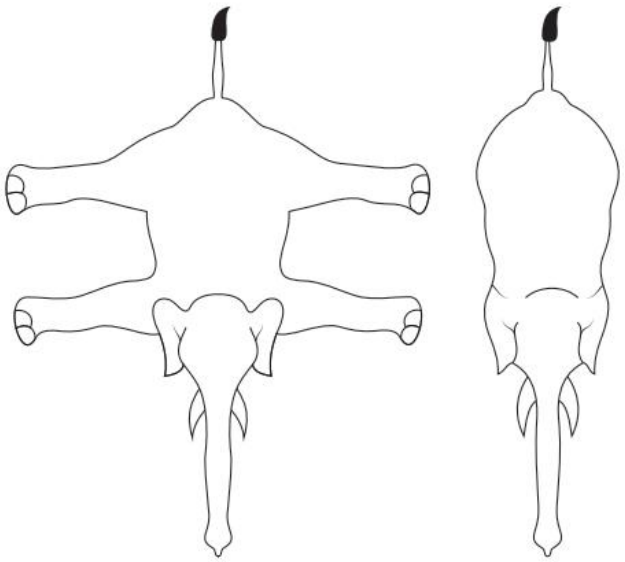


FIGURE 8.18 The elephant drawing on the left shows a split-view perspective and the right a top-view perspective. Deregowski (1972) found that the split-view drawing was generally preferred by African children and adults.

visual constancies A group of perception principles that allow us to view objects as unchanging in terms of their actual size, shape, brightness and orientation regardless of changes to the image the object casts on the retina

size constancy A perceptual constancy whereby the perceived size of an object remains constant despite changes in the size of the image the object casts on the retina

shape constancy A perceptual constancy whereby the perceived shape of an object remains constant despite changes in the size of the image the object casts on the retina

brightness constancy A perceptual constancy whereby an object's perceived level of brightness relative to its surroundings stays the same under changing light conditions

orientation constancy A perceptual constancy whereby we perceive an object's true orientation (position) as being unchanged despite changes in the orientation of the object's image on our retina

culture All the beliefs, values, customs, traditions and behaviours transmitted from one generation to the next that underpin a group's way of life

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8.2

FOCUS ON RESEARCH

HOW CULTURE IMPACTS VISUAL PERCEPTION

In 1960, researcher William Hudson investigated how pictorial depth cues affected the perception of simple two-dimensional drawings. Hudson showed participants in Western cultures and South Africa a drawing that depicted a man holding a spear, a gazelle and an elephant (see Figure 8.19). Various pictorial cues for depth that people in Western cultures are familiar with were also included, such as height in the visual field (the elephant was higher up in the visual field), relative size (the elephant was smaller than the gazelle) and interposition (the man and the gazelle blocked the hills).

Participants were asked a series of questions, including 'What is the man doing?' and 'What is closest to the man?' Western participants answered as if the picture was a three-dimensional image, so they took into account depth cues. For example, they said the gazelle was closer to the man than the elephant. The South African participants did not seem to perceive depth in the picture and said the elephant was closer to the man than the gazelle.

Hudson said the results suggested that perceptual development is influenced by training and education, as those in Western societies are trained from a very young age to perceive pictures in three dimensions. The task used in this research was, however, extremely ethnocentric. The two-dimensional picture perception task is a culturally specific task based on Western drawing styles. Thus we must be careful in drawing conclusions on cultural differences because the findings may be biased by ethnocentrism (Deregowski, 1972).

Based on Hudson's findings, it seems that to perceive depth in a drawing, some familiarity with conventions for representing depth in pictures and photographs would seem necessary. Of course, members of non-Western cultures can learn to interpret drawings of depth if they are given a chance to practise (Mshelia & Lapidus, 1990).

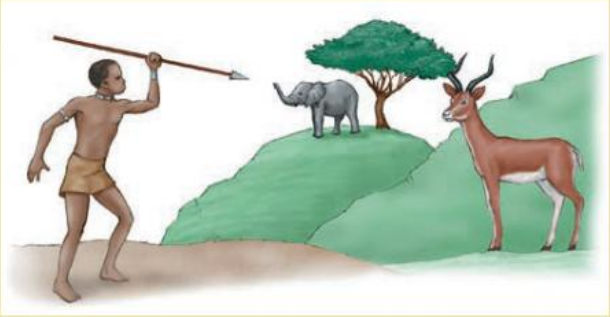


FIGURE 8.19 A Hudson test picture

QUESTIONS

1. Identify the independent variable (IV) and dependent variable (IV) in this research.
2. Identify the control group and the experimental group.
3. Identify the research design used.
4. Write a hypothesis for this research.
5. What conclusions can be drawn from the results?

TASTE: OUR GUSTATORY EXPERIENCE

Taste, also known as gustation, refers to the sensory experience of a substance that is put into the mouth and perceived as flavour. For many years it was generally agreed that humans have four primary tastes: sweet, sour, bitter and salty. However, in 1908, Kikunae Ikeda, a professor at the Imperial University of Tokyo, proposed the existence of a fifth taste, which he named *umami* (Japanese for delicious savoury taste). Umami is a taste sensation that is meaty or savoury and is produced by glutamate and several amino acids usually associated with meats and other high-protein foods.



FIGURE 8.20 The five tastes humans are sensitive to.

Scientists believe taste evolved as a survival mechanism because it enables us to distinguish between foods that are nutritious or harmful, and identify foods that provide pleasure. Taste protects us from swallowing things that are harmful and it ensures we receive the nutrients we need to remain healthy. Many poisons, for example, taste bitter or sour and we tend to reject these tastes. However, we usually find salty and sweet-tasting foods pleasant, so by eating them we meet our nutritional requirements for salts and carbohydrates.

Sensitivity to these tastes is distributed across the cells on the surface of the tongue, the main sense organ for taste. Although most taste cells are specialised to respond to a specific primary taste, they also respond to more than one of these. While our taste experience is predominantly the result of a mixture of these primary tastes, it can also be affected by the smell, texture appearance and temperature of food or drink. For instance, when we sip a cup of soup, we take in its aroma and feel its

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warmth through other senses. The taste sense only responds to the sweet, sour, bitter, salty or savoury components of the soup.

For taste to occur, we must first experience a sensation when chemical molecules contained in food and liquid interact with saliva in the mouth. Then our brain forms a perception of them in the form of a taste or flavour.

TASTE SENSATION AND PERCEPTION

Sensory receptors: Gustatory cells and taste buds

Soluble chemical molecules found in food and liquid are the physical stimuli for taste, and different types of molecules activate different sensory receptors. When food is placed in the mouth, these molecules are dissolved by saliva and come into contact with taste buds. When this happens, the taste sensation begins.

Taste buds are tiny structures contained in goblet-shaped papillae, the small bumps on the surface of the tongue (see Figure 8.21). The tongue is the main sensory organ of the gustatory system and most taste buds are found on the tip, sides and back of the tongue. Some are also located in the soft palate, the larynx (the voice box that contains vocal cords) and the pharynx (the section of throat between the mouth and the larynx). Each of us has about 10 000 taste buds located on the tongue's surface.

Taste buds contain clusters of receptor cells, known as gustatory receptors, which absorb and identify chemicals as they dissolve in saliva. Each taste bud has approximately 100 gustatory receptors. Taste buds have a life span of approximately 10 days and they are continuously being replaced. This is because they are constantly exposed to hazards, such as heat, infection and toxins, and they are easily damaged. New cells form at the edge of the taste bud and migrate inwards to die at the centre. Every gustatory receptor has a spindly protrusion called a gustatory hair that reaches the outside environment through an opening called a taste pore (see Figure 8.21). The chemical molecules in food and drink mix with the saliva, enter the taste pore, interact with the gustatory hairs and bind to the surface of the receptor.

RECEPTIVE FIELDS

Like all receptor cells, once an individual gustatory receptor comes in contact with the stimuli they are specialised to respond to, they are fired into action.

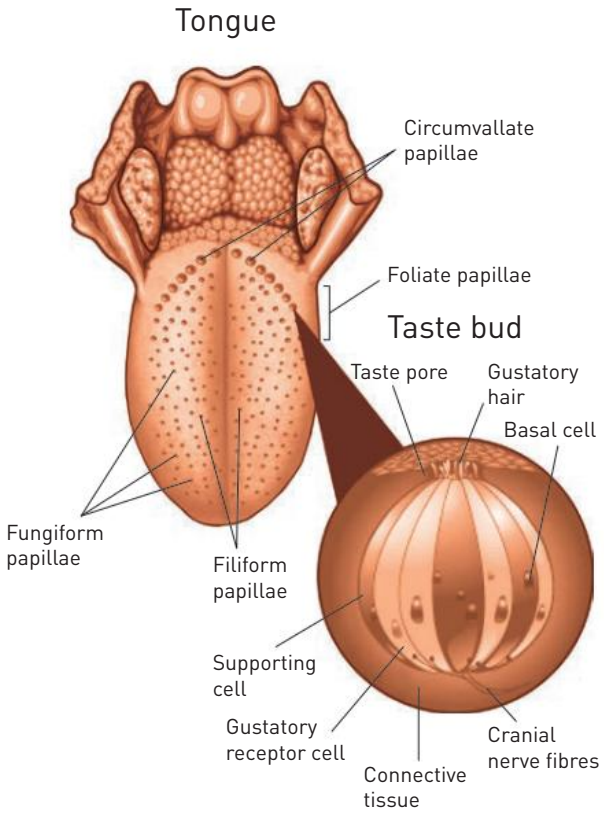


FIGURE 8.21 Structure of the human tongue and taste buds

The portion of the individual gustatory receptor's surface that comes in contact with the stimulus represents that receptor's receptive field. Each taste bud, which contains multiple receptors, also has its own receptive field, therefore the number of gustatory cells contained in each taste bud will determine the size of that taste bud's receptive field. In addition, each cluster of taste buds has its own receptive field. Furthermore, each gustatory receptor is connected at the synapse to a sensory neuron leading back through the cranial nerves (nerves connected directly to the brainstem) and then to the brain. A single sensory neuron can be connected to several taste cells in each of several taste buds.

taste The sensory experience of a food or drink that is put into the mouth and perceived as a flavour

gustation The sensory experience of a food or drink that is perceived as flavour

umami A taste sensation produced by glutamate and several amino acids that is experienced as meaty or savoury

taste buds Tiny structures located in the papillae on the tongue's surface

papillae The small bumps on the tongue's surface

gustatory receptors The receptor cells for taste; located on the surface of taste buds

gustatory hair A tiny protrusion through the opening in a taste pore that helps chemical molecules of food and drink dissolved in saliva bind to the gustatory receptor's surface

taste pores Tiny openings on the surface of a gustatory receptor through which the gustatory hair protrudes

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Once reception has occurred, the gustatory receptors transduce the chemical stimuli into impulses of electrochemical energy that contain information about what kind of chemicals are in the mouth, and transmit it to the brain via the nerve pathway for taste.

Transmission: From taste bud to brain

The neural pathway for taste begins in the tongue and ends in the brain, and damage to any section of the neural pathway can cause taste problems. Neural impulses travel from the taste buds to the medulla in the brainstem via cranial nerves (see Figure 8.22). The facial nerve (cranial nerve VII) carries information from the front section of the tongue. The glossopharyngeal nerve (cranial nerve IX) carries information from the back section of the tongue. The vagus nerve (cranial nerve X) carries taste information from the back part of the mouth. Another cranial nerve, the trigeminal nerve (cranial nerve V), relays information related to touch, pressure, temperature and pain.

When the medulla receives the information, it relays it to the thalamus. Some taste impulses transmitted into the thalamus trigger the salivatory nuclei that stimulate the salivary glands. This taste reflex is the reason for salivating when eating. The same nerves that carry messages about taste also transmit information about chewing, swallowing and the temperature and texture of the food.

Once the thalamus receives the impulse, it relays it to the primary gustatory cortex, the brain's receptive area for taste (see Figure 8.22). The primary gustatory cortex is located deep in the brain. It comprises two substructures: the *anterior insula*, located between the temporal and parietal lobes, and the *frontal operculum*, a part of the frontal lobe that covers the insula (insular cortex). These specialised structures filter and initially analyse the taste stimuli, including the type of taste and the intensity of the sensation, and send it to other areas of the brain involved in taste perception.

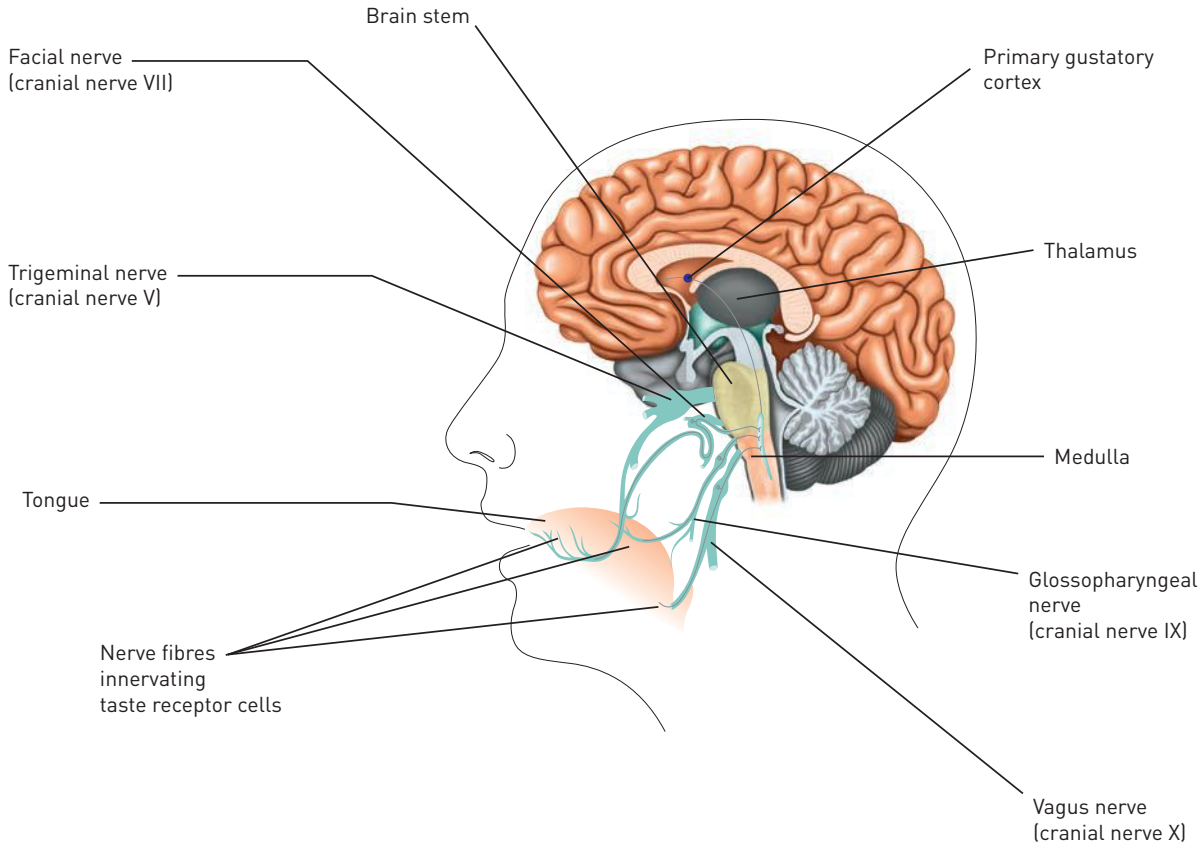


FIGURE 8.22 The neural pathway for taste

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Neuroimaging techniques and genetic manipulation applied in animal studies has led to much progress in understanding the coding of taste at the receptor level. However, much less is known about the cortical processing of taste sensation and the organising principles of the gustatory cortex.

Taste information is also transmitted to the *limbic system* (hippocampus, hypothalamus and amygdala). The limbic system plays an important role in emotional states and in memory formation, so when taste messages arrive here, we experience pleasant or aversive feeling when a memory of a previous taste is triggered. Chemical molecules also float in the air, so because taste and smell are both reactions to the chemical make-up of solutions, the two senses are closely related. For example, the ability to identify a taste declines with the absence of odours. This is why food tends to lose its taste when you have a cold and your nose is blocked. You can't taste the food properly because you can't smell it properly.

8.8 CHECK YOUR UNDERSTANDING >>

1 Taste receptor cells are renewed approximately:
   - A every 60 days.
   - B every 10 days.
   - C every 6 weeks.
   - D every 10 weeks.

2 In the neural pathway for taste:
   - A taste buds transmit information to the medulla via cranial nerves.
   - B the medulla transmits information to the thalamus.
   - C the thalamus transmits information to the primary gustatory cortex.
   - D All of the above

3 Which of the following statements about the sense of taste is not true?
   - A Gustatory receptors are the only receptors sensitive to chemical molecules.
   - B A person's perception of taste can be altered by their sense of smell.
   - C Taste perception is affected by the sensations of temperature, texture and pressure.
   - D Taste is composed of five sensory experiences: sour, salty, bitter, sweet and savoury (umami).

4 Explain why psychologists would describe the sense of taste as adaptive.

5 Describe the difference between a gustatory receptor cell and a taste bud.

8.2 TRY IT YOURSELF >>

TASTING WITH AND WITHOUT YOUR NOSE

For this activity you will need a glass of your favourite beverage, such as orange juice, coffee or hot chocolate.

Once you have your drink, pinch your nostrils shut while you drink the beverage. As you are drinking, pay attention to the quality and intensity of the taste. After one or two mouthfuls, release your nostrils and notice whether you perceive a flavour. Finally, just drink the beverage normally, with your nostrils open, and notice the flavour. What differences did you notice?

You can also try this with food.

Taste representation in the cerebral cortex

Each of the major senses is represented in the brain in the primary somatosensory cortex of the parietal lobes. The sensory receptors in sense organs (such as the tongue, pharynx and larynx) are connected to the primary somatosensory cortex by a chain of sensory neurons that become more complex as they approach the brain.

When the taste impulses are relayed from the gustatory receptors to the thalamus, they are redirected to various parts of the cerebral cortex, including the primary somatosensory cortex. When they arrive there, we feel a sensation of the original stimulus. Once we become aware of the sensation, we form a perception of what it is and where it came from. This means we are able to discern whether a taste is strong or weak, and whether the molecules that activated the receptors are bitter, sour, sweet, salty or savoury.

At the same time, chemical molecules associated with the odour of the food or liquid are taken in by the sensory receptors in the nose. These cells send signals to the brain about the molecule's odour. So, taste and smell information is combined to give the sensation of flavour. Since variations exist in the number of taste buds individuals have, and the number of sensory receptors their nose has, there will also be variations in an individual's sensitivity to certain tastes.

primary gustatory cortex An area deep in the middle of the brain, consisting of the anterior insula and frontal operculum, that is the receptive area for taste

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The primary somatosensory cortex represents body parts according to their sensitivity, not their size, so the number of gustatory receptors located in the tongue, pharynx and larynx determine how much of the somatosensory cortex will be devoted to representing these areas. Each area of the body is represented on the somatosensory cortex according to its position on the body, and body parts are represented in the opposite order to their position on the body. This means that body parts involved in tasting food and drink, such as the lips, mouth and pharynx, register towards the bottom of the somatosensory cortex.

TASTE SENSITIVITY

Taste sensitivity refers to the intensity with which we perceive the sensation of a taste and flavours. People with high taste sensitivity experience flavours (and smells too) as being very strong. They are also able to distinguish individual flavours in a mixture very well. For people with low taste sensitivity, tastes and flavours are not as strong and they do not distinguish individual flavour as easily.

Apart from being sensitive to chemicals that are sensed as taste, the tongue and mouth are also sensitive to touch, temperature and pain. When our brain forms a perception of the food, this perception is influenced by all of the information the brain receives about the food.

Although the process of taste sensation works in the same way for us all, taste sensitivity may vary between individuals (Figure 8.23). This is because taste sensitivity is also influenced by a person's absolute threshold for stimulus detection. An absolute threshold refers to the minimal amount of stimulus energy an individual requires to be conscious of a sensation.

An individual's absolute threshold for taste will be affected by the number of taste buds they have, so variations in absolute thresholds will differ between people. Some people are more sensitive to stimuli than others, so they require fewer stimuli to activate a sensation.

INFLUENCE OF BIOLOGICAL, PSYCHOLOGICAL AND SOCIAL FACTORS ON GUSTATORY PERCEPTION

People vary considerably in their sensitivity to and perception of certain tastes. These differences can be influenced by a range of biological, psychological and social factors.

BIOLOGICAL INFLUENCES ON TASTE

The differences in physiological make-up between individuals is one reason why perceptions of a taste may vary, and these differences are usually linked to taste buds. Some people may even be born with rare deficits in taste. Taste disorders can also result from injury or illness. Ageusia (loss of taste) or dysgeusia (distorted taste) are serious disorders that can lead to depression, weight problems, nutritional deficiencies and a lower quality of life.

Basic taste preferences also appear to be innate; they are automatically regulated by physiological mechanisms. For example, infants automatically react positively to sweet tastes. Many psychologists believe this assures the infant is receiving the carbohydrates they need. They also believe infants react negatively to bitter, salty or sour tastes because these tastes usually signify that food is spoiled or poisonous.


ISTOCKPHOTO.COM/SKYNESHER



FIGURE 8.23 Taste sensitivity varies between people.

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Age

Like all body parts, sensory systems undergo gradual, although not always significant, deterioration with ageing. Ageing also has an impact on our gustatory system. We have the greatest number of functional taste buds during childhood. However, as we age they do not regenerate as quickly or they cease regenerating altogether, and the overall number of our taste buds decreases. This has a noticeable impact on our experience of taste, and may explain why older people often find the taste of food bland and lose interest in food (Figure 8.24). They may also use more salt and spices because they simply cannot taste their food as well as they used to. In effect, their taste buds require more stimulation to achieve the same taste sensations they had when they were younger (Morris, 1978).



FIGURE 8.24 As we age, our taste buds do not regenerate as quickly. This is why food is often described as tasteless by older people.

Genetics and biological make-up

How sensitive we are to sweetness, bitterness or any other taste can also be affected by our genetic and biological make-up. Some people have as few as 500 taste buds, whereas most of us have approximately 10 000.

Research suggests that some people, characterised as supertasters, inherit more taste buds and gustatory receptor cells than other people, and have about four times as many taste buds per square centimetre as people who are classified as non-tasters. Although both groups may respond similarly to many foods, supertasters find tastes more intense, so they tend to avoid powerfully flavoured foods. Supertasters tend to have stronger tastes for sweet and bitter, and for irritants such as alcohol and capsaicin (the chemical that makes chillies hot). Generally, they will avoid sugary desserts and they will use more salt than other people because it blocks the bitter taste of certain foods. Women are more often supertasters. Non-tasters tend to prefer sweet and fatty foods, which may be why supertasters tend to be slimmer than non-tasters (Bartoshuk, Duffy, & Miller, 1994).

8.9 CHECK YOUR UNDERSTANDING >>

1 The minimum amount of chemical stimulation that an individual's taste buds can detect is known as their:
   - A perceptual set.
   - B absolute threshold for taste.
   - C minimum threshold for taste.
   - D perception of taste.

2 Someone classed as a supertaster:
   - A has more taste buds and gustatory receptor cells than other people.
   - B has a lower absolute threshold for taste than other people.
   - C enjoys foods with very intense flavours.
   - D is usually male.

3 At 60 years of age we have:
   - A fewer taste buds than at 6 years of age.
   - B more taste buds than at 6 years of age.
   - C the same number of taste buds we were born with.
   - D stronger taste buds than we were born with.

4 What is the difference between ageusia and dysgeusia?

taste sensitivity The intensity with which we perceive tastes and flavours

absolute threshold The minimal amount of stimulus energy an individual requires to be conscious of a sensation

supertasters People who have more taste buds than normal and find tastes more intense than others

non-tasters People who have fewer taste buds than normal and find tastes less intense than others

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8.3 TRY IT YOURSELF >>

CAN YOU TASTE THE DIFFERENCE BETWEEN AN APPLE AND A POTATO?

What you will need:

- a small piece of peeled potato
- a small piece of peeled apple (make it the same size and shape as the potato so you can't tell the difference.

Close your eyes and move the pieces around so that you can't tell which is apple and which is potato.

Hold your nose and taste each piece. Can you tell the difference? What does this suggest about your sense of taste and your sense of smell?

PSYCHOLOGICAL INFLUENCES ON TASTE

Perceptual set (expectancy)

When our brain receives information about the chemical properties of a food from our gustatory system, it simultaneously receives visual information about the food's appearance from our visual system and odour-related information from our olfactory system (the sensory system for smell). When we see, smell or taste food, a number of factors influence the perception we form of the food. For example, our memory of past food experiences, preconceived beliefs about the taste of the food, our emotional state at the time we taste the food and the context we experience the food in all create an expectation of what the food will taste like, and this expectation influences the perception we form. In other words, our perceptual set affects the way we perceive the taste of food (Figure 8.25).



FIGURE 8.25 Our expectations about what a food will taste like influences our perception of the food's taste.

PAST EXPERIENCE: MEMORIES OF PAST TASTES

The cerebral cortex does not have a specific lobe devoted to taste or odour. When we see, smell or taste a new food, information is sent to a number of brain areas, including the hippocampus and amygdala. When the information reaches the hippocampus, it triggers memories of previous taste experiences. When the amygdala is activated, it adds the emotional element to the taste experience. This is why the smell or sight of a food triggers a memory that influences your perception of the food, often before you have even tasted it.

If, in the past, you have had a negative experience with a food (such as vomiting after eating a specific food), you may form a negative memory of this experience. You may associate the taste with the negative experience. This association could lead to a long-lasting taste aversion to that taste, which will bias your attitude towards future foods or tastes of the same type, so you will avoid these foods. When you see this food in the future (or perhaps even think about it), the taste cue becomes an aversive signal that triggers your negative memory (Figure 8.26).



FIGURE 8.26 A taste aversion can be acquired after only one bad experience with a food.

FOCUS ON RESEARCH 8.3

SOME LIKE IT SWEET, OTHERS NOT SO MUCH: IT'S PARTLY IN THE GENES

A new study from Philadelphia's Monell Center and collaborating institutions suggests that a single set of genes affects a person's perception of sweet taste, regardless of whether the sweetener is a natural sugar or a non-caloric sugar substitute.

'Eating too much sugar is often seen as a personal weakness. However, our work suggests that part of what determines our perception of sweetness is inborn in our genetic makeup,' said study author Danielle Reed. 'Just as people born with a poor sense of hearing may need to turn up the volume to hear the radio, people born with weak sweet

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taste may need an extra teaspoon of sugar in their coffee to get the same sweet punch.'

In the study, researchers tested 243 pairs of monozygotic (MZ, or identical) twins and 452 pairs of dizygotic (DZ, or fraternal) twins. Studying twin pairs allowed the researchers to determine how much influence the twins' shared genetics contributed to their perception of sweet taste intensity. A further 511 unpaired individuals were also tested. Each participant tasted and then rated the intensity of four sweet solutions: fructose, glucose, aspartame, and neohesperidine dihydrochalcone (NHDC). The first two are natural sugars, while the latter two are synthetic, non-caloric sweeteners.

The resulting data indicate that genetic factors account for approximately 30 per cent of person-to-person variance in sweet taste perception. In addition, those who perceived the natural sugars as weakly sweet experienced the sugar substitutes as similarly weak. This suggests that there may be a shared pathway in the perception of natural sugar and high-potency sweetener intensity.

Scientists are still working to unravel the molecular processes behind how we detect the many different types of sweet molecules. Earlier studies with mice showed that there is one main detection pathway for non-caloric sweeteners and natural sugars, but also a second pathway that responds only to sugars. The current findings suggest that these two pathways might converge into a single experience of sweetness intensity.

The current study also found little evidence for a shared environmental influence on sweet perception. Assuming twin pairs took part in communal meals during childhood, this result challenges the common belief that access to foods high in sugar may make children insensitive to sweetness.

Source: Adapted from Monell Chemical Senses Center. (2015, July 17). Some like it sweet, others not so much: It's partly in the genes: Twin study suggests a common genetic pathway underlies sweet taste perception of natural, non-caloric sweeteners. *ScienceDaily*.

QUESTIONS

1 What was the aim of this research?
2 Construct a hypothesis for this study.
3 Identify the experimental group and the control group.
4 What conclusion(s) did the researchers draw?
5 Was the hypothesis you constructed supported or refuted by the results?

MOTIVATION AND EMOTIONAL STATE

Emotions and motivation can have a dramatic impact on how we perceive the world around us. If you had been deprived of food for several hours and you were extremely hungry, when offered a food you normally didn't like the taste of, you might eat this food and decide that it did not taste too bad. Because you were hungry, you were more motivated to perceive the taste in a certain way. When we are feeling stressed or unhappy, we often want to eat a specific food because we know it will alleviate these negative emotions and make us feel more positive. What represents a 'comfort food' may be specific to the individual or influenced by culture and traditions (Figure 8.27).

In addition to taste, the smell, texture and appearance of food can instantly evoke memories of not just eating the food, but also of the emotions we felt at the time we tasted it. For example, the smell of a cake baking might elicit fond memories of spending time at your grandmother's house when you were a small child (Figure 8.28).



SHUTTERSTOCK.COM/GAYVORONSKAYA_YANA

FIGURE 8.27 Chocolate is a common comfort food for many people.



ISTOCKPHOTO.COM/IMAGE SOURCE_

FIGURE 8.28 The taste of a food can evoke strong memories and emotions associated with the food that influence how we perceive the food's taste.

CONTEXT: FOOD PACKAGING AND COLOUR

Our perceptual response to the taste and flavour of a food or beverage is influenced by a range of factors other than the sensation that activates our taste buds. The information that surrounds the food, or

taste aversion A learned avoidance of a specific food after it has been associated with an unpleasant experience

the context we experience the food in, influences our perception of its taste. For example, taste perception may be influenced by factors such as appearance, place of purchase, colour, branding, packaging, country of origin and price.

Unlike many animals, humans rely on vision more than their other senses to provide knowledge of the outside world, and the visual cues our brain receives are some of the most powerful cues for taste. Before we eat or drink, we generally look at what we are eating or drinking. This means that our brain often receives visual information about the food or drink before it receives taste information, and this affects the perception we form. For example, it is likely that people learn to associate visual cues, such as the food's colour, with tastes. These learned associations influence our taste perception because they help to create expectations about how a food should smell and taste. We may expect a yellow drink to have a banana or lemon flavour and red jelly beans to have a cherry or cinnamon flavour. In fresh foods, such as fruits and vegetables, we rely on the colour to determine their level of ripeness and freshness. If the colour of a food product does not match our expectations, we may perceive its taste and flavour differently.

SOCIAL INFLUENCES ON TASTE

Culture

Culture, or the patterns of behaviour, beliefs, traditions and values shared by a group that set it apart from other groups, can also influence the way we interpret a taste sensation.

Although some basic aspects of taste perception may be inborn, research suggests that taste preferences are largely learned and are heavily influenced by social processes (Rozin, 1990), particularly child-rearing processes. This social influence contributes greatly to the striking ethnic and cultural disparities found in taste preferences. For example, foods that are a source of disgust in Western cultures – such as worms, fish eyes and blood – may be delicacies in other cultures.

What you have been exposed to provides a learning experience that affects your perception of foods and their taste. It is a common observation that people in certain cultures develop tastes for specific foods that are typically associated with that culture. A research team led by Howard Moskowitz (1975) investigated the notion that the perception of flavour can be influenced by culture by asking a group of Indian medical students and a group of Indians from the Karnataka province to rate the pleasantness of a number of compounds. The medical students described citric acid as having an unpleasant sour taste and quinine as having an unpleasant bitter taste. However, the Karnataka Indians described both compounds as being pleasant-tasting. Moskowitz felt that past experience was the most likely explanation for the Karnataka Indians' unusual preference for sour and bitter compounds. Their diet consisted of many sour foods, with a sour tamarind fruit making up a large portion of it. The researchers concluded that constant exposure to this fruit led to an acquired taste preference for sour foods even if it didn't change the flavour they experienced.

The effect observed by the Karnataka Indians is similar to the observation that children, who often avoid unfamiliar foods, come to prefer these foods if they are repeatedly exposed to them (Birch, 1979). Other experiments where people have repeatedly tried foods they normally wouldn't eat have yielded the same results. It seems that with repeated exposure, our appreciation for a new taste typically increases; furthermore, exposure to one set of novel foods tends to increase our willingness to try another (Pliner, 1982).

8.10 CHECK YOUR UNDERSTANDING >>

1 The _____ is the brain structure that adds the emotional component to a food memory.
   - A amygdala
   - B insular cortex
   - C frontal operculum
   - D hippocampus

2 What role does memory play in taste perception?

3 Explain one reason why someone who likes the taste of ice-cream may be reluctant to eat ice-cream that is dyed black.

4 Use your knowledge of perceptual set to explain why you might not like the taste of a new food if you were in a bad mood, but you might like the taste if you were in a good mood.

5 How can a liking for spicy foods be influenced by social factors?

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CHAPTER SUMMARY

What is sensation and perception?

- Sensation is a physical process that involves the body detecting and processing stimulus energy from the external environment. Sensation is a purely physical process that translates various kinds of external energy into neural impulses that are transmitted to the brain.
- Perception is a physical and psychological process. It involves organising and interpreting sensory stimuli into a meaningful pattern so that we understand the world around us.

What are the stages in sensation and perception?

- Sensory receptors located in sense organs are responsible for the *reception* of physical energies and they use *transduction* to convert these energies into electrochemical nerve impulses that can be transmitted to the brain.
- During transmission, nerve impulses transmit sensory information through a neural pathway leading to the brain where it undergoes selection, organisation and interpretation, which results in a meaningful perception of the original stimulus.

How does the sensory system for vision operate?

- The eyes, optic nerves and brain make up the visual system.
- Visible light is the external energy source for visual perception. The spectrum of visible light consists of electromagnetic radiation in a narrow range to which the human eye is sensitive.
- Light-sensitive photoreceptors in the retina receive and transduce (convert) the light stimulus into impulses of electrochemical energy that are transmitted to the brain's occipital lobe via the optic nerve.
- The brain selects, organises and interprets the visual stimuli.

What biological, psychological and social factors influence visual perception?

- The perception individuals have of a common visual stimulus can vary. Each person's perception is unique and can be influenced by a range of biological, psychological and social influences. Biological influences include differences in individual physiological make-up, the effects of ageing and genetic factors.
- Psychological factors include the application of visual perception principles (Gestalt principles, depth cues and visual constancies). The effect of perceptual set influences our perception because it creates an expectation of what a new stimulus will be. Cultural training also influences our visual perception.
- Visual perception principles are a set of innate rules the brain uses to quickly organise constantly changing and often incomplete visual stimuli into a pattern that can be given meaning.

How does the sensory system for taste operate?

- Humans sense five different tastes: sweet, sour, salty, bitter and umami (savoury).
- Taste involves the gustatory receptors on taste buds detecting chemicals in food, transducing them, and then sending them on to higher-order sensory neurons for transmission to the brain.
- There is no specific cortical lobe for taste. Cranial nerves transmit the taste stimuli to the brain stem's medulla, which relays it to the thalamus. The thalamus relays the stimuli to the gustatory cortex (the anterior insular and frontal operculum located deep in the brain) where the stimuli are filtered and initially analysed.

What biological, psychological and social factors influence taste perception?

- The perception individuals have of a common food stimulus can vary. Each person's perception is unique and can be influenced by a range of biological, psychological and social influences. Biological influences include differences in individual physiological make-up, the effects of ageing and genetic factors. Psychological factors include the effect of perceptual set, which influences our perception because it creates an expectancy of what a new food stimulus will be. Cultural training also influences our taste perception.

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APPLY YOUR KNOWLEDGE AND SKILLS

SECTION A: MULTIPLE-CHOICE QUESTIONS

Answer the following questions by writing the correct letter in your workbook. Only one answer is correct for each question.

1 A stimulus is:
- **A** the physical energy that begins sensation.
- **B** the psychological energy that begins perceptions.
- **C** the way in which sensory nerve fibres communicate with each other.
- **D** another word for perception.

2 The conversion of electromagnetic radiation into electrochemical energy is called:
- **A** reception.
- **B** transmission.
- **C** transduction.
- **D** transformation

3 Sensory information in the visual perceptual system is processed by biological units called _____. The relaying of information between these components along the optic pathway is called _____.
- **A** rods and cones; transduction
- **B** neurons; reception
- **C** rods and cones; reception
- **D** neurons; transmission

4 Which of the following statements about photoreceptors is false?
- **A** Rods are mainly concentrated in the fovea.
- **B** Cones operate best in bright light.
- **C** Cones provide colour information.
- **D** Rods adapt relatively slowly to the dark.

5 The photoreceptors least sensitive to light are:
- **A** ganglions.
- **B** feature detectors.
- **C** cones.
- **D** rods.

6 When viewing a man of average height next to a group of basketball players, the man of average height will look quite short; but when standing next to jockeys, the man will appear tall. This is best explained by _____.
- **A** Gestalt principles
- **B** context
- **C** illusions
- **D** past experience

7 In the retina of the eye, a receptive field is an area that:
- **A** contains only rods, and is very sensitive to dim light.
- **B** is used to help focus the image coming into the eye.
- **C** affects other cells in the visual system when stimulated.
- **D** contains only cones, and is capable of colour vision.

8 As a door opens, the shape of the image it casts on the retina changes, yet to an observer the door retains its rectangular form. This is an example of:
- **A** size constancy.
- **B** shape constancy.
- **C** orientation constancy.
- **D** a visual illusion.

9 _____ are one of the few types of neurons that can replace themselves in adult life.
- **A** Papillae
- **B** Taste buds
- **C** Rods
- **D** Cones

10 The little bumps that are visible on your tongue are called:
- **A** taste buds.
- **B** gustatory cells.
- **C** papillae.
- **D** taste receptors.

11 Each taste bud has a cavity with a pore called a:
- **A** gustatory hair.
- **B** papilla.
- **C** taste pore.
- **D** ganglion pore.

12 Which of the following statements about taste is false?
- **A** Taste buds die approximately every 21 days.
- **B** Taste buds respond to the five basic tastes.
- **C** Most people have about 10 000 taste buds.
- **D** Taste buds are found on the tongue's papillae.

13 The insular cortex:
- **A** is the first primary cortical processing area for taste.
- **B** is the last area to receive taste information during the gustation process.
- **C** transmits taste information to the medulla.
- **D** Both answers A and C apply.

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14 Which of the following structures is responsible for transduction in the gustatory system?

- **A** Papillae
- **B** Taste buds
- **C** Gustatory receptors
- **D** Taste pores

15 When a person can taste and smell a substance, the added odour:

- **A** increases the strength of the food's smell.
- **B** increases the strength of the food's taste.
- **C** decreases the strength of the food's taste.
- **D** decreases the strength of the food's smell.

SECTION B: SHORT-ANSWER QUESTIONS

1 Explain the differences between sensation and perception.

2 Describe the processes of reception, transduction and transmission in the visual perceptual system. Provide an example to illustrate your answer.

3 Describe feature detectors and explain their function in the visual perception system.

4 Explain the processes of organisation and interpretation in the visual perceptual system. Provide an example to illustrate your answer.

5 Name three pictorial depth cues used by artists to create three-dimensional pictures on two-dimensional surfaces. Explain how each cue contributes to developing a three-dimensional image.

6 Explain why it is easier to identify a flavour while using both nose and mouth.

7 Explain how taste perception is an innate survival mechanism.

8 Identify the steps involved in taste perception.

9 Use an example to describe the role of past experience in taste perception.

10 Explain how the hippocampus and amygdala help us form a taste perception.

SECTION C: EXTENDED-RESPONSE QUESTION

A study conducted by food scientists at a food company wanted to find out whether background sounds affect the perception of the flavour of a food. They found that there was a correlation between noise levels and perception of levels of saltiness or sweetness in a food. Their results showed that when noise levels increased, people perceived foods as less salty and less sweet. When noise levels decreased, the perception of saltiness and sweetness increased.

You want to replicate this study using an independent groups design. In preparation for this task, complete the following:

- Identify your population of interest.
- Write an operational hypothesis for this study.
- Identify the sampling procedure you intend to use and how you will implement this procedure.
- Using dot points, design a simple method for this study.
- Identify one possible extraneous variable that might affect this study and explain how you intend to control it.

This question is worth 10 marks.

SECTION D: ASSESSMENT TASK

ANNOTATING A PICTORIAL DEPTH CUE ACTIVITY

Artists rely on a range of pictorial depth cues to create the illusion of depth in their two-dimensional pieces of art.

MATERIALS YOU WILL NEED:

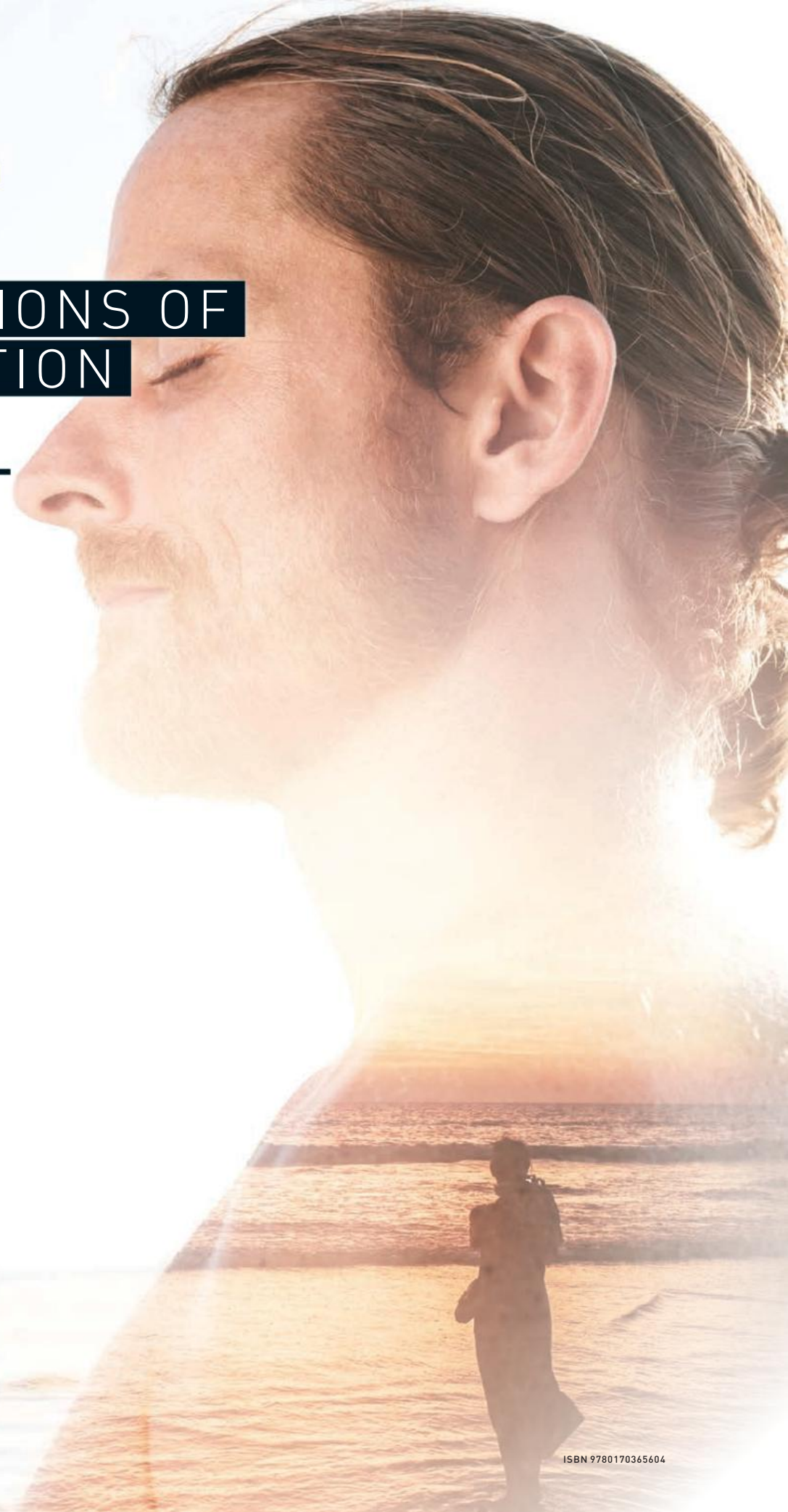
- magazines and newspapers
- a large piece of poster cardboard
- glue, scissors, pens, coloured markers and a ruler.

YOUR TASK:

- You are to find a series of five different pictures. Each picture must depict one of the following pictorial depth cues: linear perspective, relative size, height in the visual field, interposition and texture gradient.
- Divide your poster cardboard into six equal spaces.
- Place one picture in five of the spaces – be sure to leave enough room for annotations.
- In the sixth space, explain:
  - what depth is
  - what a depth cue is
  - why we need depth perception.
- For each picture, do the following:
  - Name and define the cue – circle or highlight where it can be seen in the picture.
  - Explain how the artist has used the principle or cue.

CHAPTER 09

DISTORTIONS OF PERCEPTION



KEY KNOWLEDGE INCLUDES:

- the fallibility of the visual and gustatory perception systems, demonstrated by visual illusions and the judgment of flavours (influence of perceptual set, colour intensity and texture)
- distortions of perception of taste and vision in healthy, intact brains as providing insight into brain function related to perception, illustrated by synaesthesia.

Psychology Area of Study Key knowledge points derived from *VCE Psychology Study Design 2016*, p. 21; © The Victorian Curriculum and Assessment Authority (VCAA). Used with permission.

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PERCEPTUAL ERRORS

Most people with an intact brain have no trouble sensing and correctly perceiving the constant barrage of incoming stimuli they are exposed to from the external environment. This means that if we do not have some form of physical abnormality related to our senses, when we are exposed to sensory stimuli our sensory systems will receive, transduce and transmit the information to the brain without error. Our brain will then automatically select the important features of the stimuli and efficiently organise them into a meaningful whole that it interprets correctly. The result of the sensation and perception process is that we form an accurate perception of the world around us. Sometimes, however, our perceptions are not always accurate. In other words, our perception can be fallible. Even a normal, healthy, fully functioning brain can make perceptual errors.

A range of factors can contribute to a perceptual error. Sometimes perceptual fallibility is due to external factors, such as when the stimulus itself gives us misleading cues. Our sensory systems may process the information efficiently but, because we are processing misleading information, the interpretation we arrive at is bound to be faulty. However, in other cases of perceptual error we find that psychological factors unique to the individual, such as the factors that make up their perceptual set, influence their perceptions and lead to perceptual error. When this happens, the person's perception does not match the sensory stimuli that triggered it and they experience a perceptual error, causing them to incorrectly perceive the stimulus.

FALLIBILITY OF VISUAL PERCEPTION

Visual perception directs our interactions with the environment. Before the brain can transform sensory information into meaningful perceptions, it must organise it into something the brain can recognise. The brain must perceive objects as distinct from their surroundings, see them as having a meaningful and constant form, and estimate how far away they are. When attempting to assign meaning to stimuli, the brain applies its rules for constructing perceptions – visual perception principles. Thankfully, this use of perception principles is usually reliable and our perceptions of the outside world are accurate – they match the reality. Sometimes, however, errors do occur and visual perception is not always accurate.

VISUAL ILLUSIONS: DON'T BELIEVE WHAT YOU SEE!

One such error of visual perception is visual illusion – a consistent perceptual error in interpreting a real external stimulus. That is, illusions distort stimuli that actually exist and lead us to make a false judgment of reality. Figure 9.1 is an interesting example of how our brain can be tricked into making a perceptual error.

When we experience a visual illusion, the stimulus provides us with cues that mislead our perception. As a result, a mismatch between our perception and the reality of the actual stimulus occurs. Although perception of common stimuli is often described as unique, this is not the case with a visual illusion. With visual illusions, all individuals tend to be misled by the stimulus in the same way. In a visual illusion, length, position, motion, curvature or direction of the stimulus is consistently misjudged (Gillam, 1980).



FIGURE 9.1 In this illusion as the staircases shift orientation, the people start to defy gravity.

perceptual error An incorrect perception of a stimulus

visual illusion A consistent perceptual error in interpreting a real external stimulus

In contrast, in hallucinations, people perceive (see, hear, taste or smell) objects or events that have no external reality; that is, hallucinations create stimuli that do not have a separate, material existence. For example, someone experiencing an auditory hallucination might hear voices that are not there. While a visual hallucination can generally be disproved by trying to experience the stimuli through another sense (for example, by trying to touch the wings of a hallucinated giant butterfly), to detect an illusion it is often necessary to measure the stimulus (such as a drawing) or apply a straight edge to it.

Illusions are a fascinating challenge to our understanding of perception. We know they intentionally manipulate the cues we are experienced in using to create a perception, but not all illusions can be explained to everyone's satisfaction. Generally speaking, size and shape constancy, habitual eye movements, continuity and perceptual habits combine in various ways to produce visual illusions such as those in Figures 9.2 and 9.3.

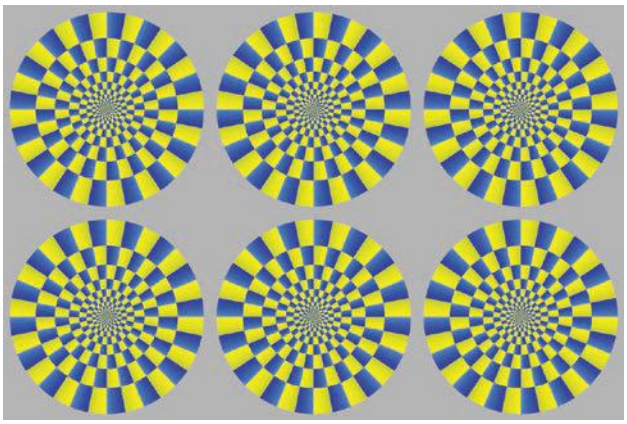
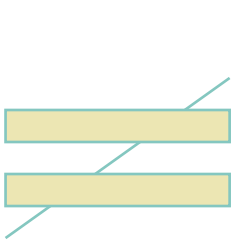
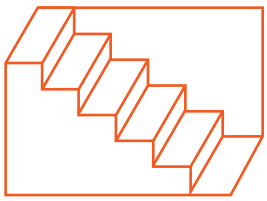


FIGURE 9.2 In this illusion of motion, circles appear to 'rotate' spontaneously.



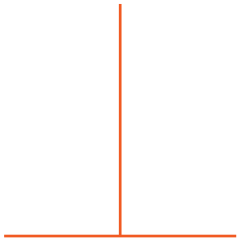
a Is the diagonal a straight line? Check it with a ruler.



b Is this a drawing of a staircase descending from upper left to lower right, or is it a view from under a staircase from lower right to upper left?



c Are these lines parallel? Cover some of the slash marks to see.



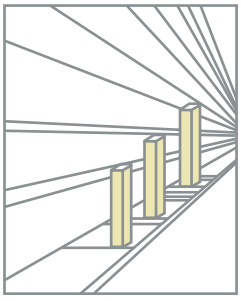
d Which line is larger: the horizontal or the vertical line?



e Notice how the background distorts the square.



f Which shape is larger?



g Which column is shortest? Which is longest?

FIGURE 9.3 Some visual illusions

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9.1 CHECK YOUR UNDERSTANDING >>

1 Which one of the following statements about visual illusions is correct?
   - A Visual illusions are not caused by the stimuli providing misleading cues.
   - B The experience of a visual illusion is unique to the individual.
   - C Visual illusions can be caused by damage to part of the neural pathway for vision.
   - D Visual illusions intentionally distort the cues we use to form a visual perception.

2 Hallucinations:
   - A are the same as illusions.
   - B involve an actual stimulus giving you false information about its reality.
   - C have no connection to a real stimulus.
   - D involve a mismatch between our perception and the reality of the actual stimulus.

3 Jordan hears voices in her head that tell her what to do and what to say. Jordan is experiencing:
   - A a delusion.
   - B a hallucination.
   - C an illusion.
   - D a compulsion.

4 Explain one reason why we may make a perceptual error when viewing a stimulus.

5 Explain the difference between a visual illusion and a hallucination.

The Müller–Lyer illusion

In the Müller–Lyer illusion the horizontal line capped with outward pointing (< >) arrowheads appears shorter than the line capped with inward-pointing (> <) arrowheads (see Figure 9.4). This is an illusion because a quick measurement will show that in reality both lines are of the same length and cast the same-sized retinal image, but one is perceived as shorter (or longer).



FIGURE 9.4 The Müller–Lyer illusion. Which of the horizontal lines is the longer?

The illusion of differing lengths is created by the different figures at the ends of each line. How does the illusion work? According to Richard Gregory (1990), our 'reading' of the Müller–Lyer illusion is based on our past experience of living in a three-dimensional world where our buildings are basically square or rectangular in shape so that we have constantly been exposed to the edges and corners of buildings and rooms. Gregory believes we see the horizontal line with the inward-pointing arrowheads as though it were the inside corner of a room. The line with the outward-pointing arrowheads, on the other hand, suggests the corner of an outer wall of a building. Because the lines cast images of the same length, the more 'distant' line is perceived as being longer. In other words, cues that suggest a three-dimensional space alter our perception of a two-dimensional design (Enns & Coren, 1995). This explanation presumes that you have had years of experience with straight lines, sharp edges and corners – a fairly safe assumption if you have lived most or all of your life in a built-up environment.

Another theory that attempts to explain the Müller–Lyer illusion focuses on the size of the retinal images cast by the two lines and their distance from our eyes. It suggests that if two objects make retinal images of the same size, the more-distant object is perceived as being larger. This is known as size–distance invariance (whereby the size of an object's retinal image is precisely related to the distance from the eyes). Gregory (1990) believes that this concept explains the Müller–Lyer illusion. Gregory suggests that if the line with inward-pointing arrowheads looks further away than the line with outward-pointing arrowheads, then we must compensate by seeing the line with inward-pointing arrowheads as longer (see Figure 9.5). This explanation is known as the apparent-distance hypothesis, whereby an apparently more-distant object that has the same-sized retinal image as an apparently nearer object will be perceived as the larger.

hallucination A perceptual error resulting in the perception of an object or event that has no external reality

Müller–Lyer illusion A visual illusion in which two lines of equal length – one capped with inward-pointing arrowheads, the other capped with outward-pointing arrowheads – are perceived as being of different lengths

apparent-distance hypothesis A prediction that an apparently more-distant object that has the same-sized retinal image as an apparently nearer object will be perceived as the larger

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FIGURE 9.5 Why does line b in the Müller–Lyer illusion look longer than line a? Probably because it looks more like a distant corner than it does a corner seen close up. As you can see in the photo, additional depth cues accentuate the Müller–Lyer illusion.

How can we test whether past experience causes the illusion? If we could test an adult who saw only curves and wavy lines as a child, we would know if experience with a 'square' culture is important. Fortunately, a group of people in South Africa, the Zulus, live in a 'round' culture. In their daily lives, Zulus rarely encounter a straight line. Their houses are shaped like rounded mounds and arranged in a circle, their tools and toys are curved, and there are no straight roads or square buildings.

The typical Zulu villager who looks at the Müller–Lyer illusion does not experience the illusion. At most, they see the line with inward-pointing arrowheads as only slightly longer than the other (Gregory, 1990). This would seem to confirm the importance of perceptual expectancy and past experience in determining our view of the world. But, like many topics in psychology, room for debate remains. The Müller–Lyer illusion also seems to be partly based on directly misperceiving where the lines end (Morgan, Hole & Glennerster, 1990). Thus, it could be that apparent size and misperception cause the illusion.

The Ames room illusion

As we know, in visual perception perceptual expectancy involves a readiness to perceive visual stimuli in a particular manner, through expectations that are based on factors such as past experience and context. Magicians rely on perceptual expectancy when they use sleight of hand to distract observers while performing tricks. Another kind of 'magic' is related to consistency in the environment. For example, based on your past experience with the shape of rooms it would be safe to assume that rooms you see in the future will be roughly shaped like a box. This need not be true, as illustrated by the Ames room illusion.

An Ames room (named after Adelbert Ames, who designed it) is a lopsided room that appears square when viewed through a peephole located at a certain point in the wall. Two people, who in reality are of equal size, stand in the back corners – one in the rear left corner and one in the rear right corner (see Figure 9.6).

The illusion is created when the person standing in the rear-left corner walks diagonally across the room to the front-right corner. As they do this they appear to increase in size, and when the person standing in the rear-right corner crosses from right to left, they appear to decrease in size.

The illusion is partly due to the unusual construction of the room. The proportions of the walls, floor, ceiling and windows have also been distorted to provide misleading information about depth and distance. In addition, its lopsided shape causes the two back corners to appear an equal distance from the viewer, but the rear-left corner is actually further

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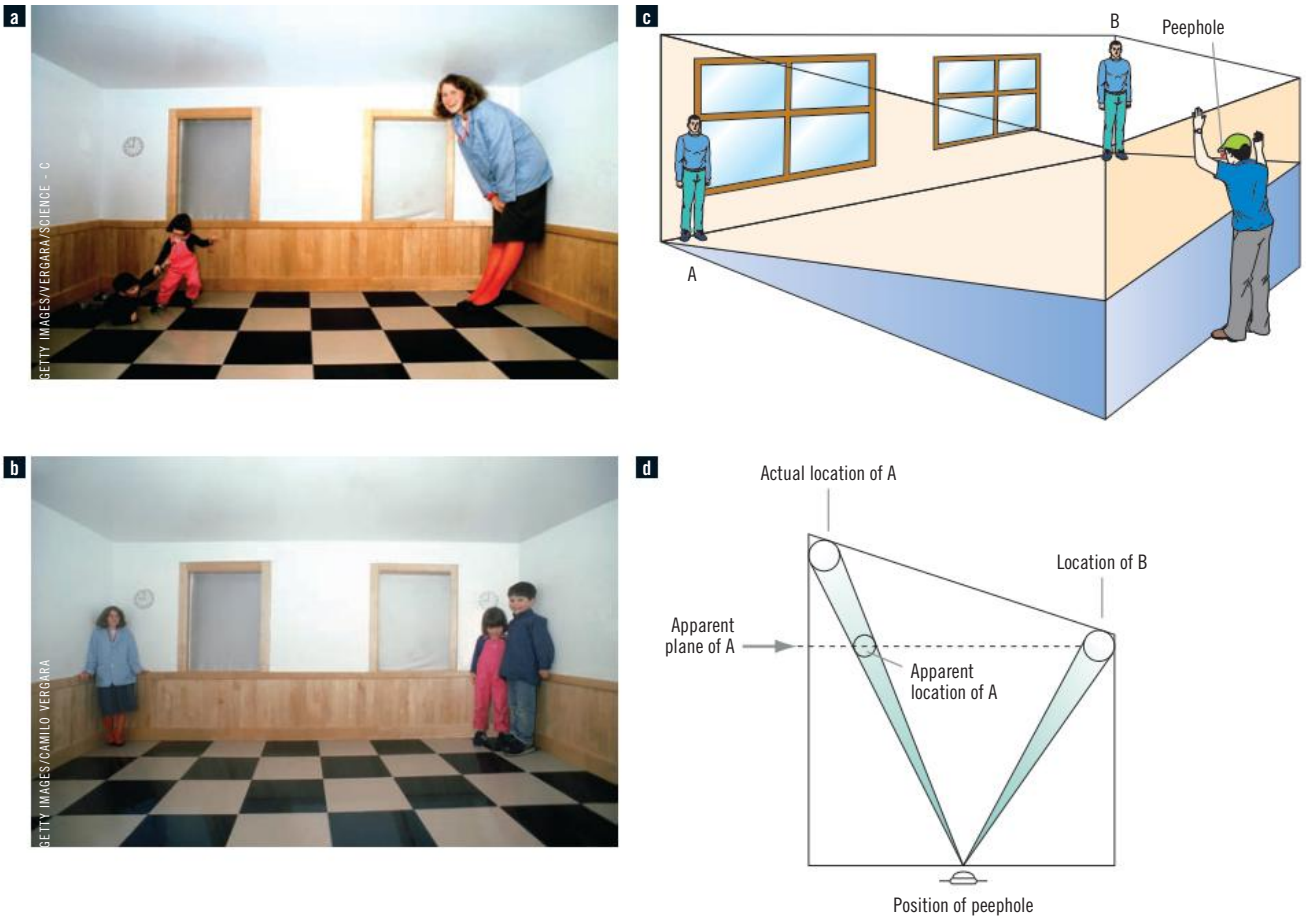


FIGURE 9.6 The Ames room. From the front, as shown in **a** and **b**, the room looks normal; the actual right-hand corner is very short and the left-hand corner is very tall. The diagram in **c** shows the shape of the room and reveals why people appear to 'grow' as they cross towards the nearer, shorter right-hand corner. The floor plan in **d** shows people's actual positions in the Ames room in relation to the viewer.

away from the peephole than the rear-right corner. The person standing in the rear-left corner is perceived as smaller because they cast a smaller retinal image than the person in the rear-right corner. In reality, however, they are just further away. As they walk across the room from left to right, their retinal image size increases and they are perceived as growing taller, but the reality is they are getting closer to the viewer. This faces the viewer with a conflict: they can either maintain shape constancy by perceiving the room as square, or they can maintain size constancy by refusing to see the person 'grow'. Most people maintain shape constancy, and so see people 'shrink' and 'grow' before their eyes, but misapply size constancy.

The illusion is also created by the fact that the viewer is viewing the room through the peephole, so they can only receive information contained in monocular cues. We know from earlier discussions in Chapter 8 that we also rely on binocular depth cues to provide information about the depth and distance of objects in the environment. Viewing through one eye limits the cues our brain receives to judge depth and distance and disrupts our perceptual constancies to create the impression that people change size as they cross the floor.

This explanation is consistent with the apparent-distance hypothesis. According to Gregory and Wallace (1963), if two objects (such as people) of the same size are introduced into the room, the object in the left-hand corner comes in further away from the viewer than the object in the right-hand corner. Yet because of the room's distortion, both objects appear to be the same distance from the viewer. These objects of the same size and apparent distance will cast different-sized retinal images. Hence, the objects will appear to

Ames room illusion An illusion caused by an intentionally distorted room, viewed through a peephole, disrupting perceptual constancies and misleading the viewer to perceive people changing size (shrinking or growing) as they cross the floor from one corner of the room to the corner diagonally opposite

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be of different sizes even though this is at odds with the viewer's past experience of them (for example, the person in the rear-left corner can appear as a giant). We experience the Ames Room illusion not because our perceptual processes are faulty, but because we try to apply size constancy in the usual way to an extremely unusual situation. In other words, the Ames room itself causes us to misapply size constancy, but maintain shape constancy.

9.2 CHECK YOUR UNDERSTANDING >>

1 Which of the following statements is true?
   - A Visual illusions are always caused by a real external stimulus.
   - B Visual illusions are always caused by a real internal stimulus.
   - C Visual illusions can be experienced by most people exposed to the same stimulus.
   - D Visual illusions are the same as visual hallucinations.

2 Cross-cultural studies indicate that people raised in areas where there are few right angles are _____ susceptible to the Müller–Lyer illusion than people who are raised in areas where right angles and rectangles are common.
   - A much less
   - B much more
   - C somewhat less
   - D equally

3 To experience the Ames room illusion, the Ames room must:
   - A be viewed through a binocular peephole.
   - B be furnished with oddly shaped furniture that is perceived as normal.
   - C be constructed as a rectangle but perceived as being trapezoidal.
   - D have one back corner that is further away from the viewer than the other back corner.

4 Explain what causes the Ames room illusion.

5 What is the apparent-distance hypothesis?

9.1 TRY IT YOURSELF >>

CREATE A VISUAL ILLUSION

Try the following activity to see how you can turn two pictures into one.

MATERIALS

A piece of white cardboard, coloured pencils, scissors, cellotape

TASK

1 Cut two squares from the cardboard.
2 On one square, draw a fish. On the other square, draw a fish tank.
3 Place the 'fish' square face down, so you are looking at the unmarked side.
4 Place a pencil on the unmarked side and cellotape it to the bottom half of the square – the remainder of the pencil should extend beyond the square.
5 Place the 'tank' picture on top of the square with the pencil, so that the 'tank' is facing you.
6 Cellotape the two top edges and the sides together.
7 Hold the pencil between your palms and rub your hands together to make the pictures spin around. Did you see the fish inside the tank? If you moved the pictures quickly enough, you should have created the illusion of movement, so the fish appeared to be in the tank.

The Ponzo illusion

The Ponzo illusion (also known as the 'railroad track' illusion) consists of two horizontal lines of equal lengths drawn inside two converging lines, but the line in the narrower section of the converging lines is perceived to be longer (see Figure 9.7).

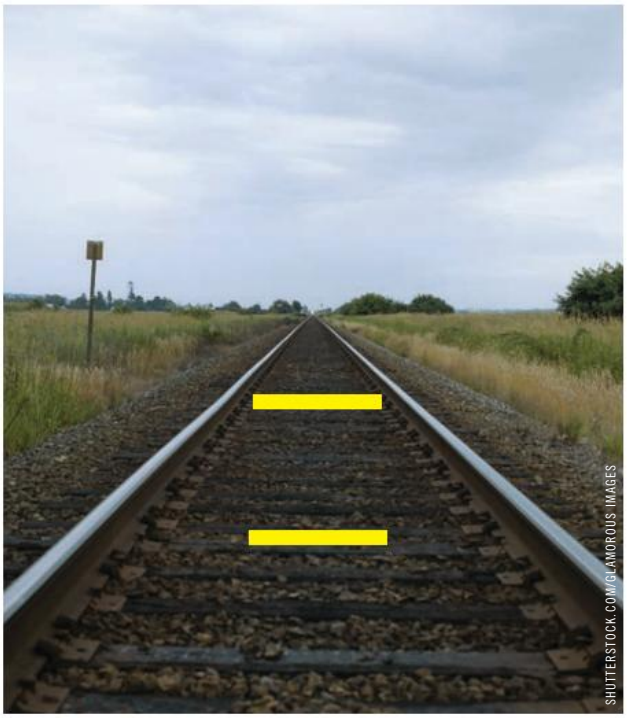


FIGURE 9.7 The Ponzo illusion. How can equal lines appear to be different lengths?

We can use the apparent-distance hypothesis to explain this illusion. The Ponzo illusion is a man-made two-dimensional drawing, but we use the depth perception principles we use in a real three-dimensional world to try to estimate the length of the horizontal lines. Our experience using depth cues such as linear perspective and height in the visual

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field influences our perception of the top line as being further away because that is what we know from our 'real' experience. Both lines cast the same-sized retinal image, but because we perceive the top line to be further away, our use of size constancy reinforces the perception that it must be longer.

So we can see that when we attempt to apply the same principles we use to perceive a three-dimensional world to this two-dimensional drawing, the result is an error in perception.

The Moon illusion

We constantly use both pictorial cues and bodily cues to sense depth and to judge distances. Depth cues also produce an intriguing perceptual effect called the Moon illusion – where the Moon appears larger the closer it is to the horizon.

Contrary to what some people believe, the Moon is not magnified by the atmosphere. If you take a photograph of the Moon and measure it, you will find it is not larger when it is near the horizon – it merely looks nearly twice as large when it is low in the sky compared to when it is overhead (Plug & Ross, 1994). This occurs even though the Moon's apparent distance is greater when it is near the horizon than when it is above us (Kaufman & Kaufman, 2000).

The Moon illusion comes about because when the Moon is overhead, few depth cues surround it. In contrast, when you see the Moon on the horizon, it is behind houses, trees, telephone poles and mountains. These objects add numerous depth cues, which makes the horizon seem more distant than is the night sky overhead.

This explanation is consistent with the apparent-distance hypothesis, which is that an apparently more distant object that makes the same-sized retinal image as an apparently nearer object will be perceived as the larger object.

You can test this by removing depth cues while you look at the Moon on the horizon. Try looking at it through a rolled-up paper tube, or make your hands into a 'telescope' and look at the next large Moon you see. It will immediately appear to shrink when viewed without depth cues (Plug & Ross, 1994). Note that the Moon illusion is so powerful it can occur in photographs that contain depth cues (Coren & Aks, 1990) (see Figure 9.8).



FIGURE 9.8 The Moon illusion: the Moon appears larger the closer it is to the horizon.

Father-and-son team Lloyd and James Kaufman recently confirmed the apparent-distance hypothesis in an experiment using a computer to project two images of the Moon onto a mirror. This allowed them to superimpose an artificial moon on the sky. In addition, the mirrors were movable. Volunteer observers reported that the Moon moved closer as its size diminished. The effect was most dramatic when the Moon was near the horizon (where most depth cues are found). This is the most powerful confirmation yet of the apparent-distance theory (Kaufman & Kaufman, 2000).

OTHER WAYS TO MANIPULATE VISUAL PERCEPTION

Ambiguous figures and impossible figures

How our perception of a stimulus can be manipulated is also illustrated by ambiguous figures – that is, patterns allowing more than one interpretation. If you look at a cloud, you may discover dozens of ways to organise its contours into fanciful shapes and scenes. Stare at the image in Figure 9.9. Do you see a duck or a rabbit? Even clearly defined stimuli may permit more than one interpretation. Stare at the Necker's cube in Figure 9.10. Do you see the shaded areas as the back

Ponzo illusion An illusion where two horizontal lines of equal length are drawn inside two converging lines, but the line in the narrower section of the converging lines is perceived to be longer

Moon illusion An illusion where the Moon appears larger the closer it is to the horizon

ambiguous figure A stimulus that can be interpreted in more than one way

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wall of the cube or as the face of the cube? When we view the world around us, usually it appears as stable and unambiguous. In other words, our perceptions are consistent and not open to interpretation. However, when we view an ambiguous stimulus, our perception is challenged because more than one interpretation of the stimulus is possible. When viewing an ambiguous figure, we shift our attention and mentally reorganise the elements of the stimulus in order to construct a stable, unambiguous interpretation of the stimulus, although the stimulus itself remains unchanged. If you doubt that perception is an active process, remember that we construct meaningful perceptions; we do not simply record the events and stimuli around us (Hoffman, 1999).

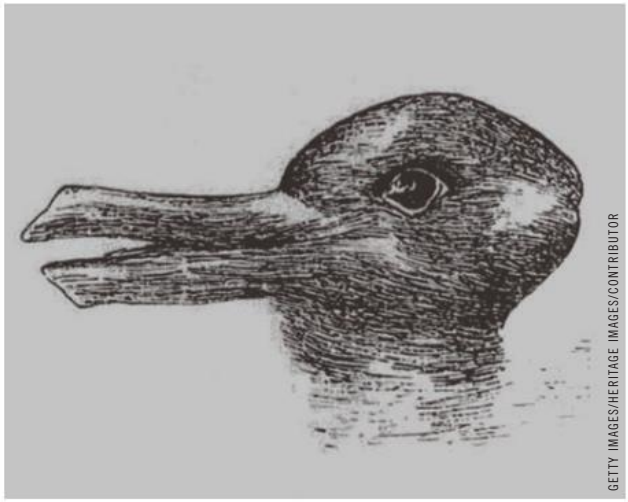

GETTY IMAGES/HERITAGE IMAGES/CONTRIBUTOR

FIGURE 9.9 An example of an ambiguous figure

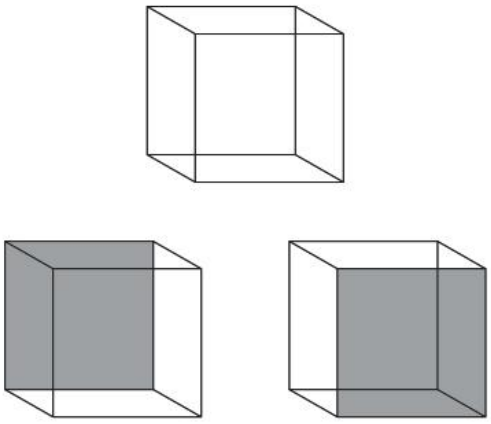


FIGURE 9.10 Necker's cube

In some instances, a stimulus may offer such conflicting information that perceptual organisation (or reorganisation) becomes impossible. These stimuli are known as **impossible figures**. The patterns of an impossible figure cannot be organised into stable, consistent or meaningful perceptions because they cannot exist in reality, even though they appear to do so. For example, the tendency to make a three-dimensional object out of a drawing is frustrated by the 'three-pronged widget' (see Figure 9.11).

All drawings are two-dimensional; however, they often represent three-dimensional objects. A three-dimensional representation of an object is created by using a variety of pictorial cues to create the illusion of depth in the drawing. These cues include linear perspective, interposition, height-in-the-visual-field, texture gradient and relative size (see Chapter 8). When we misapply these cues or they become distorted, they can create impossible figures that appear to have depth, yet are not physically possible.

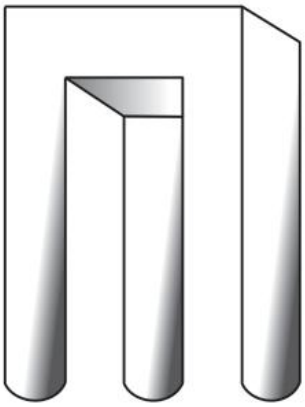


FIGURE 9.11 The impossible three-pronged widget

9.3 CHECK YOUR UNDERSTANDING >>

1 In the Ponzo illusion we perceive the line in the narrower section of the converging lines to be longer because of the influence of which two depth perception principles?
   - A Height in the visual field and proximity
   - B Linear perspective and height in the visual field
   - C Linear perspective and retinal disparity
   - D Retinal disparity and relative size

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2 Which is the best definition of an ambiguous figure?
   A A stimulus that cannot be organised into a meaningful perception because it does not exist in reality
   B A stimulus that causes us to maintain shape constancy at the expense of size constancy
   C A stimulus that can be interpreted in more than one way
   D A stimulus that confuses our use of depth cues

3 In the Moon illusion, the Moon appears _____ when near the horizon than when overhead.
   A larger
   B smaller
   C no different in size
   D None of the above

4 Figure 9.12 can be perceived as either a white vase on a black background or two black profiles of people on a white background. This is an example of:
   A a visual illusion.
   B an impossible figure.
   C an ambiguous figure.
   D a perceptual error.



FIGURE 9.12

5 Explain the Moon illusion in terms of the apparent-distance theory.

The motion after-effect

Have you ever had the experience of watching a moving scene, such as a waterfall, and then perceived a static object you looked at afterwards as moving in the opposite direction? This particular phenomenon is often called the waterfall illusion; however, in psychological terms it is known as the motion after-effect.

One explanation for the motion after-effect is that the neurons in the visual cortex that fire in response to the motion become fatigued over time. When you stare at a moving object, these cells signal movement in one particular direction. When you shift your attention to something else, these neurons fail to fire. However, as neurons that signal movement in the opposite direction are now generally more active than those that are fatigued, your brain interprets that as movement in the opposite direction. To experience the motion after-effect, stare at the moving wheel of a car or a bicycle for a few seconds. Then look away for a few seconds and look at another non-moving wheel – it will appear to be turning in the opposite direction.



FIGURE 9.13 The waterfall illusion is an example of motion after-effect.

Change blindness and inattentional blindness

A popular joke on TV sitcoms in past and present eras is the gender-stereotyping situation where a woman comes home with a new haircut or wearing a new outfit, and her husband does not notice. The woman then makes more extreme changes to her appearance in an effort to be noticed. Her husband still does not notice. This is known as change blindness – a form of perceptual blindness that occurs when we fail to notice large changes in a visual scene. This failure to notice is usually because the changes occur at the same time as a disruption to our vision and, in particular, a disruption to our attention.

impossible figure A figure whose features cannot be organised into a stable, consistent or meaningful perception because they cannot exist in reality, even though they appear to do so

motion after-effect A perceptual anomaly experienced after viewing a moving object for a period of time and then viewing a static object – the static object appears to move in the opposite direction to the original moving stimulus

change blindness A perceptual anomaly or form of perceptual blindness involving a failure to notice large changes in a visual scene

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This disruption most commonly involves moving the eyes. For example, if you travel a familiar route to school each day, it may take you several days before you notice that a large tree has been removed or a house has been painted a different colour.

In order to detect a change, we must have two visual images held in our memory so we can compare them. If the change occurs in an object that is not important to us, it is likely we have not stored its image in our memory, or we have only stored part of it, so a comparison is not easily made. We may be aware that a change has occurred but cannot identify exactly what it is.

Change blindness can be a serious limitation. For example, when driving long distances, any interruption to our visual attention may mean we fail to notice changed driving conditions, which could have serious consequences. This is just as serious a problem for a VCE student when proofreading a piece of writing – how often have you missed the most obvious errors?

Closely related to change blindness is the concept of inattentional blindness, which is the failure to notice an unexpected object that is fully visible in the environment because attention was not focused on it. One famous demonstration of this was carried out by Dan Simons and Chris Chabris in 1999. An audience was shown a video of a group of young people passing a basketball to each other. Before viewing the film, the audience was instructed to count the number of passes and report back at the end of the film. In the film, as the ball was being passed, a person dressed in a gorilla suit walked into the middle of the scene, waved at the camera and walked off (see Figure 9.14). When the audience reported back at the end of the film, approximately half of them did not report having seen the gorilla.

It would seem that those people were distracted by the counting task and therefore failed to attend to the gorilla. Even when prompted, those participants said they did not recall seeing the gorilla. However, we know that they must have seen the gorilla – the image was there, so it must have reached the retina in the back of their eyes and travelled to the brain's visual cortex.



IMAGES PROVIDED BY DANIEL SIMONS. WWW.THEINVISIBLEGORILLA.COM

FIGURE 9.14 Many people watching this video, who were focused on counting the number of times the basketball was passed, failed to notice the person in the gorilla suit.

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9.1 FOCUS ON RESEARCH

THE CHANGE BLINDNESS EXPERIMENT

Inattentional blindness is one of two perceptual phenomena that have begun to change scientists' views of visual perception. In the 1970s, researchers began to recognise a phenomenon called 'change blindness', finding that people often fail to detect change in their visual field, as long as the change occurs during an eye movement or when a person's view is otherwise interrupted. Such findings have spurred debates about how – and indeed, whether – the brain stores and integrates visual information.

In a classic experiment to demonstrate change blindness, Simons and Levin (1998) asked a confederate (person A) to approach people with the pretence of asking directions. When the unsuspecting participant began to give directions, Simons and Levin had another pair of confederates walk rudely between them and person A carrying a door. Person A used the shield provided by the door to sneak off, and another experimental confederate, person B, took their place. The research measure is whether the person giving directions noticed that they were now giving them to a totally different person. Amazingly, slightly less than half of the people approached noticed the switch.

This research confirms how narrow our perception of the world around us is. As with our visual blindspots, we think we capture a full-spectrum high-resolution image of the world, but actually we only sample a very limited slice, and our perceptual machinery fills in the gaps.

QUESTIONS

1. What was the aim of this experiment?
2. Create a hypothesis for this experiment.
3. Identify the independent variable (IV) and dependent variable (DV) for this experiment.
4. What conclusion(s) can be drawn?
5. Identify and explain two ethical principles the researchers would need to follow.

9.4 CHECK YOUR UNDERSTANDING >>

1. Which is the best definition of a perceptual anomaly?
   - A A visual illusion
   - B A perceptual hallucination caused by a deviation from normal mental processes that give meaning to stimuli
   - C A perceptual irregularity caused by a deviation from normal mental processes that give meaning to stimuli
   - D A perceptual confusion caused by sensory overload
2. What limitation of our perceptual processes does motion after-effect demonstrate?
   - A Neurons in the brain that are specialised to receive sensory input are limited when that input is continuous or unchanging.
   - B Neurons become fatigued over time.
   - C A failure of selective attention
   - D None of the above
3. Which is the best example of change blindness?
   - A You can't remember what colour shirt your best friend was wearing on the weekend.
   - B You don't notice that your teacher has had a haircut since yesterday.
   - C You realise that a noisy machine has stopped but don't remember it starting.
   - D You are absorbed in reading a book and don't notice that the room has gone dark.
4. Explain the difference between inattentional blindness and change blindness.
5. What is the motion after-effect?

FALLIBILITY OF TASTE PERCEPTION

Like all forms of perception, the perception of taste – or how we perceive flavour – has a biological basis. Taste buds help us identify the type of taste a food has so we know whether the food is sweet, salty, sour, bitter or savoury (umami). As we noted in Chapter 8, when the chemical molecules in food come in contact with taste buds, the sensation of taste is activated and the taste buds send signals to the brain about the type of taste being sensed. In most cases, largely because of our prior experience with the food type, our brain correctly perceives the taste. Sometimes, however, mistakes can be made. In other words, our perception of food can be fallible. A number of factors may contribute to an incorrect taste perception. These factors include perceptual set, colour intensity and texture.

THE EFFECTS OF PERCEPTUAL SET AND CONTEXT ON TASTE PERCEPTION

Contextual factors associated with a food, including the colour of cutlery, crockery or tableware, also influence taste perception. In 2013, *Scientific American* reported on an experiment where 57 participants were given hot chocolate in red, orange, white and cream-coloured cups. After drinking the chocolate, they were asked to rate the sweetness, aroma, flavour and overall

inattentional blindness
A perceptual anomaly involving the failure to notice an object that is fully visible in the environment, because attention was not focused on it

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likeability of each cup. The results showed that hot chocolate in the orange cup was rated more likable and 'chocolatey' than the others – even though each cup had the same hot chocolate (Intagliata, 2013).

Oxford University researchers tested the influence of weight, colour and shape of cutlery on taste. They found that when the weight of the cutlery conformed to expectations, this impacted on perceptions of the food's taste. For example, participants in their study rated food as tasting sweeter if it was eaten with small spoons. Colour contrast was also an important factor in their perceptions – white yoghurt eaten from a white spoon was rated sweeter than white yoghurt tasted from a black spoon (Figure 9.15). Similarly, when testers were offered cheese on a knife, spoon, fork or toothpick, they reported that the cheese from a knife tasted saltiest. On the basis of these responses, the researchers concluded that size, colour and weight of cutlery all have an effect on flavour perception (Briggs, 2013).

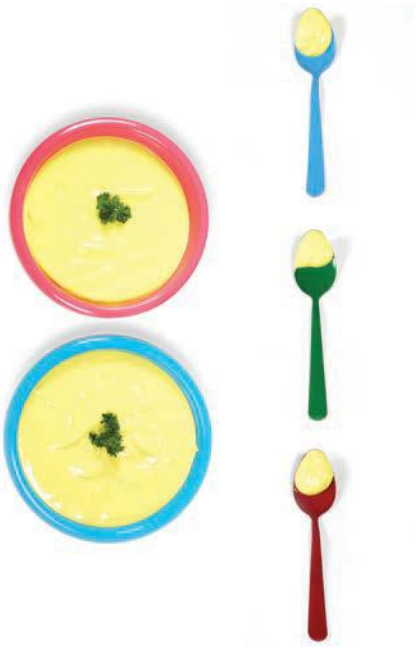


FIGURE 9.15 Taste perception is influenced by a range of contextual factors, such as the size and colour of the cutlery used when eating.

A similar Oxford University study also found that plate shape and plate colour interact to influence taste perceptions so much that food presented on a round white plate will be perceived as sweeter (Figure 9.16). For example, cheesecake presented on a white plate is perceived as sweeter than cheesecake on a black plate. In addition, when compared to round black and square white plates, intensity ratings for sweetness were significantly higher for round white plates (Stewart & Goss, 2013).



FIGURE 9.16 Plate shape and colour influence perception of a food's taste.

Psychologists suggest that shapes act as symbols of the things we desire, therefore they are linked to pleasure. Because of this subconscious association, the shape of the plate the food is presented on influences our choice and may affect our perception of flavour (Spence & Ngo, 2012).

The suggestion that the shape of the food itself affects the perception of the food's taste has also been demonstrated. In 2012 when chocolate manufacturer Cadbury changed the shape of its Dairy Milk bars, it received a mass of online complaints about changes to its recipe. Even though the recipe remained the same, the change in the shape of the chocolate bar was enough to change consumer perception of its taste (Spence, 2013).

It would appear that there is a strong link between rounded edges and sweet flavours. So, if you want people to perceive food as sweeter, have them eat it in a room with lots of curves and no sharp edges. Also make sure that your plates, glasses and other items of tableware are rounded.

THE IMPACT OF VISUAL CUES: DO YOU EAT WITH YOUR EYES?

For many years scientists adopted the view that the tongue, nose and brain dominated how people experience the flavours of food. Scientists argued that our perception of a food was based on intrinsic cues,

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or the characteristics inherent in the food itself, such as fat and salt content, colour and freshness. This view has now been revised to include the effect of extrinsic cues, or characteristics that are external to the food such as packaging, country of origin, crockery and cutlery. Throughout our life, we have learned to associate certain foods with specific qualities such as taste, colour, intensity and texture. These previous food experiences set up an expectation of what a new food should taste like, which influences our judgment of the quality and taste of that food (Stillman, 1993).

Why is colour important?

Visual stimuli create the initial desire for a product and trigger emotions that shape decisions on purchase or consumption. The appearance also impacts on the perception of the products during consumption. For example, at the most basic level, having a correct colour helps identify its flavour. More intense colourings often result in a stronger flavour response.

The effect of colour

As humans, we rely heavily on visual information to perceive the world around us. At the sight of food, our eyes send signals to the brain to interpret what we see, and these signals arrive before the information sent from our taste buds arrives. This visual information is registered and initially processed in the visual cortex, but it is also shared with other areas of the brain, including areas involved in taste perception. To form a perception of taste, our brain integrates information about the food's aroma and memories of tastes from the past. As a result, we often form a perception of the taste and flavour of a food or beverage before we eat or drink.

When looking at food, the first characteristic we tend to notice is colour. Because of our past experiences, we have learned to associate certain colours with various types of food, and we equate these colours with the food's other sensory qualities. For example, because blue doesn't exist in any significant quantity as a natural food colour, we don't have an automatic appetite response to blue or purple. Furthermore, because blue, black and purple are often warning signs of potentially poisonous or rotten foods, we tend to have a negative perception of foods of these colours (Figure 9.17). Whether an apple is red or green leads us to expect a certain degree of ripeness and, often, quite specific levels of sweetness and acidity. Adding red colouring to a sweet solution tends to increase the solution's perceived sweetness, while the addition of any colour to a solution containing an odour increases how intense we perceive that odour to be repulsive (Zellner & Kautz, 1990). So, if you want to trick someone into believing a food is sweet and pleasant to the taste, dye it red. If you want them to perceive the food as bitter or unpleasant, try dying it blue.



FIGURE 9.17 We often make judgments about a food based on its colour.

To test the perceptual effect of colour on taste perception, marketing pioneer Louis Cheskin manipulated the colour of soft drink and then asked consumers to describe the drink's flavour. Cheskin reported that adding 15 per cent more yellow to green cans of the soft drink 7 Up caused consumers to perceive the soft drink as having a more intense citrus flavour (Cheskin, 1957). In a similar experiment in 1973, participants were served a plate of steak, french fries and peas in a room installed with special lighting that obscured the actual colour of the food. Under this lighting effect, participants thought the food tasted normal. However, once the lighting was returned to normal, they saw that the steak was dyed blue, the french fries green and the peas red. On seeing this, many of the subjects lost their appetite and some became ill (Wheatley, 1973).

intrinsic cues (for food) Any physical characteristics inherent in a (food) stimulus

extrinsic cues (for food) Any characteristics that are external to a (food) stimulus but are associated with the stimulus

In another classic experiment to test whether a change in colour affected the perception of taste, French researchers used an odourless dye to colour white wine red and asked a panel of wine experts to describe its taste. Their descriptions consisted of terms typically associated with red wine rather than those used for white wine. The researchers concluded that colour played a significant role in the way the wine was perceived (Small, 2008).

The role colour plays in our perception of taste has long been researched by food companies who want to influence the perception of their products. Food manufacturers know that if they manipulate the colour of their product, they can influence customer perception of how products will taste. A not so successful example of this occurred in 1992, when the makers of the soft drink Pepsi introduced Crystal Pepsi, a soda drink that had no caffeine and was clear instead of brown in colour. Consumers complained that Crystal Pepsi was the wrong colour for soda and that the drink tasted like lemon and lime, the colour of clear sodas. Because of the very poor sales, Crystal Pepsi was pulled from the shelves after only a couple of months (Hill, 2011).

The way food looks on a plate also has a lot to do with the judgments we make about the food and how much we enjoy it. Researchers have demonstrated that a variety of visual factors, such as the colour and balance of the food on a plate, can influence a diner's perception of, and response to, food. This is the reason why chefs and restaurants put so much time and effort into presentation. In one experiment to test this effect, researchers presented participants with a salad in three different ways: simple (all salad ingredients tossed together), artistic (arranged to look like a painting), and neat (organised in a neat but non-artistic manner). Participants were asked to answer two questionnaires, one presented before eating the salads and the other after, to evaluate their expectations and actual sensory experiences.

Before eating the salad, the art-inspired presentation was rated as more artistic, more complex and more liked than the other presentations. The participants were also willing to pay more for the art-inspired salad and, after eating it, they rated its tastiness as higher than the other two salads. Interestingly, after consumption, the results revealed higher tastiness ratings for the art-inspired salad. The researchers concluded that the visual display of a food influences both a person's expectations and their experience of the food (Michel, Velasco, Gatti, & Spence, 2014).



SHUTTERSTOCK.COM/PINKYONE



SHUTTERSTOCK.COM/R. ASHRAFOV

FIGURE 9.18 A study has shown that restaurant patrons are willing to pay more for art-inspired salad than for tossed salad, and believe it tastes better.

The impact of packaging

Food marketers have long understood the power of extrinsic cues on our decisions to buy a product. They rely on emotional triggers and sensory cues in packaging design to attract buyers and create a bond with the product. They understand that if the food and the packaging are satisfying to the buyer, they will continue to purchase the product. Consumer research has shown that consumers transfer their perception of packaging to the product it contains. When we see the packaging, we receive visual cues about the food, so the type of memory and emotional response triggered by these cues will be transferred to the product itself.

In one experiment, preschool children were asked to taste identical foods in packaging from McDonald's and in matched but unbranded packaging, and to indicate if they tasted the same or if one tasted better. The results found that children stated a preference for the McDonald's-branded food and drink over the unbranded

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food and drink, even though the unbranded items were identical. The results also showed a strong preference for food and drink that displayed the McDonald's brand, regardless of whether or not the food or drink was actually marketed by McDonald's: in this case, the children reported that even carrots and plain milk, which are not sold by McDonald's, tasted better if they thought they were from McDonald's (Robinson et al., 2007).

The impact of texture

Food scientists know that texture, or the way a food or drink feels in the mouth (known as mouthfeel) affects the expectation we have of a food and influences how we perceive a food or beverage. They know that by manipulating the amount of fat, salt or sugar, they can change the texture of a food or drink, thereby influencing chewing behaviour, salivation and how we view the level of sweetness or saltiness. For example, some studies suggest that a thicker drink will be perceived as having lower sweetness or flavour intensity. In addition, whether a food is crisp, chewy, soft, firm, creamy, crunchy or smooth influences how we perceive the food's flavour.

9.5 CHECK YOUR UNDERSTANDING >>

1 Which statement about taste is false?
   - A Changing the colour of a food can alter the perception of its flavour.
   - B Changing the background music in a restaurant can alter customers' perception of how flavoursome their meal is.
   - C Research suggests that there is a strong perceptual link between rounded edges and salty flavours.
   - D Food packaging affects our perception of the food's taste.

2 If a red dye is added to a food:
   - A it changes our perception of the food because it changes the food's texture and mouthfeel.
   - B we tend to perceive the food as sweeter.
   - C we tend to perceive the food as saltier.
   - D it has no effect on taste perception.

3 Which of the following colours is most commonly associated with bitter or spoiled food?
   - A Green
   - B Red
   - C Blue
   - D White

4 Explain two ways visual cues arising from a food's colour help us to survive.

5 What is the difference between an intrinsic food cue and an extrinsic food cue? Provide an example for each cue type.

9.2 TRY IT YOURSELF >>

CAN YOUR EYES FOOL YOUR TASTE BUDS?

Ask three friends if they will help you in a food-tasting experiment. Assure them that you will not ask them to taste anything unpleasant or harmful.

MATERIALS

- A bottle of apple juice
- Red and green food colouring
- Nine small, clear plastic cups
- Paper and pencil

WHAT TO DO

In an area where your friends cannot see you:

- half-fill nine cups of apple juice
- put a few drops of red food colouring in three cups and a few drops of green food colouring into another three cups, and leave the remaining three cups without food colouring.

Then:

- Place one cup of red juice, one cup of green juice and one cup of normal juice in front of each friend.
- Ask your friends to taste the red juice and tell you what flavour it is. Record their answer.
- Repeat the above step with the green juice and the normal juice.

Did the colour of the juice affect your friends' perception of flavour? Did they mistakenly identify the flavours? What does this suggest about the effect of a food's colour on our perception of taste?

9.2 FOCUS ON RESEARCH

DON'T LIKE THE FOOD? TRY PAYING MORE

Customers paying more at a restaurant buffet perceive the food as tastier than the same food offered at a lower price, suggesting taste perception can be manipulated by price alone. Researchers in nutrition, economics and consumer behaviour often assume that taste is a given – a person naturally either likes or dislikes a food. But a new study suggests taste perception, as well as feelings of overeating and guilt, can be manipulated by price alone. 'We were fascinated to find that pricing has little impact on how much one eats, but a huge impact on how you interpret the experience,' said Brian Wansink, a professor at the Dyson School of Applied Economics and Management at Cornell University who oversaw the research. 'Simply cutting the price of food at a restaurant dramatically affects how customers evaluate and appreciate the food.'

→

mouthfeel The way a food or drink feels in the mouth

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The researchers teamed up with a high-quality Italian buffet in New York to study how pricing affects customers' perceptions. They presented 139 diners with a menu that offered an all-you-can-eat buffet priced at either $4 or $8. Customers were then asked to evaluate the food and the restaurant and rate their first, middle and last taste of the food on a nine-point scale.

Those who paid $8 for the buffet reported enjoying their food on average 11 per cent more than those who paid $4, though the two groups ate the same amount of food overall. People who paid the lower price also more often reported feeling like they had overeaten, felt more guilt about the meal, and reported liking the food less and less throughout the course of the meal.

'We were surprised by the striking pattern we saw,' said one of the researchers. 'If the food is there, you are going to eat it, but the pricing very much affects how you are going to feel about your meal and how you will evaluate the restaurant.'

The researchers said the results could offer lessons about how to optimise a restaurant experience. 'If you're a consumer and want to eat at a buffet, the best thing to do is eat at the most expensive buffet you can afford. You won't eat more, but you'll have a better experience overall,' said Wansink.

The study fits within a constellation of other work by Wansink and others offering insights about how health behaviours can be manipulated by small changes, such as putting the healthiest foods first in a display or using a smaller dinner plate.

Source: Adapted from Federation of American Societies for Experimental Biology (FASEB). (2014, April 29). Don't like the food? Try paying more. *ScienceDaily*.

QUESTIONS

1. Identify the aim of the study.
2. Identify the independent variable (IV) and the dependent variable (IV) in the study.
3. Create a hypothesis for the study.
4. Identify two extraneous variables that may have affected the results.
5. Describe how these extraneous variables could be controlled.

SYNAESTHESIA: CAN I SEE WHAT I HEAR OR TASTE WHAT I SEE?

WHAT IS SYNAESTHESIA?

Do you see colours when you hear music? When you hear specific sounds, do they have a unique odour or taste? If you do, then you would be experiencing an unusual perceptual condition known as synaesthesia. The word synaesthesia comes from two Greek words, *syn* (together) and *aisthesis* (perception). Therefore, synaesthesia literally means 'joined perception'.

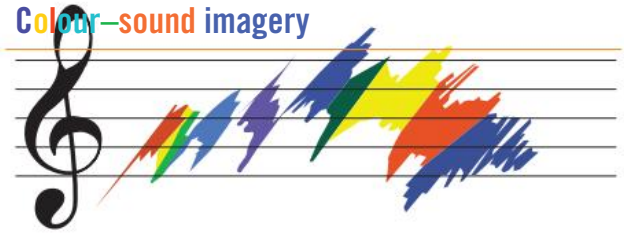


FIGURE 9.19 For people with synaesthesia, information taken in by one sense triggers a sensation associated with a different sense. For example, in one form of synaesthesia, musical notes evoke the experience of specific colours.

Some people experience a form of sensory 'crossover', where information taken in by one of their senses is experienced in a way normally associated with another sense (see Figure 9.22). Sounds, for example, can be experienced as tastes or colour (Figure 9.20); tastes and smells can be experienced as sounds or associated with visual input. Recent studies have estimated that synaesthesia occurs in one in 2000 people (Baron-Cohen et al., 1996). Synaesthesia is an involuntary condition that is usually present from birth. People with synaesthesia usually have the condition for life and the trigger for their synaesthetic experience usually always evokes a vivid and highly consistent perceptual experience.

In 1880, English scientist and explorer Sir Francis Galton reported the first case of synaesthesia. Galton noticed that some people who were otherwise completely normal, seemed to have a certain peculiarity: one sensory stimulus caused them to experience a number of different sensory responses. For example, on hearing musical notes they saw distinct colours; F-sharp might be red and C-sharp might be blue. Or the printed number 5 always 'looks' green, whereas 2 looks red (Ramachandran & Hubbard, 2003).



FIGURE 9.20 People with synaesthesia may visualise sounds as a specific colour.

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Generally, however, synaesthesia was largely dismissed as a phantom condition, and it is only relatively recently that it has been accepted as a genuine neurological condition. This acceptance is mostly due to the application of brain imaging techniques such as PET and fMRI, which have provided evidence that sensory cross-activation in the brains of synaesthetes occurs. For example, activation of brain regions associated with visual perception was observed in blindfolded synaesthetes listening to words that evoked visual experiences. These activations were shown to be clearly different from those evoked in either non-synaesthetes or the same synaesthetes listening to tones that did not induce visual experiences. Activation of areas strongly associated with the perception of colour was also observed in a group of word–colour synaesthetes. This was not observed in non-synaesthetes, even after they were trained to associate pairings of words with colours (Mulvenna & Walsh, 2005).

During normal everyday conversations, people often use metaphors that are synaesthetic; that is, they describe one sensory experience with vocabulary best suited to another. This includes descriptions such as cool colours, loud wallpaper, bitter cold, sweet silence, a sour facial expression, an icy stare, hot (attractive) people and a rough (bad) day. When we hear these descriptions, they help us visualise what people are talking about, but this does not mean we are synaesthetic.

Professor Vilayanur Ramachandran, director of the Centre for Brain and Cognition at the University of California, suggests that synaesthesia plays a role in how most people use language. His studies into synaesthesia involved presenting participants with a two-letter alphabet consisting of one round-shaped letter and the other letter resembling a pointed star (see Figure 9.21). Participants were asked which letter might be called 'booba' and which letter called 'kiki'. His results showed that 99 per cent of people select 'booba' for the round letter and 'kiki' for the star-shaped letter. Ramachandran concluded that this is because the mouth assumes a rounded contour when saying 'booba' so it mimics the round contour of the letter; and 'kiki', in contrast, has a sharp verbal edge to it that mimics the sharpness of the pointed star (Ramachandran & Hubbard, 2001).

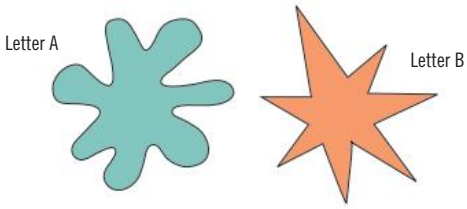


FIGURE 9.21 Most people who view the two letter shapes call letter A 'booba' and letter B 'kiki'.

COMMON CHARACTERISTICS OF SYNAESTHESIA

One of the basic characteristics of the synaesthetic experience is that it requires a trigger. Triggers can be external (such as a sound or odour) or internal (such as the thought of a number or a food) and, if the specific stimulus trigger for the synaesthetic experience is present, the experience will always occur. This means that synaesthetic perception is stable over time. For example, a synaesthete may always experience seeing yellow when they see the letter 'T', or experience the taste of strawberries when they hear middle C played on a violin.

People with synaesthesia only experience it in one direction. For example, the taste of a specific food might trigger the perception of a specific colour, but exposure to the colour doesn't trigger the perception of the taste (Ward & Mattingly, 2006).

The synaesthetic experience is unique to the individual. Although people may share the same form of synaesthesia, the experience is different for each individual. Some people's synaesthesia is specific to one sense and others may experience a combination of the senses. The experience is also vivid for the person and can be remembered clearly.

Synaesthesia is involuntary or automatic. Synaesthetes report that they cannot stop or start their synaesthesia at will, and empirical research is largely consistent with this. More recently, Baron-Cohen and colleagues (1996) found that synaesthesia is more common in females than males with a ratio of six to one. Synaesthesia also appears to be more common among artists, poets, novelists and creative people in general. One survey of Australian synaesthetes found that 24 per cent were employed in an artistic

synaesthesia A perceptual anomaly where information taken in by one sense is experienced in a way normally associated with another sense

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profession, whereas in the non-synaesthete population this applies only for 2 per cent (Rich, Bradshaw, & Mattingley, 2005). Synaesthetes are also more likely to be left-handed.



FIGURE 9.22 Synaesthetes experience a crossover of senses, so they experience information taken in by one of their senses in a way normally associated with another sense.

9.3 TRY IT YOURSELF >>

INVESTIGATING SYNAESTHESIA

Do you see specific colours when you hear some words? Do letters of the alphabet or numbers have a shape or smell? Perhaps tastes have colours and sounds and shapes? If your answer is 'Yes' to any of these, you could be a synaesthete.

To find out, take some of the many tests available online.

9.6 CHECK YOUR UNDERSTANDING >>

1 Which of the following statements about synaethesia is false?
   - A Synaesthesia is a disorder caused by a malfunction in sensation.
   - B Synaesthesia is an involuntary condition; it cannot be controlled.
   - C Neuroimaging techniques demonstrate that when synaesthetes are exposed to specific stimuli, they experience sensory cross-activation of brain areas that is different to non-synaesthetes exposed to the same stimuli.
   - D A synaesthetic response can be triggered by thinking about a specific stimulus.

2 A person may have synaesthesia if:
   - A they see things that are not linked to an external stimulus.
   - B they have a specific taste sensation every time they see the number 4.
   - C they look at a stationary object but have the sensation that the object is moving.
   - D they consistently make a perceptual error when interpreting a real external stimulus.

3 Which of the following statements about synaesthesia is true?
   - A With enough practice, a person can acquire synaesthesia.
   - B Some adult synaesthetes can control when they have a synaesthetic experience.
   - C More males than females are synaesthetes.
   - D More females than males are synaesthetes.

4 Outline three major characteristics of synaesthesia.

5 Why is synaesthesia described as a perceptual anomaly?

WHAT CAUSES SYNAESTHESIA?

Synaesthesia is not a perceptual disorder. A perceptual disorder occurs when a person has limited ability to make sense of information taken in through their sensory systems. When this happens, difficulties analysing and interpreting information arise, causing the person to have a distorted perception of the information they have sensed. People with synaesthesia do not experience a loss of ability, and the condition rarely interferes with their daily life. Indeed, most people with the condition see it as an unusual gift that provides an extra dimension to their perception of their world. Synaesthesia is a type of perceptual anomaly. Synaesthetes experience irregularities in their perceptions that cause them to experience sensations that are not consistent with a stimulus.



FIGURE 9.23 Singer-songwriter Pharrell Williams says he always visualises specific colours when he hears musical notes.

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If people with synaesthesia do not have brain damage, how can this anomaly occur? Despite considerable research, there is still no clear explanation.

Is synaesthesia innate or learned?

The experience of synaesthesia is not the same as the experience we have when we remember something. Memory involves acquiring associations between items of information, such as the word 'beach' being associated with the colour blue, the smell of sunscreen, or the sound of seagulls. Memory is based on experience and learning, but most neuroscientists believe that synaesthesia is not.

Synaesthesia appears to have a genetic basis, and almost every study of synaesthesia agrees that it seems to run in families (Ramachandran & Hubbard, 2003; Hatch, 2002; Baron-Cohen et al., 1996; Cytowic, 1995). To see if genes play a role in synaesthesia, a team led by Julian Asher of the University of Oxford took genetic samples from 196 individuals belonging to 43 families. From this group, 121 experienced auditory-visual synaesthesia, meaning they 'saw' sounds. The results showed four chromosomal regions, where gene variations seemed to be linked to the condition, suggesting that there was a genetic link to synaesthesia (Robson, 2009).

One theory suggests that synaesthesia is linked to learning during childhood, when children learn to associate numbers or letter with colours, possibly to aid memory. However, this does not explain why siblings with synaesthesia who are raised in the same or similar environments report different colours for the same trigger, or experience different variants of synaesthesia (Society for Neuroscience, 2012).

Excess neural connections: The failure to prune

As the condition is more common in childhood, one theory suggests that it is the result of the brain's failure to remove excess neurons, so adult synaesthetes simply have more of these connections than non-synaesthetes. This theory is based on the belief that we are all born with extra brain cells and synapses, and the ones that do not get used are pruned. Neuroscientists speculate that infants experience sound–vision synaesthesia in the earliest weeks of life. Later, the synaesthetic experience disappears because of the pruning of the cross-connections between the visual and auditory centres.

Another popular explanation is that synaesthetes have additional neural connections that cross over from one area of the cerebral cortex to another, particularly in brain regions that are in close proximity (Cytowic, 1993). For example, a synaesthete may experience a burst of colour or tastes as well as a sound sensation while listening to music. This explanation is disputed by some researchers, who claim it does not explain the fact that synaesthesia can occur when under the influence of some drugs or during epileptic seizures. They suggest it is more likely that the association cortex is involved (Greenfield, 2001).

Drugs and brain damage

Synaesthesia can also be caused by taking hallucinogenic drugs, such as LSD (lysergic acid diethylamide) or psilocybin. It can also be caused by brain injuries that leave one part of the brain without its normal innervation (the supply of nerves to a part of the body), causing neighbouring nerve fibres to invade the damaged area and rewiring it, but this is very rare.

9.7 CHECK YOUR UNDERSTANDING >>

1 Synaesthesia is a type of:
   - A perceptual illusion.
   - B hallucination.
   - C perceptual irregularity.
   - D perceptual error.

2 If I look at a photo of a child with a dog and I instantly visualise 'Lulu', my much loved dog from childhood, am I having a synaesthetic experience? Explain.

3 Discuss one limitation of the theory that synaesthesia is the result of childhood experiences.

4 Why is synaesthesia considered a perceptual anomaly rather than a perceptual disorder?

5 Outline the role of genetics in synaesthesia.

COMMON TYPES OF SYNAESTHESIA

Synaesthesia can manifest itself in many different forms. It can occur between any two senses, and different forms of synaesthesia can be experienced by different people. However, each individual has a unique experience of synaesthesia. We look at some of the most common forms of synaesthesia next.

perceptual disorder An impaired ability to form a perception of stimuli taken in by the senses

perceptual anomaly A perceptual irregularity due to deviation from the normal mental processes used to give meaning to stimuli

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Grapheme–colour synaesthesia: Words have colours

Grapheme–colour synaesthesia occurs when specific numbers, letters or words trigger specific colours, and it is the most common form of synaesthesia. The colour of the first letter of a word is usually the most important, but other letters can also influence the overall colour of a word. Usually, two people won't report the same colour for letters and numbers, but some studies have shown that many synaesthetes see some letters the same way, for example 'A' is likely to be red (see Figure 9.24).



FIGURE 9.24 An example of the alphabet with a grapheme–colour system

In a common test for grapheme–colour synaesthesia, the person looks at a picture with several black letters or numbers. Someone who does not have this form of synaesthesia will see black letters or numbers. However, when a grapheme–colour synaesthete scans the picture, they will see each letter or number as a specific colour (see Figure 9.25).

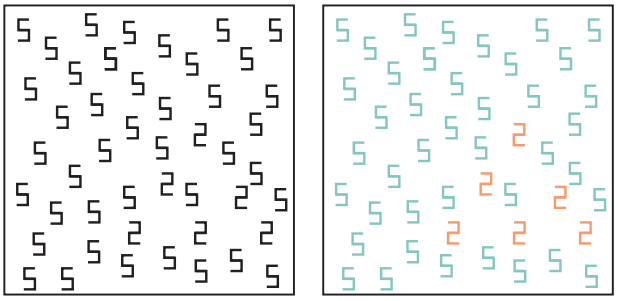


FIGURE 9.25 A common test for grapheme–colour synaesthesia

Sound-to-colour synaesthesia: Sounds have colours too

When a sound automatically triggers the visualisation of coloured, generic shapes, the person experiences sound-to-colour synaesthesia. For most people with this form of synaesthesia, their experience is triggered by specific sounds. However, for others, many different sounds might trigger their colour visualisations, but usually the perceived colours appear in generic shapes, such as squares or circles. Some people only experience sound-to-colour synaesthesia for spoken words, which are influenced by the voice's accent, pitch and intonation; others just for music.

Number-form synaesthesia: Numbers create a mental map

A number form is essentially a mental map that consists of numbers. When a person with number-form synaesthesia thinks about numbers, they automatically visualise a number map (see Figure 9.26). One theory suggests that the number forms are a product of 'cross-activation' between regions in the parietal lobe – the area of the brain involved in numerical and spatial cognition (Hubbard et al., 2005).

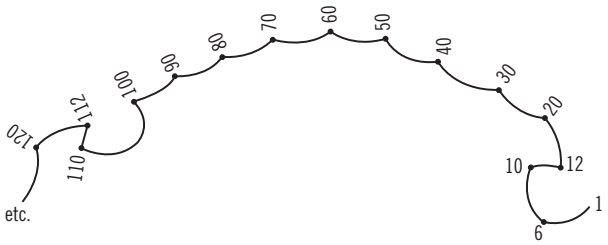


FIGURE 9.26 Number-form synaesthetes automatically visualise a number map when they think about numbers.

Personification: Some information has personality traits

People who experience this form of synaesthesia, also known as ordinal-linguistic personification or OLP, associate ordered sequences such as numbers, letters, months and days with various personalities. For example, when looking at letters, they may experience 'D' as a noisy male and 'H' as a quiet female, or when looking at a calendar they may describe March as friendly and September as nervous, or a Monday as a grumpy boy and a Saturday as a happy girl (see Figure 9.27).

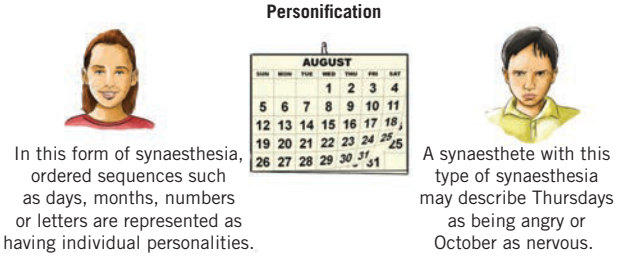


FIGURE 9.27 Some synaesthetes automatically assign personality characteristics to ordered sequences of information.

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Lexical–gustatory synaesthesia: The taste of words

People with **lexical–gustatory synaesthesia** automatically experience unique tastes when writing, speaking or hearing words (Figures 9.28 and 9.29). Some synaesthetes may even experience the sensation of temperatures or textures just hearing or writing words. For example, the word 'jail' may evoke the taste of pineapple.

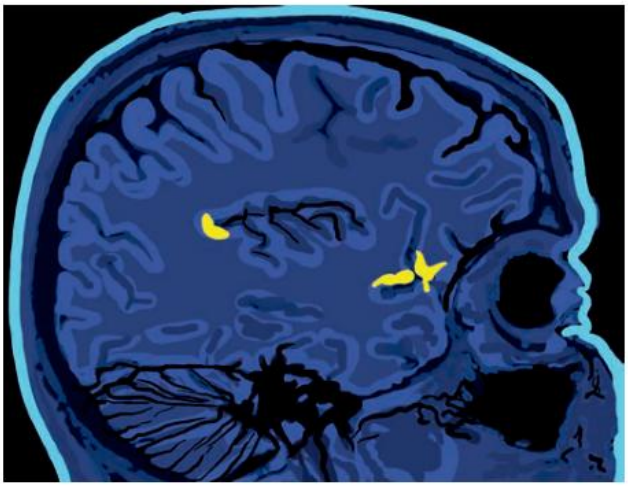
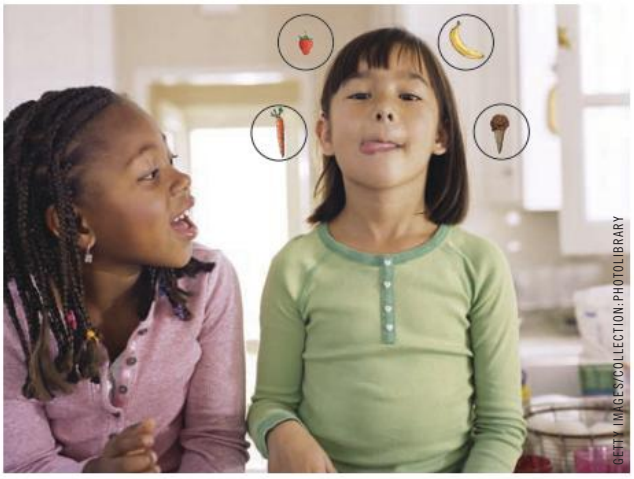


FIGURE 9.28 People with lexical–gustatory synaesthesia experience unique tastes when they hear, see or speak specific words. The left anterior insula area of the cortex, a brain area heavily involved in taste perception, is activated by words. On this reproduction of an fMRI, the activated areas are shown in yellow.



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FIGURE 9.29 Some people experience specific tastes when they hear, write or speak certain words.

9.3 FOCUS ON RESEARCH

SYNAESTHESIA: WHAT COLOUR IS THAT WORD?

What colour is the letter B? Have you ever smelled the musical note middle C? Around 10 000 Australians have the condition synaesthesia, where a sensory experience normally associated with one sensory system is interpreted as belonging to another (for example, where colours seem to have a 'taste').

Researchers Anina Rich and Dr Jason Mattingley of the Cognitive Neuroscience Laboratory at the University of Melbourne have collected the world's largest database of people with synaesthesia. In one experiment, the researchers investigated the relationship between brain activity and the synaesthetic colour experiences caused by viewing letters. This form of synaesthesia is known as grapheme–colour synaesthesia, and means that letters, words and numbers cause vivid experiences of colour.

The participants were seven grapheme–colour synaesthetes (six female; two left-handed; mean age 28 years) and seven non-synaesthetic controls. The two groups were matched on age, sex and handedness. All participants were exposed to three display conditions (see Figure 9.30):

1 chromatic letters, where the letters were displayed in a colour that matched the synaesthetic colour
2 achromatic letters, where the letters were displayed without colour
3 neutral rectangles, which were non-coloured rectangles that did not induce synaesthesia.

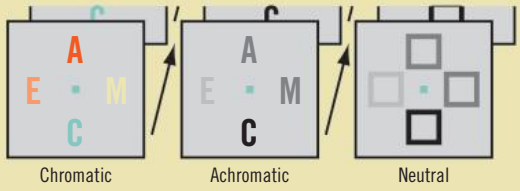


FIGURE 9.30 Example stimuli for the conditions of the synaesthetic experience experiment undertaken at the Cognitive Neuroscience Laboratory at the University of Melbourne

grapheme–colour synaesthesia A common form of synaesthesia in which numbers, letters or words trigger specific colours

sound-to-colour synaesthesia A form of synaesthesia in which sound automatically triggers the visualisation of coloured, generic shapes

number-form synaesthesia A form of synaesthesia in which a person automatically visualises a number map when they think about numbers

personification A form of synaesthesia (also known as ordinal-linguistic personification or OLP) in which ordered sequences such as numbers, letters, months or days are associated with various personalities

lexical–gustatory synaesthesia A form of synaesthesia in which people associate words (or sound) with tastes

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An MRI scanner was used to monitor and record the brain activity of each participant experiencing each condition. Results showed an obvious difference between the control and experimental groups in the type of occipital lobe activity (see Figure 9.31). This was particularly evident in the achromatic letter display, where only the synaesthetic participants showed activity in the areas of the brain thought to be involved in synaesthesia experiences.

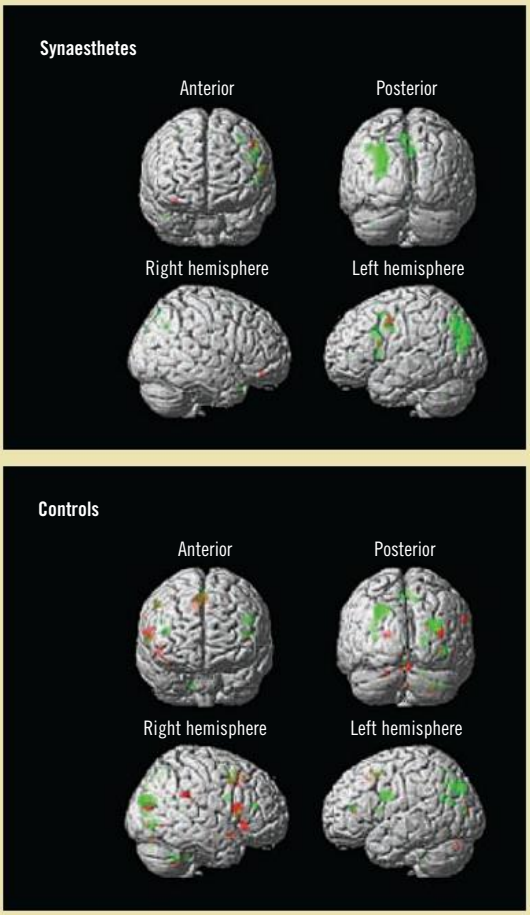


FIGURE 9.31 Synaesthesia brain activity compared with normal brain activity: chromatic – neutral (green), and achromatic – neutral (red)

QUESTIONS

1. Identify the independent variables (IVs) and dependent variables (DVs) for this study.
2. Identify the control and experimental groups.
3. The participants in the control and experimental groups were matched on age, sex and handedness. What does this indicate about the type of study design chosen?
4. Synaesthesia is relatively rare. What implications does this have for sampling procedures and for participant selection?
5. What ethical considerations are relevant to this experiment?

9.8 CHECK YOUR UNDERSTANDING >>

1. The many different forms of synaesthesia:
   - A are always experienced by people in the same way.
   - B all have a genetic basis.
   - C are all linked to memory.
   - D are all experienced in an individual way.
2. _____ is an alternative term for ordinal-linguistic synaesthesia.
   - A Sound-to-colour synaesthesia
   - B Grapheme-colour synaesthesia
   - C Lexical-gustatory synaesthesia
   - D Personification
3. Lexical–gustatory synaesthesia refers to an association between:
   - A colours and tastes.
   - B sound and tastes.
   - C numbers and tastes.
   - D words and tastes.
4. Describe two key characteristics of grapheme–colour synaesthesia.
5. For a person with sound-to-colour synaesthesia, in which two lobes of the brain would you expect to see greatest activity when exposed to a trigger for their synaesthesia?

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CHAPTER SUMMARY

Although our perception of stimuli is usually accurate, at times we make a perceptual error that causes us to incorrectly perceive a stimulus.

The fallibility of visual perception

- Visual illusions demonstrate how visual perception can be intentionally distorted. A visual illusion is a consistent perceptual error that is made when interpreting a real external stimulus.
- Visual illusions occur because the stimulus provides misleading cues and, when the brain applies its normal processes during organisation and interpretation, this misleading information causes it to make an error in perception.
- Hallucinations are not visual illusions because they concern objects or events that have no external reality.
- The Müller–Lyer illusion, Ames room illusion, Ponzo illusion and Moon illusion are all well-known visual illusions.
- The Müller–Lyer illusion is where two lines of equal length – one tipped with inward-pointing arrowheads, the other with outward-pointing arrowheads – appear to be of different lengths.
- The Ames room is an intentionally distorted room that interrupts perceptual constancies and creates the illusion of people changing size as they cross the floor from one corner to another.
- The Moon illusion is the tendency for the Moon's size to appear to change when viewing it on the horizon compared to when it is high in the sky.
- Our ability to mistakenly perceive visual stimuli is also demonstrated by ambiguous figures, impossible figures, motion after-effect and change blindness.
- An ambiguous figure is a stimulus that can be interpreted in more than one way. An impossible figure cannot be organised into a meaningful perception because it cannot exist in reality even though it appears to do so.
- Motion after-effect occurs when we view a moving object for a period of time and then view a static object – which then appears to move in the opposite direction to the original moving stimulus. Change blindness occurs when we fail to notice large changes in a visual scene, usually because they occur at the same time as a disruption to our vision, and in particular to our attention to the visual scene.

The fallibility of gustatory perception

- We can also mistakenly perceive the taste of a food or beverage. Our gustatory perception can be affected by a range of factors, including perceptual set, colour intensity and texture.
- Our past food experiences create an expectation of what a new food will taste like.

Contextual factors, including the size, shape and colour of crockery, cutlery and tableware, influence how we perceive a food.

- The colour of a food has a major impact on taste perception. Because we associate certain attributes of a food with its colour (such as freshness and flavour), manipulating a food's colour can lead to an incorrect perception of the food's taste.
- Changing the texture of a food or beverage changes how we experience it when it is in our mouth, so manipulating texture can also alter our perception of the food or beverage.

Synaesthesia

- Synaesthesia is a perceptual anomaly, not a perceptual disorder. Synaesthetes do not have limited perception. They do not have brain damage but their brain function results in unusual perception of some stimuli. Synaesthesia occurs when information taken in by one sense is experienced in a way normally associated with another sense, such as a sound being experienced as a taste.
- Synaesthesia can involve any of the senses, or a combination of the senses. It is involuntary and is triggered by specific stimuli (internal or external). Synaesthesia appears to have a genetic link. A number of theories exist that attempt to identify the cause of synaesthesia but, as yet, no definitive cause has been established.

APPLY YOUR KNOWLEDGE AND SKILLS

SECTION A: MULTIPLE-CHOICE QUESTIONS

Answer the following questions by writing the correct letter in your workbook. Only one answer is correct for each question.

1 If a man looks at da Vinci's famous *Mona Lisa* painting and says he sees worms crawling out of Mona Lisa's eyes, he is experiencing:

A an illusion.
B a hallucination.
C poor eyesight.
D synaesthesia.

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2 A perceptual anomaly is best described as:

- **A** a form of visual illusion.
- **B** a distortion in perception arising from confusing stimuli.
- **C** a misinterpretation of a stimulus.
- **D** a deviation from the normal cognitive processes that results in a perceptual irregularity.

3 The floor of the Ames room:

- **A** slants away from the viewer at the peephole.
- **B** slants towards the viewer at the peephole.
- **C** does not slant.
- **D** is rectangular in shape.

4 If we mistakenly perceive a stimulus because the stimulus gives us misleading cues, we are experiencing:

- **A** a perceptual disorder.
- **B** a hallucination.
- **C** synaesthesia.
- **D** an illusion.

5 Marissa is planning an experiment on taste perception. She intends to use random sampling to select her participants from the population of VCE students at her school. To select her sample, Marissa should:

- **A** ask every student in her Psychology class to participate.
- **B** ask all her friends at school to volunteer.
- **C** assign each VCE student a number and select every tenth one.
- **D** assign each VCE student a number, put all the numbers in a container and draw out the number of participants she needs.

6 Which one of the following constancies is not maintained in the Ames room illusion?

- **A** Size
- **B** Shape
- **C** Brightness
- **D** Orientation

7 Jack and Sunita are watching an episode of their favourite TV show when Jack notices that the actor in a scene has been replaced by someone else playing the same character. Sunita did not notice the change. This is an example of:

- **A** motion after-effect.
- **B** change blindness.
- **C** divided attention.
- **D** synaesthesia.

8 Which of the following is an example of an extrinsic cue that could affect taste perception?

- **A** Temperature
- **B** Texture
- **C** Fat content
- **D** Packaging

9 When we look at food, we tend to notice its _____ first.

- **A** colour
- **B** texture
- **C** shape
- **D** size

10 Food research indicates that if we taste a food or drink that feels thin in our mouth, we will usually rate it as _____ than a food or drink that feels thick in our mouth.

- **A** being less sweet
- **B** having the same level of sweetness
- **C** sweeter
- **D** saltier

11 A synaesthete hears the word 'Monday' and always experiences the taste of onions. This experience is known as:

- **A** personification.
- **B** grapheme–colour synaesthesia.
- **C** lexical–gustatory synaesthesia.
- **D** number-form synaesthesia.

12 After viewing a moving visual stimulus for a period of time, our neurons adapt to the movement and when we look at a stationary object we may still see movement. This is known as:

- **A** motion after-effect.
- **B** change blindness.
- **C** synaesthesia.
- **D** movement detection.

13 Synaesthesia refers to:

- **A** one sense inducing an experience in another sense.
- **B** the process by which stimuli are transmitted to the brain's cortex.
- **C** seeing the colour green after staring at the colour red.
- **D** an inability to correctly perceive stimuli.

14 _____ is the most common form of synaesthesia.

- **A** Personification
- **B** Grapheme–colour synaesthesia
- **C** Lexical–gustatory synaesthesia
- **D** Number-form synaesthesia

15 If we taste lemons every time we see the word 'dog', we are experiencing:

- **A** personification.
- **B** grapheme–colour synaesthesia.
- **C** lexical–gustatory synaesthesia.
- **D** taste-form synaesthesia.

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SECTION B: SHORT-ANSWER QUESTIONS

1 Describe the Müller–Lyer illusion. Explain why it is an illusion in terms of the apparent-distance hypothesis.

2 What is the Moon illusion?

3 What is change blindness? Provide an example to support your answer.

4 Explain how the pictorial depth cue of linear perspective helps create the Ponzo illusion.

5 Explain the difference between an ambiguous figure and an impossible figure.

6 Give one reason why the shape of a plate may alter the perception of the taste of the food served on the plate.

7 What is the difference between a perceptual disorder and a perceptual anomaly?

8 What is synaesthesia?

9 Outline one theory that attempts to explain synaesthesia.

10 Why is synaesthesia considered to be a perceptual anomaly and not a perceptual disorder?

SECTION C: EXTENDED-RESPONSE QUESTION

Neuroscientists interested in determining whether the brains of synaesthetes were more sensitive to stimuli than non-synaesthetes used transcranial magnetic stimulation (TMS), a non-invasive brain stimulation technique, to activate neurons in the primary visual cortex of participants. The researchers measured the level of stimulation necessary for participants to experience streaks of light in their vision. The group of 10 volunteers consisted of five grapheme–colour synaesthetes and five people who did not have any form of synaesthesia.

The results showed that all grapheme–colour synaesthetes only needed tiny amounts of stimulation to activate neurons in their primary visual cortex compared to those without synaesthesia. The same test on the participants' motor cortex showed no difference between the groups.

The research team suggests that grapheme–colour synaesthetes have a lower absolute threshold for stimuli than non-synaesthetes. Therefore, the brain areas responsible for processing visual stimuli may be more sensitive or excitable for grapheme–colour synaesthetes.

As part of this research team preparing the report on this investigation, you are required to do the following:

- Identify your aim and population of interest.
- Write an operational hypothesis for this study.
- Identify the sampling procedure and type of research design used.
- Identify how you would apply the following ethical principles: informed consent, confidentiality and debriefing.

This question is worth 10 marks.

SECTION D: ASSESSMENT TASK

REPORT OF A PRACTICAL INVESTIGATION

You are required to conduct and write a report on an experiment that tests the relationship between the sense of smell (olfaction) and the sense of taste (gustation). You will need five volunteers for this experiment.

MATERIALS

- Two apples
- A bottle of vanilla extract
- Some cotton balls
- Pen and paper

INSTRUCTIONS

- Peel the apples and cut them into 10 pieces.
- Ask each participant to eat a piece of the apple and describe how it tastes. For example, whether it is tart, sweet or tangy. Record their answer.
- Now add several drops of vanilla extract to the cotton ball.
- Hold the cotton ball near, but not touching, your participant's nose as they eat a second piece of the apple. Encourage them to continue to smell the cotton ball while they chew. Ask them to describe how it tastes. Record their answer.
- Analyse the results and draft your report under the following headings:

➜ *Title*: Compose a statement that says what your experiment is about.

➜ *Aim*: What did you want to determine?

➜ *Hypothesis*: Create a hypothesis for this experiment – include your population and identify the independent and dependent variables.

➜ *Method*: Include the participants, procedure and materials.

➜ *Results*: Describe your data.

➜ *Discussion*: Explain whether the hypothesis was supported or refuted by the results. Identify any extraneous variables and how they could be controlled in the future. State your conclusion(s). State whether the results can be generalised.

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CHAPTER 10

SOCIAL COGNITION

KEY KNOWLEDGE INCLUDES:

- the role of person perception, attributions, attitudes and stereotypes in interpreting, analysing, remembering and using information about the social world
- the applications and limitations of the tri-component model of attitudes
- attitudes and stereotypes that may lead to prejudice and discrimination.

Psychology Area of Study Key knowledge points derived from *VCE Psychology Study Design 2016*, p. 21; © The Victorian Curriculum and Assessment Authority (VCAA). Used with permission.



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HOW WE MAKE SENSE OF THE SOCIAL WORLD WE LIVE IN

Social psychology is a branch of psychology interested in the way individuals' thoughts, feelings and behaviours are influenced by others. This chapter will focus on social cognition in particular, which involves the way people process, retain and apply information about others and social situations. A person's social cognition and behaviour influence the way they view themselves and the way they relate to others. Imagine that you are at a job interview, for example. Some of the thoughts going through your mind might be about the impression and the signals that you are sending to the interviewer; you would also be thinking about interpreting the signals given by the interviewer. How do you know whether the interview is going well (Figure 10.1)? How do you form an impression of this person? We have to process social information like this every day.



FIGURE 10.1 How do you know the job interview is going well?

DEVELOPING SCHEMAS

Psychologists are interested in the things that influence behaviour and the processes that individuals undertake to make sense of the behaviour of others. Even though we like to think of ourselves as being unique and individual, we often categorise others, form opinions and make judgments about them based on the schema we assign them.

A schema is an idea or concept that helps us to organise information into categories or groups and contains both abstract knowledge and specific examples about a particular social object. Some schemas we have about individual people may be highly detailed and others may contain very little information besides that person's appearance or the sound of their voice.

Developing a schema means that we often hypothesise about incoming stimuli, which includes plans for interpreting and gathering schema-related information (Taylor & Crocker, 1981). Schemas therefore give us some sense of prediction and control of the social world. They guide what we pay attention to, what we perceive, what we remember and what we infer. All schemas appear to influence the encoding of new information when we take it in and interpret the meaning of it, we use our memory to integrate old information and to make inferences about missing information (Maio & Augoustinos, 2005). The way behaviour is interpreted, analysed and remembered is due to the attributions, attitudes and stereotypes we hold. These allow us to process information quickly and form our view of the world.

PERSON PERCEPTION

Person perception is the process of forming impressions about others. Asch (1946) described person perception in terms of Gestalt principles of object perception. Gestalt principles are based on the theory that we naturally see objects as wholes, not as separate parts, and when only a part of an object is present, we automatically tend to fill in the gaps to create a representation of a whole in our minds. Asch suggested that person perception is similar to this concept, in that we may only receive a small portion of information about an individual, but in our minds we form a schema of the whole person by filling in the gaps (Gray, 1994). For instance, if we only see a photograph of an individual, we base our perception of that person primarily on what they look like, and we may make assumptions and fill in the gaps with regards to other parts, such as how we would imagine that person to behave and what they would be like if we were to speak to them.

social cognition The way people process, retain and apply information about others and social situations

schema An idea or concept used to organise information into categories or groups; contains both abstract knowledge and specific examples about a particular social object

person perception The process of forming impressions about others

Gestalt principles A group of principles that organise visual perceptual features and that integrate them into connected patterns or whole forms

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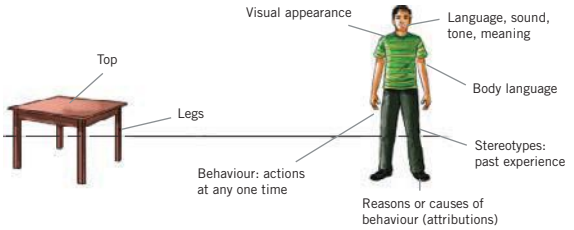


FIGURE 10.2 A table is made up of various parts, but we perceive it as a whole object. Similarly, in forming an impression about a person, we automatically 'fill in' any gaps in knowledge we have about that person in order to create a whole representation of them in our minds.

Research shows that when we meet someone for the first time, their physical appearance has an effect on the impression that we form of them, and therefore influences the schema we make about them. For example, one study showed that there was a link between the physical attractiveness of lawyers and their income. The lawyers that were more highly rated for attractiveness were those who earned between 10 and 12 per cent more in actual income (Engemann & Owyang, 2005). Many studies have replicated these results and suggest that there is a correlation between physical attractiveness and competency – the more attractive an individual, the higher paid and better job they tend to have (Collins & Zebrowitz, 1995).

Person perception, by its very nature, leads us to make judgments based on limited information, therefore it is not always accurate. For example, just because someone is attractive does not make them competent. To gauge competency, we really need more than a first impression. Competency is the ability to do something well, such as a job or study. If you were a competent student, you may be able to complete set work independently and show an understanding of the work when assessed.

Sometimes our first impressions are influenced by expectations, biases and incomplete information, among other things, and this may affect what sort of impression we form of those around us.

Research indicates that memory processes can influence the biases in person perception in a number of ways. When new information is presented to us, we tend to selectively recall facts that fit in with the schema we already hold (Fiske, 1998; Quinn, Macrae, & Bodenhausen, 2003). In a study by Cohen (1981), participants watched a video of a woman who was described as being either a waitress or a librarian.

The woman engaged in a number of activities such as listening to classical music, drinking beer and watching television. Later, when participants were asked to recall what the woman did, they tended to recall those activities that to them were consistent with the stereotype for the occupation of waitress or librarian (Figures 10.3 and 10.4). Participants who were told the woman was a waitress tended to recall her drinking beer, while those who were told she was a librarian recalled her listening to classical music (Weiten, 2007).



FIGURE 10.3 Participants who were told that the woman in the video was a librarian perceived her behaviour differently from those who were told she was a waitress.



FIGURE 10.4 Participants who were told that the woman in the video was a waitress perceived her behaviour differently from those who were told that she was a librarian.

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10.1 CHECK YOUR UNDERSTANDING >>

1 Social psychology if the study of:
   - A people's social ability.
   - B the way people's thinking, feelings and behaviour are influenced by others.
   - C the way people's behaviour is influenced by education.
   - D interviewing techniques used to get a job.

2 An idea or concept that helps us to organise information into categories or groups is called:
   - A a sensation.
   - B an attitude.
   - C a schema.
   - D a stereotype.

3 Person perception is:
   - A the process of forming impressions about others.
   - B the ideas or concepts that help us to organise information into categories or groups.
   - C not influenced by physical appearance.
   - D unbiased.

4 Describe how schemas can help us make sense of the world.

5 How do person perception and pre-existing schemas we hold influence our perception of information presented to us?

ATTRIBUTIONS

It is not possible to know everything about another person. In fact, we must form ideas about other people sometimes using only very small amounts of evidence. The impressions we make about others are influenced by the cognitive process of attribution. Attribution is the process of attaching meaning to behaviour by looking for a cause or causes to explain the behaviour. As we observe others, we tend to make inferences about their actions. Why did Mr Barry yell at Paul? Why did Voula giggle a lot when boys were around? Why does my mother ask me to unload the dishwasher in the middle of my favourite television program? In pondering questions about behaviour we see in others, we attribute people's behaviour to various causes. For example, if someone is happy, is it because that is the way they typically are (part of their personality) or because something good happened to cause the good mood, or elements of both?

When we make attributions, part of the cognitive process is to take note of the consistency of a person's behaviour. If behaviour is consistent, meaning that the same behaviour is exhibited and we observe it on a number of occasions, then it is probably how that person behaves typically. We also look for distinctiveness of behaviour when making attributions, which refers to taking note of whether the behaviour occurs only in specific circumstances. If the behaviour only occurs in some circumstances and not others, then this will change the way we attribute the cause of the behaviour.

Austro-American psychologist Fritz Heider (1958) was the first to describe how people make attributions. Heider believed that people can make two types of attributions: personal and situational. Personal attributions refer to factors within the person, such as personality characteristics, motivation, ability and effort. Situational attributions refer to factors within the environment that are external to the individual (Maio & Augoustinos, 2005). For example, if a Year 8 student went home with a smashed iPad because she dropped it in the library at school, we might consider the behaviour in terms of personal factors (such as her clumsiness or ability to take care of her property) that may have caused the behaviour. We may also look at situational attributions (such as whether the library was overcrowded or someone was fooling around with the iPad) when deciding on the reason for her behaviour. Thus, the causes of the behaviour (dropping and smashing the iPad) might be attributed to both internal and external causes (Figure 10.5). How her parents attribute the cause of the behaviour will impact on how they view their daughter. If they interpret her actions as attributable to her, their behaviour may change and they may not buy her another expensive iPad, thinking she is not responsible enough. Hence, it is clear that attributions influence how we interpret the behaviour of others, and, in turn, this affects our behaviour.

Heider suggested that we often overestimate personal factors and underestimate situational factors when looking for causes to explain behaviour.

attribution The process of attaching meaning to behaviour by looking for a cause or causes to explain the behaviour

personal attributions The factors within the person, such as personality characteristics, motivation, ability and effort that contribute to behaviour

situational attributions The factors within the environment that are external to the individual that contribute to behaviour

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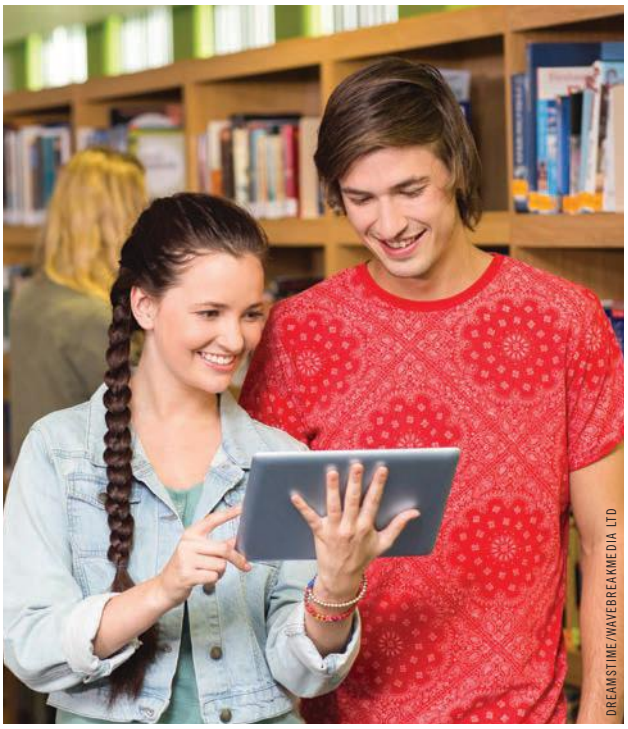


FIGURE 10.5 If this girl dropped her iPad, is the behaviour caused by personal or situational factors?

This was later called the fundamental attribution error. This can in part be accounted for by observers not being aware of many situational factors and historical considerations (events that have occurred in the past) that may influence and guide behaviour. For instance, when we view a person's behaviour, much of the time we do so without knowledge of what occurred before the behaviour and without knowledge of many of the situational factors. The historical considerations and the situation are often difficult to judge, so we rely on personal attributions. People often attribute their own behaviour inaccurately also.

When we assign attributions to people and groups, we may be unaware of how our own personal biases affect our judgment and we may unknowingly engage in defensive attribution. Defensive attribution is a cognitive process that explains the causes of an individual's misfortune by blaming the victim. In other words, we conclude that another person's behaviour and problems are somehow caused by their own personal qualities. Some psychologists suggest we do this in order to maintain our belief that we live in a just world, where we are unlikely to experience similar troubles (Lerner & Goldberg, 1999). If we engaged in defensive attribution, we may assume, for example, that a student who had their phone stolen from their locker was careless (and that we would never be so careless), or that poor people are poor because they are lazy and that's why they don't have a job or money (and we are not poor because we are not lazy).

Another bias that may influence our judgment is the self-serving bias. The self-serving bias is a tendency to, when assessing our own position, attribute our success to personal factors and our failures to situational factors that are outside our control to some degree. For example, if an individual succeeded in getting a job, they would tend to attribute the success to their personal characteristics and qualities; if they failed to get the job, they would tend to blame the situation (the interviewer asked 'stupid' questions, or they couldn't perform well because of the bad week leading up to the interview) (Weiten, 2007).

Attribution is also affected by consensus or the agreement about the behaviour by others. When many people act in the same manner, so that there is consensus in their behaviour, then we usually attribute the behaviour to an external or situational cause. For example, if thousands of people are going to support a particular football team each week, we tend to say the team must be good (external factors) (Figure 10.6). However, if one person goes to the football each week and others are staying away, the tendency is to make the inference that the person likes that team, and hence attribute the cause of the behaviour (going to the football) to personal attributions (Figure 10.7).



FIGURE 10.6 Consensus helps us to decide whether behaviour is caused by situational factors rather than personal factors if many people are displaying the behaviour.

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FIGURE 10.7 A lack of consensus means that we will often attribute behaviour to causes that are within the person because most people are not displaying the behaviour – it must be something about that person that causes that behaviour.

ATTITUDES

Attitudes are intimately woven into our actions and views of the world. Our tastes, friendships, votes, preferences and goals are all influenced by our attitudes. Attitudes are learned ideas we hold about ourselves, others, objects and experiences, and we know they play a significant part in the way people relate to each other. Attitudes are not innate; they are learned through exposure to the environment and can cause a person to respond in a positive or negative way. Attitudes summarise your evaluation of objects (Petty, Wegener, & Fabrigar, 1997). If a person positively evaluates someone or something, they will hold a positive attitude towards that person or thing. For example, a person who has a gun licence and goes hunting and shooting on the weekends probably has a positive attitude towards guns and hunting. Alternatively, it is possible to make a negative evaluation and therefore hold a negative attitude towards that person or thing. People who do not agree with guns and hunting and who do not hunt may hold a negative attitude towards guns and hunting. At times, we may lack knowledge or interest about certain things and therefore hold an ambivalent attitude towards that person or thing. Perhaps you have never really thought much about guns and hunting and don't evaluate them either positively or negatively.

Because attitudes are learned, the effects of experience, personal influence and exposure to the media need to be considered in determining the reason for the formation of an attitude. Sometimes attitudes come from direct contact (personal experience) with the object of the attitude – such as supporting special bicycle lanes on roads because you were once knocked off your bike by a car. Attitudes are also learned through interaction with others; that is, through discussion with people holding a particular attitude. For instance, if three of your friends all volunteer for an environmental organisation, and you talk to them about their beliefs, you may come to favour 'green' attitudes too.

Child rearing (parental values, beliefs and practices applied while caring for a child) also affects attitudes. For example, if both parents belong to the same political party, there is a two-out-of-three chance that their children will also belong to that party as adults. There is little doubt that many of our attitudes are influenced by our group membership; that is, our association with the people with whom we share common characteristics. For example, being a Melbourne resident will most likely cause you to view Melbourne as a better place than any other city in Australia.

Attitudes are also influenced and skilfully manipulated by the media (television, magazines, radio), which reaches large audiences. Media can have a powerful impact on the way attitudes are formed and influence behaviour.

Any attitude you hold will have an influence on the interpretation you make about others' behaviour as well as guide your own behaviour. In turn, attitudes will influence the person perception and attributions you make regarding behaviour.

fundamental attribution error Overestimating personal factors and underestimating situational factors when explaining causes of behaviour

defensive attribution A thought process that explains the causes of an individual's misfortune by blaming the victim

self-serving bias A tendency to attribute our own behavioural success to personal factors and our failures to situational factors that are outside our control

attitudes Learned ideas we hold about ourselves, others, objects and experiences

direct contact Personal experience with an object contributes to the attitude that will form as a result of the contact

child rearing The parental values, beliefs and practices that contribute to attitude formation

group membership Association with the people with whom we share common characteristics; influences the attitudes we form

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10.2 CHECK YOUR UNDERSTANDING >>

1 What are the two types of attributions?
   - A Personal and situational
   - B Personal and social
   - C Fundamental and situational
   - D Social and situational

2 An attitude is defined as:
   - A an innate idea we have about ourselves and others.
   - B a learned idea we have about ourselves, others, objects and experiences.
   - C the tendency to attribute our own success to personal factors.
   - D the process of forming impressions about others.

3 How do attributions contribute to our understanding of our own behaviour and that of others?

4 Explain the different types of attribution and give an example of each one.

5 Outline two ways a person may learn an attitude and give an example of each.

STEREOTYPES

Stereotypes are oversimplified images of people who belong to a particular group, causing them to appear more similar than they really are. Stereotyping places people in categories or schemas, based on their shared characteristics because of their membership in a particular group. An example of a stereotype is: 'People over the age of 65 are old and senile'. Stereotypes tend to simplify people by grouping them into 'us' and 'them' categories. Common stereotypes include those based on gender, age, ethnicity and occupation.

Even though stereotypes sometimes include positive traits, they can lead to prejudice, in that they are mainly an expression of a negative attitude towards a group that is used to maintain control over other people. When people have been stereotyped, the easiest thing for them to do is to abide by others' expectations – even if the expectations are demeaning. That is why no one likes to be stereotyped. Being forced into a small, distorted social 'box' by stereotyping is limiting and insulting. Stereotypes rob people of their individuality (Fiske, 1993).

Stereotyping is an automatic cognitive function that can make us more efficient when we try to make sense of our social world. Because we apply the schema automatically, this helps us to interpret information quickly. By grouping people based on their perceived similarity, we can respond appropriately to them when we don't have time to get to know them.

Using stereotypes in this way helps us to quickly identify potentially dangerous situations, so it helps our survival. Unfortunately, because we are ignoring the person's individual characteristics, any person perception, expectations or biases we have about the stereotype are transferred to the individual.

10.3 CHECK YOUR UNDERSTANDING >>

1 Which of the following statements is true about stereotypes?
   - A A stereotype can be a positive evaluation towards an object or person.
   - B A stereotype can be a negative evaluation towards an object or person.
   - C Stereotypes are always negative.
   - D Stereotypes can be limiting and insulting.

2 Stereotypes assist us in making sense of the world by:
   - A making our cognitive processes more efficient so that we can make judgments about behaviour more quickly.
   - B allowing us to interpret behaviour before we get to know someone.
   - C grouping people, because many people are exactly the same and it makes it easier.
   - D taking away individuality so people appear more similar.

3 How do stereotypes develop?

4 What purpose do stereotypes serve?

5 Explain a difficulty that stereotyping may cause when used to create schemas about the world.

10.1 TRY IT YOURSELF >>

INFLUENCES ON SOCIAL COGNITION

Create a mind map showing how social cognition is influenced by the following factors: attributions, person perception, attitudes, stereotypes and schemas. Use examples that are not in the textbook to consolidate your understanding.

THE TRI-COMPONENT MODEL OF ATTITUDES

As previously stated, attitudes are ideas we hold about ourselves, others, objects and experiences, and we know they play a significant part in the way people relate to each other. The tri-component model of attitudes proposes that there are three components that contribute to attitude formation: feelings (the affective component), actions (the behavioural component) and thoughts (the cognitive component).

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The affective component consists of feelings or emotions towards the object or person; that is, how you feel. The behavioural component refers to a person's actions towards various people, objects or institutions; that is, what you do. The cognitive component of an attitude is what a person thinks about the object or person; that is, what you believe. This is known as the ABC of attitudes. Given the complex nature of attitude formation, it can be difficult to determine the relative influences of each component.

This tri-component attitude model is applicable to many situations, such as examining factors that influence customer behaviour, determining what affects the choice of destination when you travel and identifying your choice in music.

Consider, for example, your attitude towards wearing a school uniform. You will have emotional responses to wearing a uniform, finding them either attractive and useful, or ugly and uncomfortable (the affective component). Therefore, you will have a tendency to agree or disagree with wearing a uniform and may or may not wear it properly (the behavioural component). You will have thoughts about whether wearing uniform should be compulsory or not (the cognitive component). For another example, see Figure 10.8.

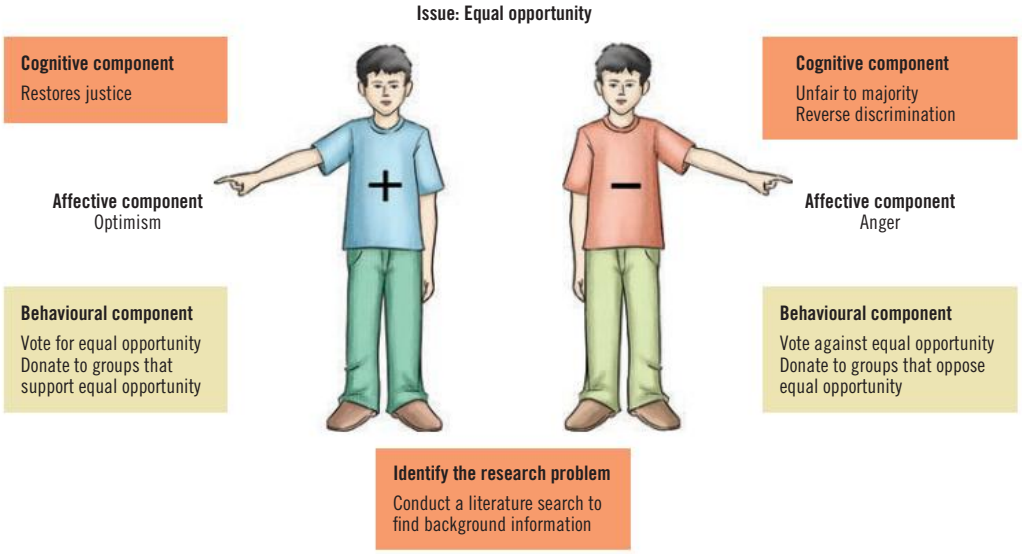


FIGURE 10.8 Positive and negative attitudes towards equal opportunity in the workplace

10.2 TRY IT YOURSELF >>

THE ABC OF ATTITUDES

Redraw the table below in your workbook. Think of four attitudes that you hold (positive, negative and ambivalent) and fill in each of the components of that attitude.

ATTITUDE	AFFECTIVE COMPONENT	BEHAVIOURAL COMPONENT	COGNITIVE COMPONENT
1			
2			
3			
4			

stereotype An oversimplified image of people who belong to a particular group, causing them to appear more similar than they are

tri-component model of attitudes Proposes that there are three components that contribute to attitude formation: feelings (the affective component), actions (the behavioural component) and thoughts (the cognitive component)

affective component Consists of feelings or emotions towards the object or person – how you feel

behavioural component Refers to a person's actions towards various people, objects or institutions – what you do

cognitive component What a person thinks about the object or person – what you believe

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LIMITATIONS OF THE TRI-COMPONENT MODEL

The tri-component model does not indicate the strength of an attitude, so it can only be used to indicate the direction of an attitude. For example, the model can indicate whether someone holds a positive or negative attitude towards something, but it does not show whether it is a strongly held view or not. This approach can be limiting because it is useful to understand the strength of an attitude. Strong attitudes are generally seen as ones that are firmly held and resistant to change; they also don't tend to change over time, therefore they have a big impact on behaviour (Olson & Maio, 2003). The tri-component model also does not indicate the accessibility of the attitude. Accessibility of the attitude, meaning how often and how quickly the attitude comes to mind, can give some indication about the strength of the attitude and so in turn can be used as a good predictor of future behaviour. If an attitude quickly comes to mind and is a strongly held view, then there is a high probability that the behaviour exhibited will follow this attitude. Psychologists attempt to use a person's attitude to predict future behaviour, and this is more possible if the strength and accessibility of the attitude can be measured.

Another major limitation of the model is that there can be a difference or clash between what a person thinks and feels and their behaviour. We look at this in more detail when we investigate cognitive dissonance. As two components of the model are psychological (thoughts and feelings), it is not possible to observe these concepts directly. Instead, we rely on observing behaviour and other indirect measurements, such as what people 'say' their attitudes are in questionnaires and interviews, to make a judgment about a person's attitude. However, someone might not be truthful when answering a questionnaire or may feel embarrassed for having particular attitudes and therefore not express them truthfully.

Finally, the tri-component model does not include an individual's ambivalence. Ambivalent attitudes may include both positive and negative feelings about an object or person. If ambivalence is high (when the ratio is equal between the positive and negative), then the attitude becomes difficult to use as a predictor of behaviour. In these circumstances, the individual is also more open to persuasive techniques to change the attitude. Consider for a moment that within a few years you will be voting in elections that affect the nation. At the moment, you may hold strong attitudes towards certain political parties, or you may be ambivalent. If you are ambivalent, political advertising and the environment you live in are more likely to have an impact in strengthening your attitude. For example, if you plan to study at university, and you learn that one political party intends to abolish university fees if they win the election, your ambivalent attitude may change.

10.4 CHECK YOUR UNDERSTANDING >>

1 The three components of an attitude are:
   - A thoughts, cognitive and affective.
   - B feelings, affective and actions.
   - C cognitive, feelings and thoughts.
   - D cognitive, affective and behavioural.

2 The measurement of attitudes is valuable to psychologists because they:
   - A can be used to predict future actions.
   - B are useful for studying academic attitude.
   - C represent unconscious and conscious cognitive interventions.
   - D predict mutual interdependence goals.

3 Donating money to Cancer Council Australia would be demonstrating which component of an attitude?
   - A Affective
   - B Behavioural
   - C Cognitive
   - D Dissonance

4 Give an example of a positive and a negative attitude that you hold towards an object or person and describe the three components that make up each attitude.

5 Outline two limitations of the tri-component model.

Cognitive dissonance theory: A limitation of the tri-component model

When a person acts in a way that is inconsistent with their attitudes or self-image, the contradiction will generally make them uncomfortable and such discomfort can motivate people to make their thoughts or attitudes align with their actions (Petty, Wegener & Fabrigar, 1997).

The explanation for this attitude-driven behaviour lies with cognitive dissonance. ('Cognitions' are thoughts; 'dissonance' means clashing.) The influential theory of cognitive dissonance states that contradicting or clashing thoughts cause mental discomfort; that is, we have a need for consistency in our thoughts, perceptions and images of ourselves (Thibodeau & Aronson, 1992; Festinger, 1957).

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For example, smokers are told on every pack that cigarettes endanger their lives, but they light up and smoke anyway (see Figure 10.9). The overwhelming medical advice is that every cigarette is doing you damage (cognitive component) and many people who smoke don't feel happy about doing it (affective component). A person who smokes could quit smoking, but it may be easier to convince themselves that smoking is not really so dangerous. To do this, many smokers seek examples of heavy smokers who have lived long lives, they spend their time with other smokers and they avoid information about the link between smoking and cancer. This eases the discomfort caused by the clashing components – by changing the cognitive and or the affective components so that they match the behavioural component.



ISTOCKPHOTO.COM/NIKOLAY KICK

FIGURE 10.9 Even with images like this one, people continue to smoke. Some will need to ease the discomfort that this information may produce by changing their cognitive and affective components to be in line with their behaviour.

According to cognitive dissonance theory, people tend to reject new information that contradicts ideas we already hold, convince ourselves that we have done the right thing, and experience dissonance after we cause an event that we wish had not taken place (Cooper & Fazio, 1984). If we were using the tri-component model to predict human behaviour, this would be a major limitation, because the three components do not match, and the behaviour is not consistent with the thoughts and feelings an individual may experience. You might believe that attending school and working hard will benefit you in the future (cognition), and you might feel happy and stimulated at school (affective); however, when your friends decide to take the day off school and go to the beach instead, you might go too (behaviour). This example shows that when cognitive dissonance occurs, the tri-component model is not an accurate predictor of behaviour.

FOCUS ON RESEARCH 10.1

A STUDY OF COGNITIVE DISSONANCE

In Festinger and Carlsmith's classic 1959 experiment, 71 male undergraduate psychology students from Stanford University were asked to spend an hour doing a number of boring and monotonous tasks (e.g. turning pegs a quarter turn, over and over again and sorting spools). The tasks were designed to produce a strong, negative attitude. Once the tasks were complete, the experimenters then asked some of the participants to talk to another participant (actually a confederate, someone working with the experimenter) and persuade them that the tasks were interesting and engaging as a favour to the experimenters. Some participants were paid $20 for this favour, another group $1, and a control group was not asked to perform the favour at all. Remembering that the value of $20 would be much more by today's standard, the three conditions produced some interesting results.

When each participant was asked to rate the boring tasks at the end of the study, those in the $1 group rated them more positively than those in the $20 and control groups. Festinger and Carlsmith theorised that people experienced dissonance between the conflicting cognitions, 'I told someone that the task was interesting' and 'I actually found it boring'. The participants who received only $1 for lying then had some cognitive work to do to overcome the dissonance between what they did and what they thought of the task. Therefore, they rated the task higher than the $20 group. The participants who were paid $20, however, had a justification for their behaviour; that is, they did it for the money, but still thought it was boring and thus experienced less dissonance. (Festinger & Carlsmith, 1959)

QUESTIONS

1. Identify the independent variables (IV) and dependent variables (DV) in this experiment.
2. Festinger and Carlsmith used deception to conduct this experiment, therefore what ethical consideration would need to be observed at the end of the experiment?
3. Which experimental design was used in this study?
4. What are the strengths and limitations of this design?
5. How could the sample of this study be a limiting factor when making generalisations?

cognitive dissonance When the thoughts and actions of a person do not match their attitude, causing a clash

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10.5 CHECK YOUR UNDERSTANDING >>

1 Charlie really dislikes rap music and thinks that it is a waste of time listening to it. However, when his best friend asks him to see a rap concert, he pays for front row tickets to go to the concert. This is an example of:
   - A person perception.
   - B affective disorder.
   - C cognitive dissonance.
   - D stereotyping.

2 Cognitive dissonance is:
   - A a mismatch of the cognitive and behavioural components of an attitude.
   - B when all of the components of an attitude are in harmony.
   - C a perception that an attitude can change over time.
   - D a disconnect between a stereotype and an attitude.

3 Give an example of your own experience of cognitive dissonance and identify the three components of the attitude.

4 Explain how cognitive dissonance may limit the use of the tri-component model of attitudes in predicting future behaviour.

ATTITUDES AND STEREOTYPES: THE LINK TO PREJUDICE AND DISCRIMINATION

The attitudes we hold about ourselves, others, objects and experiences play a significant part in the way people relate to each other. However, not all attitudes towards people are positive ones. Some are negative and form the basis of prejudice. In this section, we examine the relationship between attitudes and stereotypes and the link to prejudice and discrimination.

PREJUDICE

Prejudice is marked by suspicion, fear or hatred. It is a negative emotional attitude held towards members of a specific social group. Prejudice can exist in almost any situation. Businesses that do not encourage women to take on managerial roles may have prejudiced practices. Government agencies and businesses are not permitted to exclude older people from employment, on the basis of their age, yet some do. Like other attitudes, prejudicial attitudes can include the ABCs; for example, 'I dislike old people' (affective component), 'I wouldn't hire an older worker' (behavioural component) and 'Old people are always ill and are not as strong as young people' (cognitive component). Dissonance is still important in the study of prejudice. Take the example of an employer prejudiced against older people. Suppose the employer needs to hire 100 people and the only candidates are older people. The employer may hold the negative attitude towards older people, but employ them anyway because they are needed. If the employer refused to employ a person based on age, then we say that the prejudice has led to the act of discrimination.

Discrimination

Discrimination is the action of being prejudiced or, more simply, treating others in an unfair manner, based on the negative attitude held about that person or group. Prejudice leads to discrimination or the unequal treatment of people who should have the same rights as others. Discrimination frequently prevents people from doing things they should have the opportunity to do, such as buying a house, getting a job, riding a bus or attending a particular school.

In 1977, the *Anti-Discrimination Act* (NSW) came into force to eliminate prejudices such as sexism and racism that had become institutionalised; that is, they were reflected in government policy, schools and businesses. The Act makes it unlawful to discriminate on grounds of sex, race and marital status in the areas of employment, accommodation, goods and services, and education.

As stated earlier, stereotypes are oversimplified images of people who belong to a particular group. Stereotypes can play a large role in prejudice and discrimination, when a preconceived idea about a person or group leads us to behave in a negative way towards them or treat them unfairly.

Stereotypes do not have to be negative; for example, the stereotype that people who wear glasses are intelligent is not an insult. However, when a stereotype produces a less than favourable view of some social groups – when the stereotype is negative – prejudice and discriminatory behaviour can be the result.

Most people publicly support policies of equality and fairness, such as the government providing financial assistance to Indigenous Australians and promoting affirmative action. This involves active efforts to improve the employment or educational opportunities of members of minority groups and

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women. Yet, there are people who still have lingering biases and negative images of minority groups and women. Patricia Devine, a social psychologist, has shown that making the decision to stop being prejudiced does not immediately eliminate prejudiced thoughts and feelings. Unprejudiced people may continue to respond in an emotionally negative way to members of minority groups. Devine suggests that this is most likely the result of underlying stereotypes and prejudices learned in childhood (Devine, Monteith, Zuerink & Elliot, 1991).

10.6 CHECK YOUR UNDERSTANDING >>

1 Prejudice is _____, while discrimination is _____.
   - A an attitude; a behaviour
   - B an opinion; a judgment
   - C social; personal
   - D a behaviour; a norm

2 Claire and Peter have been working for the same employer for the past 10 years, doing the same job. Claire earns $5000 less than Peter. This is an example of:
   - A stereotype.
   - B prejudice.
   - C discrimination.
   - D judgment.

3 Prejudice:
   - A can be helpful when making sense of the social world we live in.
   - B is the behavioural component of an attitude.
   - C is an oversimplified image of people who belong to a group.
   - D is a negative attitude held towards someone or something.

4 Define prejudice and discrimination.

5 How are prejudice and discrimination different?

Forms of discrimination

The unequal treatment of people based on group association can occur in a number of forms. In all cases the individual becomes disempowered and less able to achieve the rights and opportunities afforded to others. Sexism, racism and ageism are forms of discrimination based on prejudice.

Sexism refers to an attitude that is a mixture of negative thoughts and stereotypes, and feelings of fear, envy or hostility, that results in discrimination based on gender. An example of this is when a woman who is the best-qualified and most experienced candidate for a job is not employed because she is pregnant or may become pregnant.

Racism refers to an attitude that is a mixture of negative thoughts and stereotypes, and feelings of fear, envy or hostility, that results in discrimination based on race. A research study suggested a substantive degree of racism exists in Australia. Anti-Middle Eastern sentiment is very strong and there is a persistence of intolerance against Asian, Indigenous and African Australians (Dunn, 2003).

Ageism is an attitude that is a mixture of negative thoughts and stereotypes, and feelings of fear, envy or hostility, that results in discrimination based on age. The systematic stereotyping against older people termed 'ageism' often goes unnoticed and unchallenged. Even though it is as wrong as racism and sexism, workplace ageism is now accepted as a major problem and people of any age can experience it. It determines retrenchment practices, access to training and treatment by employment agencies.

These three forms of discrimination are discussed in more detail under 'Social and cultural differences' later in this chapter.

Scapegoating

One major theory suggests that prejudice is a form of scapegoating (blaming a person or a group for the actions of others or for conditions not of their making). Scapegoating is a type of displaced aggression in which hostilities triggered by frustration are redirected at 'safe' targets. The choice of a safe target ensures that the prejudice is reinforced because the objects of this aggression are powerless to refute the claim. An example of this is when immigrants are blamed for taking jobs and contributing to unemployment for Australians.

discrimination Unequal treatment of people who should have the same rights as others

sexism An attitude that is a mixture of negative thoughts (stereotypes), feelings of fear, envy or hostility, and actions of discrimination based on gender

racism An attitude that is a mixture of negative thoughts (stereotypes), feelings of fear, envy or hostility, and actions of discrimination based on race

ageism An attitude that is a mixture of negative thoughts (stereotypes), feelings of fear, envy or hostility, and actions of discrimination based on age

scapegoating Blaming a person or a group for the actions of others or for conditions not of their making

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Direct experience

At other times, the development of prejudice (like other attitudes) can be traced to direct experiences with members of the rejected group. A child who is repeatedly bullied by members of a particular racial or ethnic group might develop a lifelong dislike for all members of that group. The tragedy is that, once prejudices are established, they prevent us from accepting more positive experiences that could reverse the damage (Wilder, Simon & Faith, 1996).

Personal and group prejudice

Distinguished psychologist Gordon Allport (1958) concluded that there are two important sources of prejudice: personal prejudice and group prejudice.

Personal prejudice occurs when members of another racial or ethnic group are perceived as a threat to one's own interests. For example, members of another group may be viewed as competitors for jobs.

Group prejudice occurs when a person conforms to group norms. This does not necessarily imply that the individual agrees with views of the group. However, long-term membership of a group can cause attitudinal change to the point where it becomes a real belief and not one just for the purposes of group identity.

The prejudiced personality

Research suggests that prejudice can also be a general personality characteristic. People with authoritarian personalities – usually rigid, inhibited and likely to oversimplify things – are more likely to consider their own ethnic or racial group superior to others. In fact, authoritarians are more likely to be prejudiced against almost everyone who is different, including people who are homosexual (Whitley, 1999).

SOCIAL AND CULTURAL DIFFERENCES

Prejudice on the basis of social and cultural difference can take the forms of racism, sexism or ageism. Sexism, racism and ageism may have become institutionalised; that is, they are reflected in government policy, in schools and so on. This can make it a long process of change to reduce the discrimination experienced by affected individuals and groups.

Inter-group contact provides the opportunity for discussion and to find the commonalities that exist between cultures. In Australia, if you walk into a shop, you expect the assistant to be courteous to you. One way of showing politeness is by smiling. In some other cultures, a smile is reserved for family members and close friends. Expressions such as 'thank you' and 'excuse me' are used less often, and strangers rarely touch each other – not even to return change. Therefore, if we are culturally aware we will not take offence at these responses.

SEXISM

Historically, women have been discriminated against, resulting in a lower position of power compared with men in employment, government and business. Today in Western culture, women are valued more positively; however, globally, women still experience prejudice. For example, in 1994, research found that gender-selective abortions and infanticides around the world totalled 76 million (Klasen, 1994); that is, 76 million children who did not get to live because they were female.

According to Klasen, in Western culture, four dominant female stereotypes contributing to prejudice can be identified: housewife, sexy woman, career woman and feminist/athlete/lesbian (Klasen, 1994). As well, some occupations are labelled 'women's work' and are therefore less valued. The NSW Pay Equity Report found that the worth of women's work varied depending on the industry – many sectors are undervalued simply because they are female dominated. Those same sectors are often disadvantaged in workplace-bargaining situations (Workers Online, 1999).

Men take home more discretionary pay than women – including over-award payments, bonus payments, profit-sharing, service increments and commissions – mostly because of the concentration of women in jobs that do not attract such payments. Much of this can be blamed on society's expectation of a woman's working role. Women still carry an inordinate amount of family responsibility, which impacts on earnings because they may not be able to work full-time, or may miss training courses and other career development opportunities.

Men can also suffer from discrimination based on their gender. For instance, men do not receive equal support for paternity leave from the government compared to women. This lack of incentive to take time off work means that many men do not take an active role in parenting because it is not financially viable. Some countries, such as Sweden, offer fathers up to

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18 months parental leave and are making workplaces more family friendly and more equal for both genders to take on parental roles.

Men and women are depicted differently in the mass media. Women are portrayed as beautiful as well as domestic goddesses. Men are shown as tough, competitive and business-savvy. This philosophy of social structure creates different expectations for men and women and leads to conflict. This tendency also contributes to sexism and therefore to prejudice, by sending the message that women are more important for their physical characteristics than their intellectual capacity, thus perpetuating gender prejudice in our society (see Figure 10.10).

In any society a network of relationships exist that establishes powers and duties of different members of society. This is known as 'social hierarchy' and provides structure and organisation. It allows those with greater power to determine the rights and privileges of others and leads to situations of inequity, discontent and discrimination.

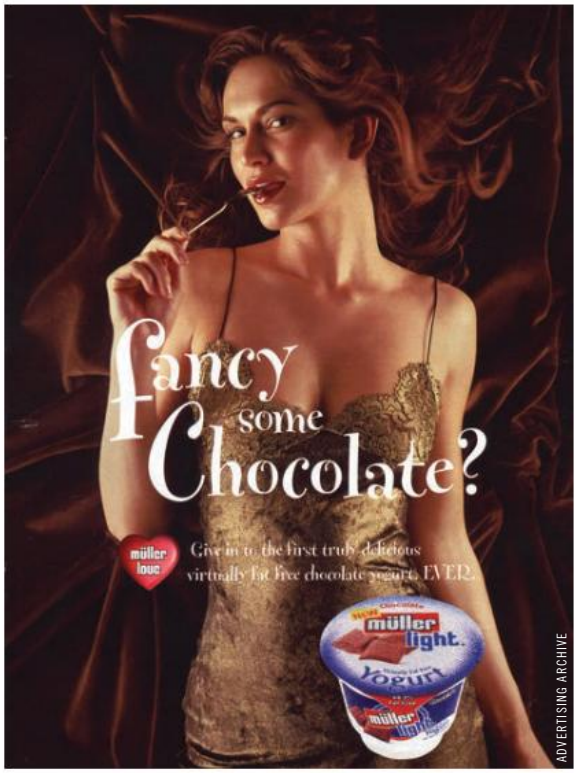


FIGURE 10.10 Some advertisements exploit the physical characteristics of women to sell their products.

Figure 10.11 shows how Australian society has been classified into a social hierarchy (Pattel-Gray, 1995). The hierarchy suggests that the experience of some groups of women is different from that of other women in Australian society because of their relative positions in the social hierarchy. Women at the top of the social hierarchy have greater privileges and rewards than women at the lower end of the social hierarchy. Sexism can affect men as well as women. The family policy of governments and employers can affect men in terms of their ability to balance work and family commitments.

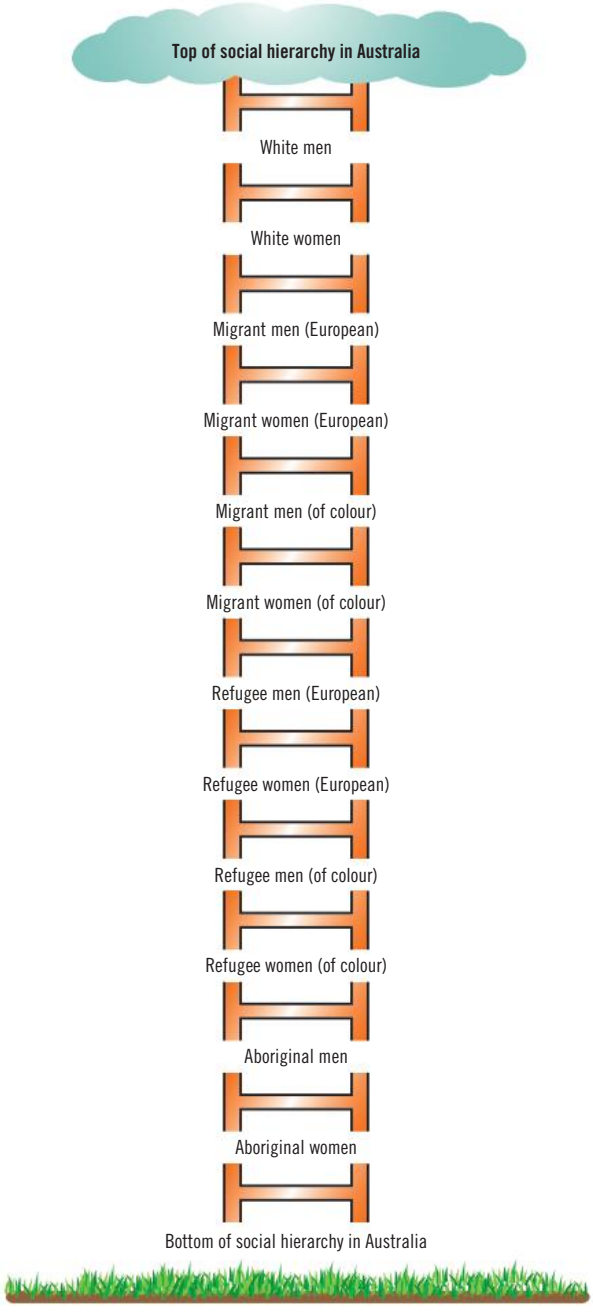


FIGURE 10.11 People at the top of the hierarchy have greater prvileges than those at the bottom.

personal prejudice An attitude whereby members of another racial or ethnic group are perceived as a threat to one's own interests

group prejudice Prejudice held out of conformity to group views

authoritarian personality A personality characterised by rigidity, inhibition and prejudice

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10.7 CHECK YOUR UNDERSTANDING >>

1 When a group of people are targeted as the cause of an issue not of their making, this is called:
   - A scapegoating.
   - B stereotyping.
   - C person perception.
   - D attitude formation.

2 Stereotyping can lead to sexism because:
   - A a particular gender is grouped together and seen as being more similar than they are, and then treated differently.
   - B people in a particular age bracket are grouped together and seen as being more similar than they are, and then they are treated differently.
   - C people of a particular race are grouped together and seen as being all the same, and therefore treated negatively.
   - D this is the first impression people perceive and will lead to cognitive dissonance.

3 Why would it be unpleasant to be labelled a 'scapegoat'?

4 Give an example of scapegoating not found in the text.

5 Name three forms of discrimination based on prejudice.

RACISM

Prejudice and discrimination on the basis of cultural differences have been responsible for many wars and horrible acts of violence over the centuries. Racism is not always obviously or overtly expressed. Vaughan and Hogg (2002) refer to a new form of racism known as modern or subtle racism. That racism takes more subtle forms. In one case reported to the Victorian Equal Opportunity and Human Rights Commission, an Indigenous woman with an above-average income was looking for private rental accommodation in a country town and had applied for several properties managed by one real-estate agent. Each time she applied, she was told it was no longer available, although she later discovered the properties were still vacant (Nader & Cook, 2008). Every time race is mentioned in a context where it is irrelevant, it provides ammunition for those who would argue that skin colour and ancestry are important. In Australia, this is evidenced by the fact that the physical, material and spiritual plight, as well as the education and employment prospects, of Indigenous Australians have not improved significantly in recent times, even though overt racism has diminished (see Figure 10.12). Over 1999–2003, in Queensland, South Australia, Western Australia and the Northern Territory, 75 per cent of Aboriginal and Torres Strait Islander males and 65 per cent of females died before the age of 65 years, compared to 26 per cent of males and 16 per cent of females in the non-Indigenous population (Australian Human Rights Commission, 2008).

A way of reducing the conflict between cultural groups because of beliefs or misconceptions is through inter-group contact. This has been promoted in the concept of multiculturalism, giving equal status to different ethnic, racial and cultural groups. In providing this equal status, multiculturalism recognises and accepts human diversity (Fowers & Richardson, 1996).



FIGURE 10.12 Protest marches draw attention to the fact that the lives of Indigenous Australians have not improved significantly in recent times.

FOCUS ON RESEARCH 10.2

A CLASSROOM EXPERIMENT ON DISCRIMINATION

In a unique experiment, the American primary school teacher Jane Elliot sought to give her students direct experience with prejudice.

On the first day of the experiment, Elliot announced that brown-eyed children were to sit in the back of the room and that they could not use the drinking fountain (see Figure 10.13). Blue-eyed children were given extra recess time and got to leave first for lunch. At lunch, brown-eyed children were prevented from taking second helpings because they would 'just waste it'. Brown-eyed and blue-eyed children were kept from mingling, and the blue-eyed children were told they were 'cleaner' and 'smarter' (Peters, 1971). Eye colour might seem like an unrealistic basis for creating prejudices, yet people primarily use skin colour to make decisions about the race of another person (Brown, Dane & Durham, 1998). Surely, this is just as superficial a way of evaluating people as eye colour is.

At first, Elliot had to maintain these imposed conditions of prejudice. She also made an effort to constantly criticise and belittle the brown-eyed children. To her

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surprise, the blue-eyed children rapidly joined in and were soon outdoing her in the viciousness of their attacks. The blue-eyed children began to feel superior, and the brown-eyed children felt awful. Fights broke out. Test results of the brown-eyed children fell.



FIGURE 10.13 A brown-eyed girl looks on while her blue-eyed classmate uses the drinking fountain, a 'privilege' denied to her in Jane Elliot's experiments.

The effects were short-lived, because two days later the roles of the children were reversed. Before long, the same destructive effects occurred again, but this time in reverse. The implications of this experiment are unmistakable. In less than one day, it was possible to get children to look down on each other because of eye colour and status inequalities, which are differences in power, prestige or privileges. Certainly, the effects of a lifetime of real racial or ethnic prejudice are infinitely more powerful and destructive. Racism is a major source of stress in the lives of many people. Over time, prejudice can have a negative impact on a person's physical and emotional health (Clark, Anderson, Clark, & Williams, 1999).

QUESTIONS

1. What was the aim of the experiment?
2. Give a reason why you think this experiment may have been ethical or unethical.
3. If this experiment were deemed to be ethical and conducted today, what are two ethical considerations with regards to participant rights that would need to be followed?

AGEISM

Ageism is broadly defined as any prejudice or discrimination against or in favour of an age group (Palmore, 1990). It is an attitude that is a mixture of negative thoughts and stereotypes, and feelings of fear, envy or hostility, that results in discrimination. Ageist attitudes are perpetuated in many ways in society: birthday cards make fun about the advance of age, the images of the aged on TV are rarely positive, and we use many colloquialisms to describe old people (for example, 'old fogey,' 'old codger', 'old maid' and 'dirty old man/woman').



FIGURE 10.14 Aged people love to have fun, just as young people do.

Aged people in some cultures are respected as wise and important people. In Japan for instance, ageing is seen as positive and greater age brings more status and respect (Kimmel, 1988). However, in other countries such as Australia, New Zealand, Canada, the United States and Britain, many elderly people are treated as burdens on society and without the same basic human rights as younger citizens. In some Western cultures, the young use 'baby talk' when talking to aged people. Most aged people find this type of communication insulting (Vaughan & Hogg, 2002).

The aged in Australia are often forced to live on a small income or pension and the government has neglected to sufficiently monitor and regulate the aged-care industry. As our community ages, fewer and fewer Australian families will be able to cope without using an aged-care facility. The standing of those who own them and the standard of the care provided within them should be the key focus of any government with a vision for the future.

In addition, institutions perpetuate ageism. Businesses frequently reinforce ageist stereotypes by not hiring or promoting older workers. Many professionals also perpetuate ageism. This is done more covertly or in a disguised way, by denying or limiting services (Robinson, 1994). Human service

multiculturalism Giving equal status to different ethnic, racial and cultural groups

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professionals also perpetuate ageism. This is done more covertly by denying or limiting services, by not including ageing issues in training material or educational offerings, and by not requiring geriatrics training for medical students even though older adults will comprise a significant proportion of their patients. The same criticism can be made about training of professional social workers who receive little information about the ageing process, although many of their clients will be older adults.

A study presented in the Australian Human Rights Commission's *Annual Report 2006–2007* aimed to identify key issues facing older people as a basis for determining the focus of a national community awareness strategy about age discrimination. This research showed that age discrimination is prevalent in Australia, that there are considerable barriers to preventing age discrimination in employment and that ageist stereotypes among employers are a significant part of the problem. Table 10.1 lists eight common myths about the aged (Robinson, 1994).

In general, the consequences of ageism are similar to those associated with all attempts to discriminate against other groups. People subjected to prejudice and discrimination tend to adopt the dominant group's negative image and to behave in ways that conform to that negative image. Furthermore, the dominant group's negative image typically includes a set of behavioural expectations or prescriptions that define what a person is to do and not to do. For example, aged people are expected to be asexual,

TABLE 10.1 Some common myths about aged people

ATTRIBUTE	MYTH	FACT
Illness	Most aged people are sick or disabled and are not healthy enough to carry out their normal daily activities.	Most aged people in Western cultures are healthy enough to engage in their normal activities. Only a small proportion of people over 65 years need help with daily activities, such as eating, bathing and dressing.
Sexuality	Aged people no longer engage in sexual activity or feel sexual desire.	Most have interest in sex and are sexually active. Some research has found that people in their 70s and 80s continue to have satisfying sexual relations (see Figure 10.15).
Ugliness	Old people are ugly and beauty is associated only with youth.	Many people, especially women, are afraid of ageing. They fear being old, wrinkled and having sagging skin. However, some cultures admire the characteristics of ageing. There is nothing ugly about the characteristics of old age. Ugliness is a subjective judgment and it reflects contemporary cultural standards.
Mental decline	Mental capacity, especially the ability to learn and remember, declines from middle age onwards.	Most aged people maintain their normal mental functioning, including learning and remembering. Their reaction time slows down with age and it may take longer to learn something; however, many differences between older and younger people are due to variables other than age. Illness, motivation, learning style, lack of practice and amount of education can affect an aged person's ability to learn. Short-term memory declines only slightly over 65. It is thought that long-term memory loss affects fewer than one in five aged people. Significant learning and memory problems are likely to be due to illness, not age.
Mental illness	Mental illness is common among most aged people.	Mental illness is not common in the aged population. About one-quarter of patients in Australian psychiatric hospitals are over 65 years. The incidence of mental illness among the aged is less than that of younger people.
Uselessness	Aged people are unable to continue working and those who do continue to work are unproductive. This belief is the main basis for compulsory retirement policies and discrimination in hiring, retraining and promotion in the workplace.	Most aged people can work as effectively as younger workers. Some studies of employed older people have shown that they perform as well as, if not better, than younger workers. Older people are less likely to leave jobs, have accidents or take time off than younger people; hence their level of productivity is higher.
Isolation	The aged are alone and lonely.	Most aged people live with their spouse or family. Very few are isolated and most have close relatives within easy visiting distance, with frequent contacts between them.
Political power	Aged people are a large political power group.	The aged in Victoria constitute about 15 per cent of the population, and therefore do not have the numbers to bring about significant political change.

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intellectually rigid, unproductive, forgetful, happy, enjoying their retirement, and also invisible, passive and uncomplaining.



FIGURE 10.15 The capacity for a satisfying physical relationship usually continues in the 70s and 80s for healthy couples.

10.8 CHECK YOUR UNDERSTANDING >>

1 Aged people are:
   - A a large political power group.
   - B able to work as effectively as younger people.
   - C more likely to suffer from mental illness.
   - D generally alone and lonely.

2 Multiculturalism can reduce racism by:
   - A giving more status and power to a racial group that is treated as inferior.
   - B working to promote stereotypes and labels.
   - C giving equal status to different ethnic, racial and cultural groups.
   - D recognising that some groups are better than others.

3 A mixture of negative thoughts, stereotypes, feelings of fear, envy or hostility, and actions of discrimination based on race is called:
   - A sexism.
   - B cultural dissonance.
   - C stereotyping.
   - D racism.

4 What are some of the ways in which ageist stereotypes are perpetuated?

5 Explain how inter-group contact may reduce racial or ageist prejudice.

REDUCING PREJUDICE

A starting point for reducing prejudice is to become aware of the factors that work towards reducing prejudice. These factors include inter-group contact, sustained contact, superordinate goals, mutual interdependence and equality (equal-contact status).

Inter-group contact

One way to reduce prejudice is to increase the inter-group contact between the people who hold the stereotype and those who are the target of the stereotype. Stereotypes can be broken down and replaced by more positive attitudes when the inter-group contact is maintained over a period of time (known as sustained contact, discussed shortly), when meeting the goals for each group requires mutual interdependence, and when equality exists through equal-status participation.

One of the effects of inter-group contact is that it positively impacts on the cognitive (belief) component of an attitude. Inter-group contact makes people aware that members of various racial and ethnic groups share the same goals, ambitions, feelings and frustrations as they do, and this has a positive effect on attitudes. This improvement in attitude can be observed when employees of different ethnic groups work side by side in the workplace. The increased contact between them actually helps to reduce prejudice. The Australian Administrative Appeals Tribunal is committed to creating a working environment that values and utilises the contribution of its employees and members from diverse backgrounds and experiences. By valuing workplace diversity, the Tribunal benefits by breaking down prejudices and avoiding stereotyping, fostering good working relationships between people, and ensuring fair and equitable staff selection (Australian Administrative Appeals Tribunal, 2010).

Sustained contact

For inter-group contact to have maximum benefit it should be sustained contact, which means that there should be prolonged and involved cooperative activity rather than a casual and purposeless contact (Allport, 1954). This means that individuals who work together to achieve a shared goal for extended periods of time have an opportunity to get to know the reality of the other groups. They may then arrive at an informed attitude about these groups rather than accept a stereotype.

prejudice A negative emotional attitude held towards members of a specific social group

inter-group contact Interactions between the holder of the stereotype and the target of the stereotype

sustained contact Prolonged and involved cooperative activity or interaction

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FIGURE 10.16 Sustained contact may reduce the incidence of prejudice.

Superordinate goals

Superordinate goals are shared goals, which groups or individuals cannot achieve alone or without the other person or group. These goals exceed or override other lesser goals that the individual or group may have. As members of the groups are forced to cooperate, this can lead to hostilities and prejudices lessening or even disappearing. Cooperation and shared goals seem to help reduce conflict by encouraging people in opposing groups to see themselves as members of a single, larger group (Gaertner et al., 1990). Superordinate goals, in other words, have a 'we are all in the same boat' effect on perceptions of group membership (Olson & Zanna, 1993).



FIGURE 10.17 The ANZACs had a superordinate goal of winning the war. This photo shows transportation of injured ANZACs on the Gallipoli Peninsula, January 1916.

In order for superordinate goals to reduce or remove prejudice, it is important that the common goal is achieved. An example of this is the formation of the ANZACs (Australian and New Zealand Army Corps) (Figure 10.17) during World War I. Their superordinate goal was to defeat the enemy and this goal overrode the competition between Australia and New Zealand over international export trade. In this instance, as a result of a superordinate goal, two separate countries became a single, larger ANZAC entity.

Mutual interdependence

According to Aronson (1984), another inter-group contact goal that is effective in reducing prejudice is mutual interdependence. That is, people must depend on one another to meet each person's goals. When each person's needs are linked to those of others in the group, cooperation is encouraged (Deutsch, 1993). An example of this is an AFL football team that has several racial and age groups within it. In order for the team to achieve its aim of winning a football game, all the players are dependent on each other. This mutual interdependence helps to reduce prejudices between players of different races and of different ages.

Aronson (1984) successfully created 'jigsaw classrooms' that emphasised cooperation rather than competition. The term refers to the pieces of a jigsaw puzzle. In a jigsaw classroom, each child is given a piece of the information needed to complete a project or prepare for a test.

In a typical session, children are divided into groups of five or six and given a topic to study for a later exam. Each child is given their own piece of information and asked to learn it. For example, one child might have information on how many Aboriginal tribes there are in Victoria; another child finds out the facts about where each tribe lives; and a third child might have information about the customs and rituals of the different tribes. After the children have learned their parts, they teach them to others in the group. Even the most competitive children quickly realise that they cannot do well without the aid of everyone in the group. Each child makes a unique and essential contribution, so the children learn to listen to and respect each other.

Research shows that, compared with children in traditional classrooms, children in jigsaw groups are less prejudiced, they like their classmates more, they have more positive attitudes towards school, their results improve and their self-esteem increases (Walker & Crogan, 1998; Webb & Farivar, 1994).

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Such results are quite encouraging, but this is not the whole answer. There is often a wide difference between attitudes and actual behaviour. Until prejudiced behaviour is eliminated, changes can be quite superficial; however, more frequent equal-status contact (or equality) between groups in conflict should reduce prejudice and stereotyping (Olson & Zanna, 1993).

Equality (equal-status contact)

Equality (or equal-status contact) involves social interaction that occurs at the same level, without obvious differences in power or status. Much evidence suggests that equal-status contact does, in fact, lessen prejudice. For example, in one early study in the USA, white women who lived in integrated and segregated housing projects were compared for changes in attitude towards their African-American neighbours. Women in the integrated project showed a favourable shift in attitudes towards members of the other racial group. Those in the segregated project showed no change or actually became more prejudiced than before (Deutsch & Collins, 1951). In other studies, mixed-race groups have been formed at work and in schools. The conclusion from such research is that personal contact with a 'disliked' group will induce friendly behaviour, respect and liking. However, these benefits occur only when personal contact is cooperative and at an equal level (Grack & Richman, 1996).

10.9 CHECK YOUR UNDERSTANDING >>

1 Prejudice can be reduced by increasing _____ between the holder of the stereotype and the target of the stereotype.
   - A inter-group contact
   - B affective interaction
   - C cognitive interdependence
   - D mutual intervention

2 Superordinate goals:
   - A can be reached if a strong leader has the power to drive the group.
   - B are aimed at reducing the amount of direct contact between conflict groups.
   - C will increase the amount of prejudice between groups.
   - D are shared goals that cannot be reached without all groups working together.

3 Which of the following are all ways to reduce prejudice between two rival gangs of youths?
   - A Equality, mutual interdependence and stereotyping
   - B Mutual interdependence, equality and superordinate goals
   - C Equality, person perception and inter-group contact
   - D Mutual interdependence, scapegoating and equality

4 Explain how inter-group contact and its three components reduce racial prejudice.

5 Explain how a jigsaw classroom uses superordinate goals to help reduce prejudice.

10.3 FOCUS ON RESEARCH

RACISM IN AUSTRALIA

Researchers from the University of New South Wales conducted a telephone survey in Queensland and New South Wales to determine the extent of racism in Australia. During October and December 2001, the researchers surveyed 5056 residents of Queensland (36 per cent) and NSW (64 per cent). The survey found that racism is prevalent in Australian society – about 15 per cent of people surveyed had experienced racism at work or in education and 25 per cent had experienced 'everyday racisms' (Dunn, 2003).

Most people surveyed felt that cultural diversity was a good thing and that interracial marriage was okay. Very few people felt they were prejudiced, yet the majority of respondents felt that there is racial prejudice in Australia. Institutional racism (experienced in work, education, housing and policing) affected one in five respondents – not surprisingly, this mostly affected people who speak a language other than English, and Aboriginal and Torres Strait Islander people. Everyday racism (experienced in shops and restaurants, and at public events) affected approximately one in three of the respondents in these groups.

➜

superordinate goals Shared goals that groups or individuals cannot achieve alone or without the other person or group

mutual interdependence Depending on one another to meet each person's goals

equality Social interaction that occurs at the same level, without obvious differences in power or status

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TABLE 10.2 Collated responses to statements about racial attitudes (%)

STATEMENT	STRONGLY AGREE	AGREE	UNDECIDED	DISAGREE	STRONGLY DISAGREE	DON'T KNOW
Cultural diversity is good.	33.5	51.0	7.7	5.4	1.9	0.4
I feel secure with ethnic difference.	24.7	49.8	13.6	8.4	2.3	1.2
There is racial prejudice in Australia.	30.2	52.9	7.7	6.9	1.6	0.6
Interracial marriage is not a good idea.	2.8	10.5	10.6	44.1	31.4	0.7
All races are equal.	38.5	44.6	4.8	8.6	3.1	0.4
I am prejudiced against other cultures.	2.6	9.4	7.5	40.9	39.3	0.3

Source: Dunn (2003)

TABLE 10.3 How often survey respondents experienced discrimination due to their ethnic origins in the given situations (%)

	WORKPLACE	EDUCATION	HOUSING	POLICING	SHOP	PUBLIC EVENTS
LOTE						
Yes	35.6	29.9	16.3	15.8	30.9	27.7
No	13.0	12.4	4.9	4.9	14.1	12.7
Born						
OS	35.2	24.5	15.9	15.0	29.5	26.11
UK/NZ	21.7	10.8	6.3	5.6	11.4	5.6
Aust.	11.9	13.6	4.6	5.0	14.8	12.6
ATSI						
Yes	28.7	36.2	21.3	23.4	33.0	29.8
No	15.9	14.5	6.1	6.0	16.2	14.4
Gender						
Male	20.8	17.1	7.4	8.7	19.0	20.2
Female	12.8	13.5	5.8	4.8	14.7	10.9
n = 5056	16.1	14.9	6.5	6.4	16.5	14.9

LOTE = languages other than English, ATSI = Aboriginal or Torres Strait Islander
Source: Dunn (2003)

TABLE 10.4 The type of discrimination experienced by respondents in the everyday situations (%)

	DISRESPECT	MISTRUST	INSULTS
LOTE			
Yes	42.5	33.0	44.3
No	18.8	10.9	21.4
Born			
OS	39.1	29.1	41.4
UK/NZ	20.5	9.3	30.4
Aust	19.2	11.8	20.9
ATSI			
Yes	42.5	30.9	37.2
No	21.5	13.7	24.4
Gender			
Male	26.1	17.9	29.2
Female	19.3	11.3	21.4
n = 5056	22.0	14.0	24.7

LOTE = languages other than English, ATSI = Aboriginal or Torres Strait Islander
Source: Dunn (2003)

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QUESTIONS

Determine the following about the research in Tables 10.2, 10.3 and 10.4.

1 What is the aim of this study?
2 What is the sample for this study?
3 Is it representative of the population? Explain your answer.
4 Are inferential or descriptive statistics used here? Explain your answer.
5 What is the conclusion for this study?

COGNITIVE INTERVENTIONS

Individuals can guard against becoming prejudiced by using cognitive interventions. Cognitive interventions are learned skills and behaviours that we can use to combat prejudice. If we think (cognition) about what skills we can use to combat prejudice, and then make a conscious effort to keep thinking about and practising these skills until they become part of our everyday behaviour (intervention) we are taking a proactive step against prejudice. Cognitive interventions can help us to:

- be less susceptible to the manipulation of others
- analyse and understand our own attitudes and those of others
- predict the behaviour of others
- promote pleasant interactions.

The following seven cognitive interventions may be helpful to overcome prejudice.

Beware of stereotypes. Stereotyping is used to control others and make the social world seem more manageable. As a result, we tend to see 'out-group' members (people that are not part of our group) as very much alike, even when they are as varied as our friends and family. A good way to reduce stereotyping is to get to know individuals from various racial, ethnic and cultural groups.

Seek individuating information. When are we most tempted to apply stereotypes? Typically, it is when we have only minimal information about a person. Stereotypes help us guess what a person is like and how they will act. Unfortunately, these guesses are usually wrong. One of the best antidotes for stereotypes is individuating information, or information that helps us see a person as an individual, rather than as a member of a group (Click, Zion & Nelson, 1988). When you meet individuals from various backgrounds, focus on the person, not the label attached to them.

Do not fall into just-world beliefs. Do you believe that the world is basically fair? Even if you do not, you may believe that the world is sufficiently just that people generally get what they deserve. It may not be obvious, but beliefs of this sort can directly increase prejudiced thinking. A just-world belief (the belief that people generally get what they deserve) can lead us to assume that minority groups would not be in such positions if they were not inferior in some way. This way of thinking amounts to blaming people who are victims of prejudice and discrimination because of their circumstances. A just-world belief can result in discrimination, which can lead to minority groups occupying lower socioeconomic positions in society. A variety of commentators in Australia – and elsewhere – have drawn our attention to a hardening of attitudes towards minority groups, the poor and disadvantaged (Lawrence, 2002).

Be aware of self-fulfilling prophecies. A self-fulfilling prophecy is an expectation that prompts people to act in ways that make the expectation come true. For example, a person who expects people to be friendly may smile more and thus receive more smiles, whereas a person expecting to be lucky may enter many more competitions and thus increase their chances of winning. People tend to act in accordance with the behaviour expected by others. If you hold strong stereotypes about members of various groups, a vicious cycle can be set up. As a result, when you meet someone different from yourself, you may treat them in a way that is consistent with your stereotypes. If the other person is influenced by your behaviour, they may act in ways that seem to match your stereotype, creating a self-fulfilling prophecy and reinforcing your belief in the stereotype.

cognitive interventions Learned skills and behaviours that can be used to combat prejudice

individuating information Knowledge that helps us see a person as an individual, rather than as a member of a group

just-world belief The belief that people generally get what they deserve

self-fulfilling prophecy An expectation that prompts people to act in ways that make the expectation come true

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Remember: different does not mean inferior. Some conflicts between groups cannot be avoided. In the political world where philosophies of government differ markedly between parties, there will always be grounds for conflict. What can be avoided is unnecessary social competition (rivalry among groups, each of which regards itself as superior to others). The concept of social competition involves some individuals seeking to enhance their self-esteem by identifying with a group. The school environment is a place where young people feel compelled to join a group to develop a social identity, and so they can benefit from a sense of security. However, this works only if the group can be seen as superior to others. Because of social competition, groups tend to view themselves as better than their rivals (Baron & Byrne, 1997), so, if we do not want to promote prejudice we must remember to avoid unnecessary social competition.

Look for commonalities. We live in a society that values competition and individual effort. Although these values can have a positive effect on our behaviour, they can also have a negative impact. In some circumstances competition and a desire to win can also encourage the desire to demean, defeat and dominate those we are competing against. Social values that control such behaviour off the sports field seem no longer relevant on the field of play. Each cricket season there are stories reported about unsportsmanlike behaviour towards an opposition player, including physical intimidation and verbal abuse. However, when we look for commonalities, or things we have in common with others who are different from us, we cooperate with them, and we tend to share their joys and suffer when they are in distress (Lanzetta & Englis, 1989).

Develop cultural awareness. Living in a multicultural society such as Australia means becoming more informed about other groups who are different to us. In other words, it means developing cultural awareness, which is one way to combat racism. Multicultural populations enrich a community's food, music, arts and philosophy. The more exposure an individual has to different cultures, the better able they are to understand the differences.

10.3 TRY IT YOURSELF >>

STEREOTYPES IN THE PRINT MEDIA

Find and cut out pictures from magazines and newspapers that show gender, race or age stereotypes. Glue the pictures onto an A3 sheet and display the poster in your classroom, or glue the pictures into your workbook, using the heading 'Stereotypes that can lead to sexism, racism and ageism'.

Once you finish reading this chapter, come back to your poster or workbook and list the factors that could reduce these forms of prejudice.

10.10 CHECK YOUR UNDERSTANDING >>

1 Which of the following defines a just-world belief?
   - A All individuals should be treated equally.
   - B Those more fortunate will support others less fortunate.
   - C People generally get what they deserve.
   - D Minority groups are well supported in society.

2 Being aware of stereotyping, just-world beliefs and self-fulfilling prophecies, and seeking individuating information are:
   - A superordinate goals.
   - B intergroup contacts.
   - C positive prejudices.
   - D cognitive interventions.

3 When Harry (aged 16) met Sally (aged 97), he was expecting a senile old woman. However, when he spent some time with her, he found that they both enjoyed debating political issues and had similar views. Harry's preconceived ideas changed because of:
   - A developing cultural awareness.
   - B looking for commonalities.
   - C avoidance of a just-world belief.
   - D avoidance of social competition.

4 Explain how cognitive interventions are different from other methods used to reduce prejudice.

5 How can cognitive interventions help us to reduce prejudice?

social competition Rivalry among groups, each of which regards itself as superior to others

commonalities Things people share or have in common, increasing cooperation with others and sharing joys and suffering

cultural awareness Awareness of cultural backgrounds different to your own

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CHAPTER SUMMARY

Social cognition

- We make sense of the social world we live in by applying somewhat automatic cognitive processes. Some of these processes include person perception, attributions, attitudes and stereotypes. All of these processes allow us to interpret, assist our analysis and help us to navigate future social behaviours because we can store information in memory.
- Person perception is the process of forming impressions about others. Attributions are when we think of the cause of behaviour; whether the behaviour is due to situational or personal factors. Attitudes are the way we evaluate an object or person. Stereotypes are about grouping together things or people that may share some similar characteristics, but we group them as if they are more alike than they really are.

Attitudes

- Attitudes are learned dispositions made up of a belief (cognitive) component, an emotional (affective) component and an action (behavioural) component. The tri-component model describes the combined effect of each component on the formation of attitude.
- Limitations of the tri-component model include cognitive dissonance (clash between thoughts and feelings and behavioural components), the inability to indicate strength of attitude and the inability to measure some components directly because they are psychological. These limitations may make it difficult to predict behaviour based on the model.
- Attitudes may be formed by direct contact, interaction with others, child-rearing practices, group membership and the media.

Prejudice

- Prejudice is a negative attitude held towards members of various out-groups. One theory attributes prejudice to scapegoating.
- Inter-group contact such as sustained contact, mutual interdependence and equality tend to reduce prejudice.

Cognitive intervention

- Cognitive interventions – avoiding stereotyping, seeking individuating information, not falling into just-world beliefs, being aware of self-fulfilling prophecies, avoiding social competition, looking for commonalities and developing cultural awareness – can reduce prejudice.

APPLY YOUR KNOWLEDGE AND SKILLS

SECTION A: MULTIPLE-CHOICE QUESTIONS

Answer the following questions by writing the correct letter in your workbook. Only one answer is correct for each question.

1 Social cognition refers to:
- **A** the way a person thinks about all things.
- **B** a person's ability to maintain a positive mood when in social situations.
- **C** an individual's behaviour when alone or in social situations.
- **D** the way people process, retain and apply information about social situations.

2 Psychologists are interested in measuring attitudes because they:
- **A** can be useful in assessing personality.
- **B** give an insight into the unconscious part of the brain.
- **C** are then able to access people's core values.
- **D** can be used to predict behaviour.

3 According to psychologists, attitudes are:
- **A** values we hold about something or someone.
- **B** statements of factual knowledge about something or someone.
- **C** judgments about how much we like or dislike something or someone.
- **D** general evaluations we make about people, objects, events or issues.

4 When Filipa says 'Capital punishment does not act as a deterrent to criminals', she is expressing the _____ component of an attitude.
- **A** affective
- **B** behavioural
- **C** cognitive
- **D** verbal

5 A schema consists of:
- **A** information stored as discrete parts.
- **B** categories or groups of ideas and concepts to help us organise information.
- **C** only images we have remembered about people.
- **D** categories or groups of ideas and concepts to help us store information that may do us harm to remember.

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6 Liam has 20 years' experience driving a car. One night while he is driving, torrential rain begins, causing Liam to skid and smash the car into a pole. Liam's behaviour is likely to be attributed to:

- **A** personal attributions.
- **B** lack of experience.
- **C** fundamental attribution error.
- **D** situational attributions.

7 When a student receives a poor result on their exam, they attribute the cause of the mark to their teacher's lack of ability instead of their own, even though before the exam they were impressed with the way the teacher was performing. Blaming the situation instead of accepting personal responsibility is called:

- **A** attributional error of judgment.
- **B** defensive attribution.
- **C** attitude.
- **D** self-serving bias.

8 'All P-plate drivers are hoons' is an example of a:

- **A** personal attribution.
- **B** stereotype.
- **C** positive attitude.
- **D** person perception.

9 Which one of the following is a limitation of the tri-component model of attitudes?

- **A** It does not give an indication of the strength of an attitude.
- **B** It can give an indication of the direction of an attitude.
- **C** It only has three components.
- **D** The behavioural component is difficult to observe.

10 Prejudice can be reduced by increasing the _____ between the holder of the stereotype and the target of the stereotype.

- **A** inter-group contact
- **B** affective interaction
- **C** cognitive interdependence
- **D** mutual intervention

11 Being aware of stereotyping, just-world beliefs and self-fulfilling prophecies, and seeking individuating information are:

- **A** superordinate goals.
- **B** inter-group contacts.
- **C** cognitive interventions.
- **D** positive prejudices.

12 Which of the following statements is a negative stereotype of aged people?

- **A** Most aged people are sick or disabled and are not healthy enough to carry out their normal daily activities.
- **B** Most aged people maintain their normal mental functioning, including learning and remembering.
- **C** Ageing does not have a significant impact on learning ability.
- **D** Short-term memory declines only slightly after 65 years of age.

13 When Sally does not get a job, she blames her lack of success on 'All the young people taking all the jobs', even though the person who was employed was older than her. This is an example of:

- **A** scapegoating.
- **B** sexism.
- **C** cognitive intervention.
- **D** inter-group conflict.

14 Ageism:

- **A** refers only to prejudice against older people.
- **B** is when a person is discriminated against based on their age.
- **C** refers to discrimination of a person based on their race or culture.
- **D** is a stereotype based on a person's gender.

15 Prejudice can be reduced by:

- **A** using cognitive interventions.
- **B** inter-group contact.
- **C** mutual interdependence.
- **D** All of the above

SECTION B: SHORT-ANSWER QUESTIONS

1 Define the term 'social cognition'.

2 Explain how person perception and stereotyping may affect the way we view a person's behaviour.

3 Define cognitive dissonance and give an example to illustrate how it may affect behaviour.

4 Explain the link between attitudes, stereotypes and prejudice.

5 List and explain the factors that contribute to the development of prejudice.

6 If violence on TV contributes to prejudice in our society, do you think it is possible that TV could also reduce prejudice? Explain your answer.

7 How do stereotypes develop? What purposes do they serve?

8 Explain how scapegoating can relate to gender prejudice. Use an example in your explanation.

9 Give an example of prejudice and how it may lead to discrimination.

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10 Draw a table of the cognitive interventions and, using an example of ageism, outline how each one may reduce prejudice.

SECTION C: EXTENDED-RESPONSE QUESTION

Ninety per cent of all people in Western societies marry at some point. What, beyond attraction, determines who we choose to marry? Studies have shown that people who marry are more likely to share similarities in age, education, race, religion and ethnic background. The term to describe when two people who are alike marry, is called homogamy (Caspi & Herbener, 1990). It also appears that there is a strong correlation between attitudes and opinions, mental abilities and socioeconomic status, and a moderate correlation for height, weight and eye colour. This shows that when deciding on a partner for marriage, people often choose someone who is very similar to themselves (Coon & Mitterer, 2006).

QUESTIONS

Devise a research study to see whether the results of these previous studies have changed over time.

1 Write an aim for your study.

2 What are the advantages or disadvantages of using questionnaires or surveys to obtain data?

3 Name and describe a technique you could use to gather a sample.

4 Explain the merit of replicating procedures and the effects of sample sizes in obtaining reliable data to compare the changes that have occurred over time. This question is worth 10 marks.

SECTION D: ASSESSMENT TASK

You are to present an essay on the topic of 'Social cognition' (approximately 600 words).

Discuss the way in which people interpret, analyse, remember and use information about the social world.

The essay should include key psychological terminology (person perception, attributions, attitudes, stereotypes, prejudice and discrimination) and it should include original examples to explain the concepts.

CHAPTER 11

SOCIAL INFLUENCES ON BEHAVIOUR



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KEY KNOWLEDGE INCLUDES:

- the influence of status and social power within groups, and obedience and conformity on individual behaviour, with reference to theorists including Asch, Milgram and Zimbardo
- the influences on helping behaviour (or reluctance to help) including personal, situational and social factors
- factors that influence bullying (including cyberbullying) behaviour and the effects of bullying behaviour on an individual's psychological functioning
- positive and negative influences of media on individual and group behaviour, illustrated by advertising, television, video games and social media.

Psychology Area of Study Key knowledge points derived from *VCE Psychology Study Design 2016*, p. 21; © The Victorian Curriculum and Assessment Authority (VCAA). Used with permission.

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SOCIAL RELATIONSHIPS

Human behaviour is affected by individual, group and situational factors. Behaviour also depends on what you notice in the environment. Some people see what is going on around them; others are lost in their own worlds and do not even see their friends walking past. How you act depends on your stage of cognitive development and how you interpret the world around you.

When psychologists speak of social relationships they are referring to the ways in which people interact in social settings. Social relationships can be positive, in that we help others and do good things for them, or they can be negative, in that we hurt those around us. Psychologists are interested in why we behave towards others in particular ways in particular situations.

SOCIAL INFLUENCES ON THE INDIVIDUAL

Imagine that you want to go to a party being thrown by someone from school. It will be held while their parents are away on holidays. You ask your parents for permission to go, but they refuse to let you. You do not want to miss the party because half your year level will be attending. You have to choose. If you obey your parents, it will probably be because of the respect you have for them and out of concern about the consequences if you defy them. If you disobey your parents, it will probably be because of pressure from your friends and others at school. What decision do you make? This chapter explores the many social influences on our behaviour, including status and social power.

STATUS AND SOCIAL POWER IN GROUPS

A group is formed when two or more people interact and influence each other and share a common objective. Most people belong to a number of groups, from structured groups such as sporting teams to temporary groups such as students assigned to work on a project together. Within these groups, individuals differ in terms of the status and power that each member has. Although status and social power are related, they are not the same thing. Status refers to a person's position in the hierarchy of a group. Social power refers to the amount of influence that an individual can exert over another person. In general, the higher a person's status, the more power they exert.

Status

All societies have people of unequal status (Brown, 1965). Status may be based on lineage, occupation or wealth. People recognise the different statuses and have accepted norms of treatment for people of high or low status.

A person's status can determine their degree of influence over others. Imagine a traffic signal brightly flashing the word 'WAIT'. As you and other pedestrians wait for it to change, a well-dressed man in a suit crosses against the light. How many people will follow him? Do you think the answer would be different if the man had an overgrown beard and was dressed in faded old clothes? (See Figure 11.1.) This street-corner scenario was used in an early experiment on social influence. As you might have guessed, more people followed the well-dressed man than the man dressed in faded, old clothes (Lefkowitz, Blake & Mouton, 1955).

In a different experiment, researchers left 20-cent coins in phone boxes. When people entered the phone box, a researcher approached and said, 'Excuse me, I think I left a 20-cent coin in this phone box a few minutes ago. Did you find it?' Seventy-seven per cent of the people who were approached returned the money when the researcher was well dressed. Only 38 per cent returned it to poorly dressed researchers (Bickman, 1974). The better treatment given 'higher-status' people in this example has been used to explain some of Western society's preoccupation with expensive clothes, cars and other status symbols.

The status given to an individual because of their role within a group can greatly affect the degree of influence they exert. Psychologist Phillip Zimbardo explored this issue in a now-famous experiment that he set in a mock prison (Zimbardo, Haney & Banks, 1973).

social relationships Interactions between people in social settings

group Two or more people interacting with a shared purpose

status An individual's position in a group

social power The amount of influence that an individual can exert over another person

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FIGURE 11.1 Dress sends a clear message about a person's status.

11.1 CHECK YOUR UNDERSTANDING >>

1 What are the three main characteristics of a group?
   - A Two or more people, interaction between members, share all interests
   - B Two or more people, share a common goal, share all interests
   - C People who share a common goal, see each other at least once a week, influence each other
   - D Two or more people, influence and interaction between members, share a common goal

2 The person in a school with the most social power is generally:
   - A the captain of the hockey team.
   - B the year level coordinator.
   - C the teacher.
   - D the principal.

3 Status refers to:
   - A a person's position in the hierarchy of a group.
   - B whether they are married or not.
   - C the shared purpose of a group.
   - D the role a person plays in life.

4 If there are six people in line to use the ATM, are they classified as a group? Explain your answer with reference to the definition of a group.

5 Use an example to explain the terms 'group', 'status' and 'social power'.

ZIMBARDO'S STANFORD PRISON EXPERIMENT (1971)

Zimbardo was interested in how perceptions of status in a group influence the way people relate to one another. More specifically, he was interested in finding out whether prison guards and prisoners behave the way they do because of their personal characteristics or because of the roles in which they are ascribed.

Zimbardo chose 24 male university students as participants and he selected only young men who showed stable personalities (see Figure 11.2).

Zimbardo randomly allocated participants to the role of prisoner or guard so that any individual differences between participants were spread equally across the experimental and the control groups.

To make the situation realistic, prisoners were collected from their homes by police in police cars. They were then driven to the simulated prison located in the basement of a building at Stanford University in California. Once they arrived at the 'prison', the prisoners were stripped of any individuality. They were ordered to undress, sprayed for lice, required to wear prison uniforms, assigned a number and ordered to answer to their numbers.

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The guards, who were dressed in a different uniform and wore reflective sunglasses, were asked to develop whatever rules they felt were appropriate for the prisoners. These rules included frequent line-ups and count-downs to keep the prisoners in their place.

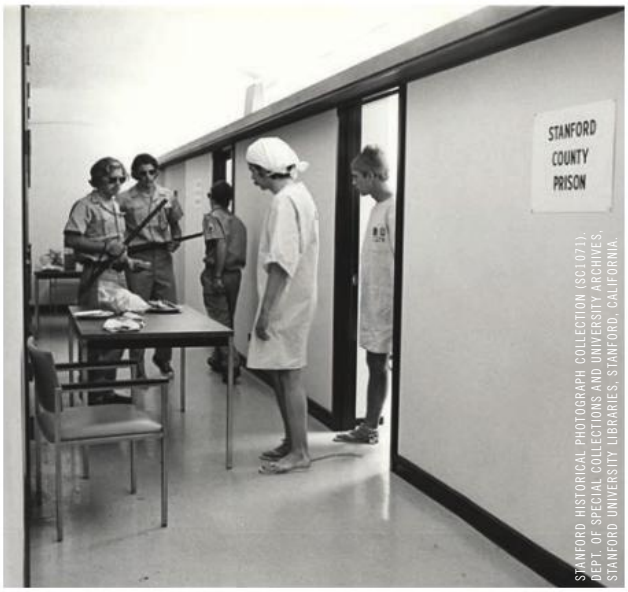


FIGURE 11.2 Participants in the prison experiment

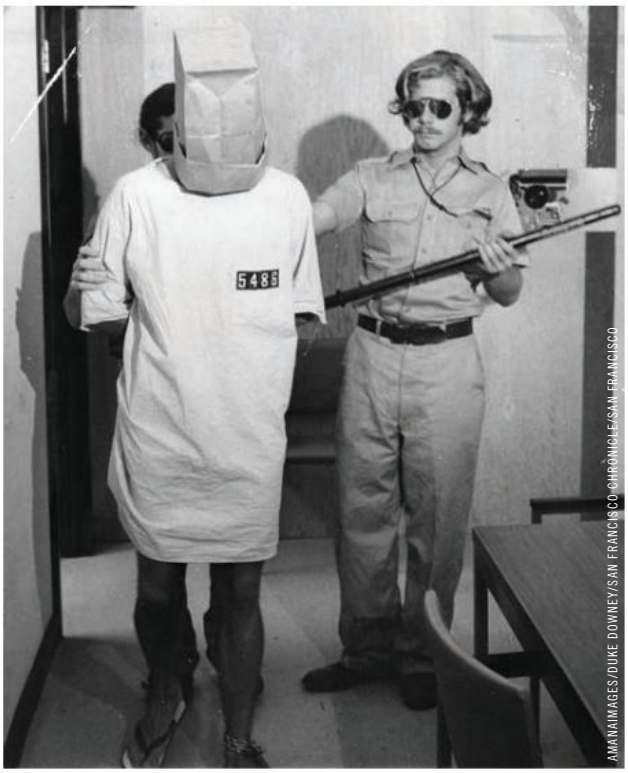


FIGURE 11.3 'Prisoner' and 'guard' in Zimbardo's experiment

After just two days in 'prison', the prisoners grew restless and defiant. When they staged a riot, the guards unmercifully suppressed the rebellion. Over the next few days, the guards clamped down with increasing brutality. In a surprisingly short time, the fake convicts looked, behaved and felt like real prisoners: they were dejected, traumatised, passive and dehumanised. Four of them had to be released because of hysterical crying, confusion or severe depression. Each day, the guards tormented the prisoners with more frequent commands, insults and demeaning tasks. After 6 days, the experiment was halted.

The assigned roles – prisoner and guard – were so powerful that in just a few days the experiment became 'reality' for those involved. Afterwards, it was difficult for many of the guards to believe their own behaviour. As one recalls, 'I was surprised at myself. I made them call each other names and clean toilets out with their bare hands. I practically considered the prisoners cattle' (Zimbardo, Haney & Banks, 1973). Clearly, the origins of many destructive human relationships can be found in roles that give some people a high level of status.

11.1 FOCUS ON RESEARCH

BARBARISM THEORY PUT INTO SICKENING PRACTICE IN IRAQ

A 1970s experiment is in the news again for all the wrong reasons. Muriel Reddy reports.

It has taken 33 years for Professor Philip Zimbardo to take his place in the sun. But even he has been astonished at the level of worldwide publicity he has received because of the parallels between what has been happening at Abu Ghraib prison in Iraq and a study he conducted in 1971.

Since the scandal detailing the sadistic abuse of detainees by US troops broke, Professor Zimbardo has been conducting interviews with media from all over the world. Now he has been asked to testify on behalf of a soldier charged with abusing prisoners in Iraq.

His cause celebre is a study he conducted at Stanford University in California, where he has been a researcher and educator since 1968, which produced such extraordinary and horrifying results that it had to be halted after six days.

In the study, designed to run for two weeks, he divided 24 college students into guards and prisoners to test the power of social situations to alter behaviour. The students had undergone psychological tests and had no history of crime, drug addiction or psychological disturbance.

However, during the experiment, these ordinary men stripped their 'prisoners' naked, humiliated them, degraded them, put bags over their heads, chained

→

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them together and finally, began a descent into sexual degradation.

Professor Zimbardo explained: 'What happened was the guards began telling one group of prisoners, "bend over, you're female camels", and to the other group, "you're male camels, hump them." ' The study was halted when four prisoners had emotional breakdowns. 'Doesn't this sound very familiar to what has been happening at Abu Ghraib in Iraq?' he asked.

Professor Zimbardo has been interested in the effect that situational factors have on events since reading William Golding's *Lord of the Flies*, which recounts the story of a group of boys marooned on an island and their subsequent descent into barbarism.

'When people feel anonymous, when they are hooded or painted – as the boys in *Lord of the Flies* were – or in uniform, their individuality is diffused. I believe that the human mind is the most incredible facility but it has the capacity to do or to be anything … In the same world that we have had Mozart and Beethoven and Bach, we have also had Stalin, Idi Amin and Pol Pot.'

Professor Zimbardo believes we have greatly underestimated the extent to which behaviour can be influenced by situation. 'We are social animals and we learn from other people. If the majority is doing it, then that is what is acceptable.'

However, while up to 90 per cent may be blindly obedient, Professor Zimbardo said another group of passive bystanders would not challenge the bad behaviour. They maintained the system with their silent dissent.

'Then there are the few heroes, the people who are able to resist. At Abu Ghraib, there were three heroes – the dog trainer who refused to let his dogs bite the prisoners, a second soldier who reported the abuse to his commander, and a third who not only resisted but took the photos as evidence for his commander.'

Professor Zimbardo believes that prisons throughout the world are veiled in a cloak of secrecy. He cites the example of Guantanamo Bay where there have been 16 suicides in the past three years and, it appears, no public or other investigations into the deaths.

'In Iraq, you had all the negative factors in place – lack of leadership, little or no accountability, no training and the CIA who clearly encouraged the soldiers to do these things,' he said. 'Some of the pictures were staged by the CIA because they planned to show them to other detainees they were going to interrogate. Once the CIA lowered the moral threshold to zero or minus, the soldiers were at liberty to do whatever they wanted to these people they regarded as animals …

'If the pictures we saw are not the final phase, then you move from simulated sodomy to sodomy …'

Professor Zimbardo said US President George Bush insists the prisoner abuse 'does not reflect the actions of good American soldiers. That just illustrates the arrogance of Americans.'

Source: Reddy, M. (2004, May 16). Barbarism theory put into sickening practice in Iraq. *The Age*.



FIGURE 11.4 Prisoners at Abu Ghraib experiencing inhumane treatment by the US army

QUESTIONS

1 Why can the situation that occurred at Abu Ghraib be considered a case study and not an experiment?
2 Making reference to Abu Ghraib, what are the benefits of case studies?
3 What are the similarities between Abu Ghraib and Zimbardo's experiment?

SOCIAL POWER

While the concepts of status and social power are related, they are actually based on separate ideas. Status refers to a person's standing in the community or group; social power is about a person's capacity to exert influence over others. Often a person with high status also has social power. For example, a teacher has a high level of status in a class and also has power, in that they can influence the behaviour of class members. Often having high status gives a person a level of power.

It is also possible that a person could have high status and a lot of social power in one situation or group, but not in another. Consider the oldest child in a family, who has high status among the children of the family. That same child may have low status at school and little social power in that context.

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Sometimes the social power that a person exerts can be quite subtle and they may not realise that they are influencing those around them. A person who is perceived by their peers as 'popular' may not be aware of the social power they possess. In this instance, the influence they have on the behaviour of others may not be intentional. Think of the example of the oldest child who has high status; they may not intend to influence their younger siblings' choices in music and clothing, but as a result of their status they may exert influence anyway.

Psychologists Raven and French (1958) identified five different bases of social power: reward, coercive, legitimate, referent and expert power (see Table 11.1). They suggested that, depending on the situation or group, the nature of the influence a person has differs. According to Raven and French, some individuals may possess more than one type of power. For example, a boss who is well respected by their employees could exert both reward power and referent power. Their employees are influenced because the boss pays them, but also because they aspire to be like them.

TABLE 11.1 Social power types, descriptions and examples

SOCIAL POWER	DESCRIPTION	EXAMPLES
Reward	This power is based on the ability to reward a person who complies with the desired behaviour.	Teachers reward students with results. Employers reward employees with bonuses.
Coercive	This power is based on the ability to punish a person for failure to comply.	Fines and imprisonment are used to control behaviour.
Legitimate	This power is based on our acceptance of a person as an agent of established social order.	Elected leaders Teachers in a classroom Parents at home
Referent	We refer to the person for direction. We want to be like the person.	Pop stars Sporting heroes
Expert	We recognise a person has knowledge or expertise in a specific field because of their training and experience.	Doctors Lawyers Plumbers Computer technicians

11.2 CHECK YOUR UNDERSTANDING >>

1 Zimbardo's prison experiment is considered important because it demonstrated:
   - A the need for more prisons.
   - B that prisons do not rehabilitate people.
   - C the difference in unconscious motivations and emotions.
   - D the powerful effects of role-taking by prisoners and guards.

2 Zimbardo's experiment was conducted over how many days?
   - A Two
   - B Four
   - C Six
   - D Eight

3 An individual with reward power refers to:
   - A a group member who has the ability to punish another for failing to comply.
   - B a person with particular knowledge or expertise in an area because of their training and experience.
   - C a person we want to be like or who inspires us to do what they do.
   - D a person who has been given the power to reinforce others in the group who comply with the desired behaviour.

4 Briefly describe the method Zimbardo used in the prison experiment.

5 Give an example of each of the five bases of social power.

OBEDIENCE

Obedience occurs in situations in which people change their behaviour in response to direct commands from others. A person with higher status and social power is more likely to be obeyed (Birchnell, 1993). This does not mean that you necessarily agree with the command, only that you obey and do what you are told to do. For instance, you may pick up some rubbish in the school yard if a teacher asks you to do so (obeying a direct command), even if you think that you should not have to do it as you didn't drop the rubbish. In some situations we may ignore the norms that usually govern our lives, and obey direct orders that are inconsistent with those norms. Under direction from others, we may even carry out acts that would normally be unthinkable to us and that we may even feel are morally wrong.

Obedience requires the issuing of a direct command; therefore it is more direct and less subtle than social power. However, whether the individual obeys a command might depend on the social power of the person issuing the command.

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Milgram's studies of obedience

The classic studies of obedience were conducted in the 1960s by Stanley Milgram. His experiment relied on deceiving participants to believe that they were inflicting electric shocks on another participant. Milgram wanted to see at what point people would disobey a direct command issued by the experimenter. In the initial study in 1962, Milgram studied 40 males aged 20 to 50 years. These men were drawn from a range of occupational backgrounds and included clerks, engineers and teachers. At this time it was not unusual for experiments to exclude women as participants and yet apply the findings to women also. In later studies Milgram included women.

If you had been a participant in one of Milgram's (1963) experiments, you would arrive at the laboratory and find that there were two participants scheduled to take part in the same experiment. You and the other participant would draw slips of paper to find out who would be the teacher and who would be the learner. Let's say you draw the slip to be the teacher. The 'learner' is really a confederate and is working with the experimenter. As the teacher, you are told by the experimenter that you are to read a list of word pairs to the learner. You will then test the learner to see how well he has memorised the word pairs. You are to read the first word of the pair to the learner, who should then tell you the second word of the pair. If the learner makes a mistake, you are to give him an electric shock.

The learner is connected to a complicated-looking piece of equipment that will be used to deliver the shocks. His arms are strapped to the chair so that he does not displace the electrodes that are connected to the backs of his hands. Each time the learner makes a mistake, you are to administer the electric shock by pressing a lever on a shock generator to which he is connected. The shock generator has a clear scale showing the levels of shock. These range from 15 volts to 450 volts. There are also verbal descriptions displayed, ranging from 'Slight shock' to 'Danger: severe shock'. Each time you give the learner a shock, you are told to increase the level by 15 volts.

Soon the learner makes a mistake. You deliver a shock. The learner makes more and more mistakes and you deliver more shocks of increasing voltage. The learner moans after each shock and, concerned by the level of shocks, you ask the experimenter if the learner is all right. The experimenter assures you it is all right and that the shocks might be painful, but will not cause any permanent tissue damage. When the learner refuses to supply answers, the experimenter tells you to treat this refusal as a wrong answer and to continue. You become even more concerned about the learner. You start to sweat and become shaky. You again discuss the situation with the experimenter, who tells you to go on. You go on to deliver shocks of 450 volts to the learner.

At this point the experiment is terminated and you are interviewed by the experimenter. He asks you what you thought the study was about, and how you felt during the study. Then the experimenter explains the true purpose of the study.

Of course, in reality the learner did not receive any shocks, but the dilemma of the teacher was quite real. The learner was a confederate. 'Teachers' protested, sweated, trembled, stuttered, bit their lips and laughed nervously. Clearly they were disturbed by what they were doing, but most obeyed the experimenter's orders.

The experiment was designed to see at what point people would disobey. The results surprised everyone, even Milgram. Few participants withdrew from the experiment before delivering shocks of 300 volts, and 70 per cent of participants delivered the maximum voltage of 450 volts (see Figure 11.5). The most surprising thing is that none of the participants walked out of the experiment.

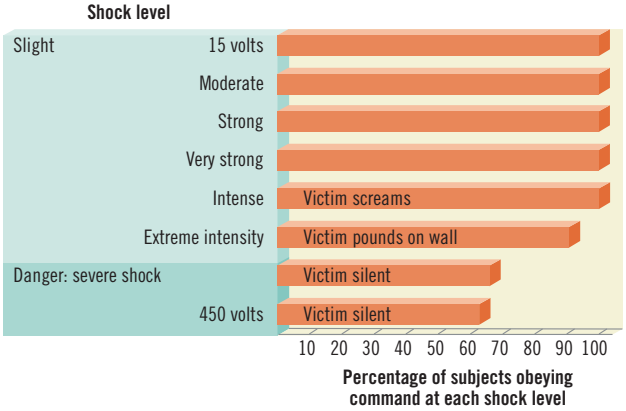


FIGURE 11.5 The level of shock shown on the shock generator

Milgram concluded that the participants were influenced by the gradual nature of the situation. Participants took on a task and gradually found that it was more and more inconsistent with their beliefs about what they should and should not do.

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However, there was no clear cut-off point at which to switch from obeying what seemed a reasonable request to disobeying what seemed to be an unreasonable command. The participants became locked into the situation. By obeying the first small command, they felt they had to keep going and obey larger and larger commands.

Milgram's research suggests that a number of environmental factors have an effect on obedience, including social proximity, legitimacy of authority figures and group pressure.

Factors affecting obedience

SOCIAL PROXIMITY

Whether or not a person will obey orders is partly dependent on social proximity, or the social distance between two parties. In the case of Milgram's experiments, the social proximity was the distance between the person inflicting the harm (the teacher) and the person being harmed (the learner), and this influenced the level of obedience. The greatest level of obedience occurred in the situations in which the learner was more remote from the teacher.

When the learner was located in a different room from the teacher, who saw the learner's responses on a display panel in front of him (see Figure 11.6), the proportion of participants obeying the experimenter's directions was highest. When the learner was able to be seen or touched by the teacher, the proportion of participants administering the high level of shock decreased (see Figure 11.7).

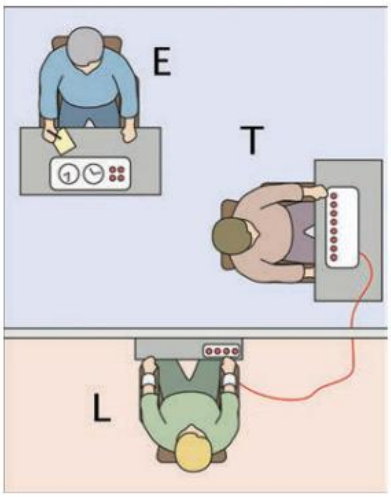


FIGURE 11.6 Experimenter, 'teacher' and 'learner' in Milgram's experiment

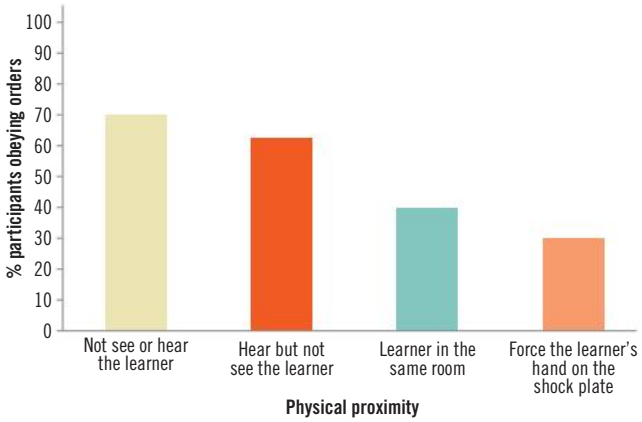


FIGURE 11.7 The physical distance from the learner had a significant effect on the percentage of teachers obeying orders.

LEGITIMACY OF AUTHORITY

Several factors influence participants' obedience to authority in this type of situation. Milgram's study was conducted at a well-known university by a high-status figure. The higher status attributed to a person who issues an instruction or command can lead participants to the conclusion that they are not responsible for their actions. They may conclude that the person who issues the instruction or command is responsible for their behaviour and they were only following orders. Milgram's participants believed that important scientists must know more about these things than they do, and that it was the scientists who were responsible for the participants' behaviour. To test this idea Milgram replicated the experiment on another site, away from the university. Similar results were obtained, but fewer participants fully obeyed the command to keep going.

GROUP PRESSURE

In another experiment, Milgram found that group support can greatly reduce obedience. For this study Milgram used the same method involving 'teacher' and 'learner', but used two other confederates as 'teachers'. When these 'teachers' refused to follow orders and walked out on the experiment, the real participants were less likely to obey. Only 10 per cent of participants continued to administer the shocks after this. This suggests that if someone has the

social proximity The social distance between one person and another; it is more variable than physical distance, because it includes the degree of opportunity to interact with the other person

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courage to disobey what they feel is misguided or unjust authority, this may encourage others to have the courage to do the same.

Further studies of obedience

In 1974, Kilham and Mann conducted a similar experiment in Australia, but used a confederate to convey orders from the experimenter to the participants. This meant that the experimenter was not directly giving orders to the teacher. Were Australian participants different? It appears not. In this situation, 40 per cent of participants were totally obedient and delivered shocks of 450 volts. Interestingly, when participants were allowed to select the level of shock administered, rather than move systematically up the shock generator, they consistently selected shock levels at the lower end of the scale. This suggests that participants were reluctant to administer higher voltage shocks and would only do so when given direct orders.

In 2009, Jerry Burger published the results of a study, which he claimed replicated Milgram's. Yet Burger made considerable modifications to Milgram's experiment, including stopping participants from going past 150 volts. This was the point at which Milgram found that the 'learner' first showed signs of distress. This difference makes it difficult to compare Burger's findings with the findings of Milgram's original study. However, given that 70 per cent of Burger's participants gave shocks up to 150 volts, the findings do suggest that perhaps not much has changed in terms of people's willingness to submit to authority.

The implications of Milgram's studies

Milgram initially conducted his experiments about obedience because of his concern about the killing of European Jews from 1933 to 1945. He was interested in when people obey orders issued by others and when they obey the dictates of their own conscience (Figure 11.8).

His research raises questions about our willingness to commit anti-social or inhumane acts commanded by a 'legitimate authority'. The excuse so often given by war criminals – 'I was only following orders' – takes on new meaning in this light. Milgram suggested that when directions come from authority, people rationalise that they are not personally responsible for their actions. Others have pointed out that 'crimes of obedience' may be committed by ordinary people responding to normal social psychological processes. In locales as diverse as Vietnam, Rwanda, Bosnia, South Africa, Nicaragua, Sri Lanka and Laos, for example, the tragic result has been 'sanctioned massacres' of chilling proportions (Kelman & Hamilton, 1989).



GETTY IMAGES/KEYSTONE-FRANCE/GAMMA-KEYSTONE

FIGURE 11.8 The persecution of Jews and the establishment of concentration camps in Europe during WWII were one result of people obeying orders. This image shows prisoners being liberated from a concentration camp in Germany in 1945.

Even in everyday life, 'crimes' of obedience are common. In order to keep their jobs, many people obey orders to do things that they personally regard as dishonest, unethical or harmful (Hamilton & Sanders, 1995). These range from a salesperson stretching the truth in order to sell a product, to encouraging someone to take out a loan that they probably cannot afford. Obedience to authority is obviously necessary and desirable in many circumstances, such as obeying firefighters during a bushfire or following a safety instruction from the pilot on a plane. Just the same, it is probably true that, as C. P. Snow (1961) observed, 'When you think of the long and gloomy history of man [sic], you will find more hideous crimes have been committed in the name of obedience than in the name of rebellion'.

11.3 CHECK YOUR UNDERSTANDING >>

1 Milgram's study showed that social proximity:
- A had no bearing on obedience.
- B was not a valid theory.
- C had an important influence on obedience.
- D was important in order for the participant to understand the experiment.

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2 Obedience refers to:
   A a person doing something for the common good.
   B a person doing what everyone else is doing.
   C a person following a direct command to do something.
   D a person having the training and expertise to know when to follow a command.
3 Studies have shown that obedience is more likely if:
   A the person giving the command has higher status.
   B the person giving the command is further away.
   C the person giving the command has no authority.
   D other people refused to obey the command.
4 What was the aim of Milgram's experiment?
5 Describe how group pressure may impact on obedience with reference to Milgram's experiment.

CONFORMITY

We can explore the influence of groups on our behaviour by considering the nature of conformity, the different types of conformity and the factors that increase conformity. Conformity occurs in situations in which individuals change their behaviour as the result of real or implied pressure from others. A number of factors affect conformity, including normative influence and culture, informational influence, unanimity, group size, deindividuation and social loafing.

Asch's studies

The process of conformity was first studied experimentally by Solomon Asch in the 1950s through a series of studies that are now seen as classics in the psychological literature (Asch 1952, 1955). As a participant in one of Asch's experiments, you would walk into a room with about four other participants. You would sit at the side of a long table and assist the experimenter in a perception task. You would look at a vertical line (called the standard line) and then look at three vertical lines (called the comparison lines). Then you would indicate which line is the same length as the standard line (see Figure 11.9).

In the first few trials, all participants give the same, obviously correct answer. Then, in the next trial, the four people before you all give the same answer, an answer which to you appears to be obviously incorrect. What do you do? Do you give the correct answer, or do you agree with the preceding four participants and give the answer they have already given?

Data presented by Asch (1955) suggested that 75 per cent of participants 'made a mistake' and went along with the group on at least one occasion, although 24 per cent of participants never conformed.

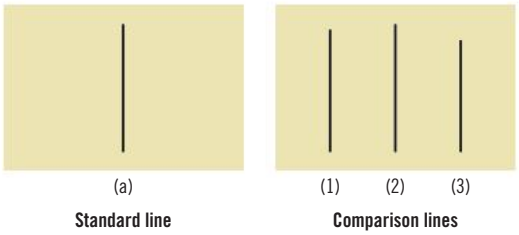


FIGURE 11.9 An example of the judgment task in an Asch conformity experiment

In contrast, people tested alone erred in less than 1 per cent of their judgments. Those who yielded to group pressures were clearly denying what their eyes told them. The other participants gave the wrong answer because they were confederates. Asch's study showed that participants were strongly influenced by the actions of those around them.

Factors affecting conformity

NORMATIVE INFLUENCE AND CULTURE

Normative influence refers to the impact of the established behaviour of the group, termed group norms, on the likelihood of a person conforming. If a group of which you are a member, such as your family, has an established norm, for example that shoes are not worn inside the house, then it is likely that you will conform to this. To avoid being ridiculed by our friends and family we have learned to conform to group norms.

Group norms are standards that are set by the groups to which we belong. They may not be explicitly stated but they are established patterns of behaviour. This may include the way you dress (Figure 11.10), the time you arrive at a party, or the way you speak.

The influence of others can lead us to conform to differing degrees. If we conform only in the presence of group members, this is referred to as public conformity. In this situation your beliefs are not consistent with your behaviour. Asch's study was an excellent example of this. In the case of private conformity, your beliefs

conformity Bringing one's behaviour into agreement with norms or with behaviour of others in a group

normative influence The impact of the standards established by the group on an individual's behaviour

group norms Standards set by a group, which group members follow

public conformity Accepting the behaviours of the group when they are present, but not accepting them as part of one's personal beliefs

private conformity Accepting the behaviours of the group as part of one's own personal beliefs

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and behaviour are consistent. You are therefore likely to exhibit similar behaviour when you are alone to what you would in a group context. A greater degree of conformity is present in private conformity, as your private thoughts have been influenced as well as your public behaviour.

The research in this area shows wide variation in the rate of conformity, depending on the cultural background of the participants. People from cultures that emphasise group cooperation, collectivist cultures like many Asian cultures, are more likely to conform to group norms than people from more individualistic cultures, such as the United States (Bond & Smith, 1996; Smith & Bond, 1998). Collectivist cultures tend to value group needs or interests over the interests of the individual. In collectivist cultures, putting yourself and your own interests first would be more likely to be seen as selfish and unacceptable behaviour. If you are part of a collectivist culture, there is an emphasis on conformity above individualism. In contrast, individualistic cultures are centred on the individual and individual needs. Within individualistic cultures people are conditioned to put their own needs above the needs of others. This is a stark cultural difference that inevitably influences the rates of conformity.

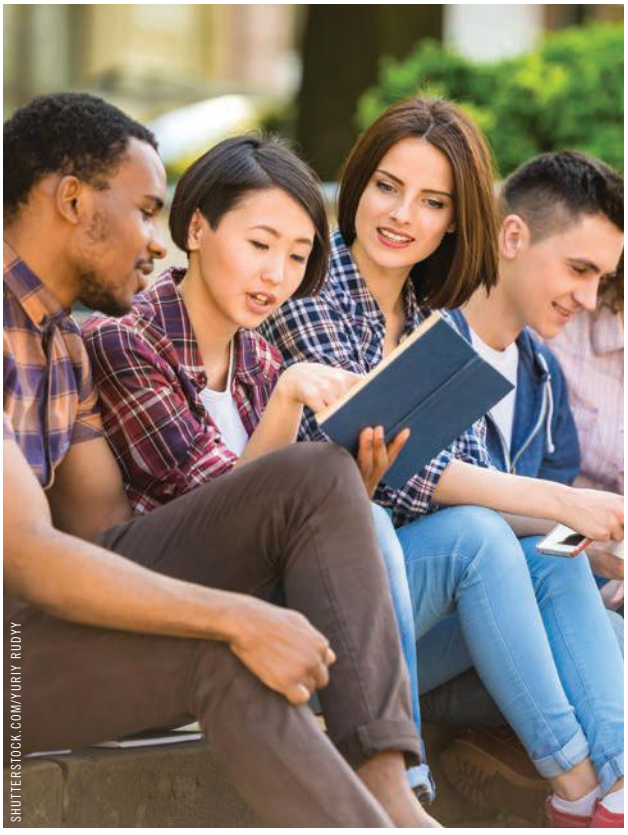

SHUTTERSTOCK.COM/YURIY RUDYY

FIGURE 11.10 Peer groups often dress and act similarly.

INFORMATIONAL INFLUENCE

When we visit a foreign country, or even when we move from primary school to secondary school, or from school to work, we observe the behaviour of others to find out how we should behave. In these situations when we are influenced by the behaviours of those around us and these shape our actions, it is called informational influence. Informational influence will also impact on conformity, as we look to others' behaviour to guide us in whether we should behave in a like manner. For instance, if you were to visit an unfamiliar place of worship, such as a church or a mosque, you would look to the behaviour of others to provide an example of how to act, such as where to sit or stand (Figure 11.11).

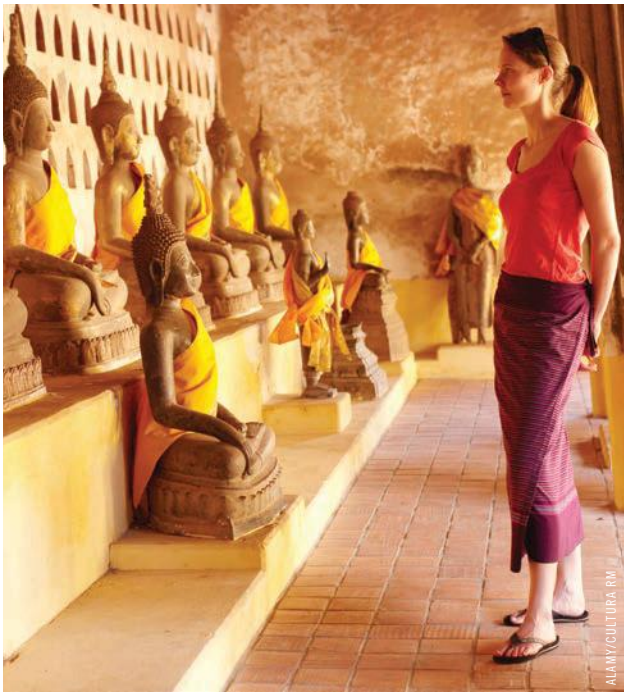

ALAMY/CULTURA RM

FIGURE 11.11 People who are not Buddhist and visit a Buddhist temple would look to the behaviour of locals to provide an example of how to act.

UNANIMITY

When everyone in the group agrees or does the same thing this is referred to as unanimity. A unanimous group is a very powerful influence for conformity. In Asch's (1952) studies, there was unanimous agreement from the group about which line was the correct line and this had a strong influence on the participants' behaviour. If we have one supporter (or ally) then we are unlikely to be influenced by the group. In terms of numbers, a unanimous group of three is more powerful than a majority of eight with one dissenting person.

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Perhaps this accounts for the rich diversity of human attitudes, beliefs, opinions and lifestyles. In many situations, if you can find at least one other person who sees things as you do, you can be relatively secure in your opposition to other viewpoints.

GROUP SIZE

The extent of group influence also depends on the size of the group. Studies have shown that the number of conforming participants increased dramatically as the size of the group grew from two to four. This means that if you were in a group with just one other person you would be less likely to conform than if there was a group of four people where the other three were all doing the same thing. However, a majority of four produced about as much yielding as a majority of eight. The next time you want to talk someone into (or out of) something, take two friends along and see what a difference it makes.

11.1 TRY IT YOURSELF >>

MIND MAPS

Create a mind map for each of the following experiments:

» Zimbardo
» Asch
» Milgram.

Include in the mind maps the method, the results and the links to the theory each experiment was testing.

11.4 CHECK YOUR UNDERSTANDING >>

1 Asch's (1953) experiments into conformity demonstrated that people would conform to the group consensus even when the response was clearly incorrect. However, the experiments also showed that the degree of conformity was affected by:
   A group size and the participants' intelligence.
   B the group leader's personality and presence of an ally.
   C task difficulty and group size.
   D group size and presence of an ally.

2 Informational influence allows people to:
   A look at the behaviour of others in order to make judgments about how to behave themselves.
   B look at the behaviour of others in order to feel better about themselves.
   C behave in ways they usually would not, because the attention is shifted to others.
   D make less effort when in a group than when by themselves.

3 Culture can affect conformity because some cultures:
   A have larger groups and therefore are more likely to conform.
   B have more conformity but less obedience.
   C are collectivist so that there is less conformity.
   D are collectivist so that there is more conformity.

4 Using an example explain the difference between private and public conformity.

5 What effect does unanimity have on conformity?

DEINDIVIDUATION

Sometimes, particularly when we are in a large group, our behaviour can be influenced by a sense of anonymity, and this can lead us to behave in a way in which we never would alone. For instance, crowds of students in a cafeteria will throw food around and crowds at the football will scream at the umpire. Psychologists explain this behaviour in terms of deindividuation. To be deindividuated is to become less self-conscious and less inhibited, becoming excited by the current situation and ignoring any possible consequences of our actions. Deindividuation involves a shift in our self-awareness away from the self to the situation or the people with whom we are acting (Diener, 1979; Zimbardo, 1969). In very large groups or crowds, most people do not accept responsibility for their own behaviour (Kogan & Wallach, 1967). Also, the group behaviour provides information: the individual feels that 'if everyone else is doing it, it must be okay'.

The concept of deindividuation was explored in a series of studies by Zimbardo (1969), who argued that the group provided the individual with a sense of anonymity that removed personal responsibility for one's actions. He conducted laboratory studies in which he made people feel anonymous by dressing them in laboratory coats and putting hoods over their heads (rather reminiscent of the Ku Klux Klan). He found that participants who were allocated to the role of

collectivist culture A culture that values the group over the individual

individualistic culture A culture that values the individual over the group

informational influence Where the social environment or situational cues are used by individuals to help them monitor or adapt their behaviour to fit with the behaviour of those around them

unanimity Agreement among all members of a group

deindividuation The loss of social identity and inhibition, causing a person to lose responsibility for their own actions and causing them to ignore possible consequences

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prison 'guard' treated the 'prisoners' worse when they were deindividuated. So within a group an individual may be more likely to conform to more extreme group behaviours if they have experienced deindividuation and are feeling a sense of anonymity.

SOCIAL LOAFING

The tendency for individuals to reduce their effort in a group has been termed social loafing. The phenomenon of social loafing was measured by Latané, Williams & Harkins (1979) in an experiment where participants were asked to clap or cheer as loudly as they could. At first they were asked to do this when alone, and then they were asked to do this in the company of others. The researchers found that the participants clapped louder when they thought they were alone compared to when they were in a group.

When individuals work together in a group in such a way that their individual efforts cannot or are not being measured, there is a tendency for these individuals to put in less effort. It seems that when individuals in the group sense that others are not pulling their weight, they sometimes reduce their effort. This is known as the 'sucker effect'. Or if they sense that others are doing enough in order to successfully achieve the task, they do not contribute as it seems they can get away with it, the 'free rider' effect.

As with other influences on conforming behaviour in groups, social loafing is influenced by cultural norms. Cultural influence plays a role in social loafing in that those cultures that are more individualistic, such as the United States of America and Australia, are likely to see more instances of social loafing than those with more collectivist cultures, such as China or Israel. Studies involving Chinese participants have demonstrated that individuals work harder in a group than when they are alone (Gabrenya, Latané & Wang, 1983, 1985). In another study, managers from the USA, Israel and China were compared. When they were told they were working in a group, social loafing was observed only in the managers from the USA. Both the Israeli and Chinese managers worked harder when they believed they were working as part of a group consisting of other workers that they knew. This difference in attitude illustrates how different cultural norms can result in completely different behaviour in group settings. Some research has also indicated that gender has an impact on social loafing. Women seem to engage in social loafing less than men (Karau & Williams, 1993).

Research suggests that some factors can reduce the likelihood of social loafing. If individual effort and output can be measured, the group and/or task has a high level of importance, or if the group is made up of friends rather than strangers then social loafing is less likely to occur (Karau & Williams, 1993).

11.5 CHECK YOUR UNDERSTANDING >>

1 An example of social loafing is:
   - A singing more quietly in a choir.
   - B driving more slowly to fit in with the speed of the traffic.
   - C not concentrating when in class.
   - D going to a concert your friend likes.

2 When people in the crowd at a soccer match become less inhibited and feel less responsible for their actions, this is an example of:
   - A hooligan behaviour.
   - B social loafing.
   - C obedience.
   - D deindividuation.

3 The circumstance in which social loafing is least likely to occur would be:
   - A high group importance, group consists of strangers, individualistic culture.
   - B low group importance, group consists of friends, collectivist culture.
   - C high group importance, group consists of friends, collectivist culture.
   - D low group importance, group consists of strangers, collectivist culture.

4 Define social loafing and give an example of when you have been a social loafer.

5 What aspects of the Zimbardo prison experiment allowed the guards a sense of deindividuation?

CHARACTERISTICS OF PRO-SOCIAL BEHAVIOUR

The presence of others often influences the way in which people behave. A number of other personal and environmental factors contribute to people's behaviour. They can lead to both pro-social and anti-social behaviour.

Pro-social behaviour occurs when a person selflessly does something to help somebody else, with little regard for their own self-interest or personal safety. This behaviour is positively valued by society.

For the behaviour to be pro-social, it has to be helpful to the person being helped. It is not a pro-social act if you assist someone to cross the road when they do not want to cross, or if you pull a child out of the water when that child is swimming happily and safely.

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The behaviour must also be selfless; that is, the person is not looking for some sort of recognition or reward or acting out of self-interest. A pro-social act is also one that is positively valued by society. Helping an elderly person walk when they are obviously having difficulty and they want help is an example of pro-social behaviour (Figure 11.12).



FIGURE 11.12 An example of pro-social behaviour

FACTORS INFLUENCING PRO-SOCIAL BEHAVIOUR

Like all forms of behaviour, pro-social behaviours are influenced by a number of factors. These factors include situational factors, social norms (the reciprocity principle and social responsibility), and personal characteristics. Learning about pro-social behaviour helps psychologists develop environments and educational programs that increase the incidence of pro-social behaviours in our society.

Situational factors

The location, the skills of the person and the number of other people present are all situational factors that influence the likelihood of a person engaging in pro-social behaviour. Examination of bystander intervention and the bystander effect provides an example of how situational factors work.

LOCATION

Research suggests that whether or not you will give help depends on where you live or where you are at the time. People in small towns are generally more likely to receive help than are those in large cities, because people in small towns often know each other and feel they are part of a community. It is expected that people in the community will help each other or anyone visiting their community. Different types of pro-social behaviour have been studied in capital cities, regional cities, towns and small communities. Studies compare the numbers of people who offer help with the number of people who do not in these different locations. The types of help needed include emergency situations, such as a car breaking down or a major health problem. Everyday behaviours studied include helping people who have dialled the wrong number, returning overpayments to a shop, mailing lost letters and buying greeting cards from charities (Baron & Byrne, 1991). The results are always the same – the bigger the city, the less likely it is that people will help.

THE VICTIM'S CIRCUMSTANCES

Helping behaviour is influenced by our beliefs about the situation of the person needing help. We look at the situation and ask ourselves, 'Does this person really need help?' If we think that the person has a genuine problem, such as a health issue, or has been injured by someone else, we may feel that we should help. If, however, we think that the person is in the situation due to their own fault and that they are responsible for their predicament, we may stop thinking of them as a victim and rather as someone asking for trouble.

This type of thinking stops some people from helping a person who is drunk, for instance. Studies have shown that when a man passed out on a train, he was more likely to receive help if he carried a cane (appearing to be disabled) than if he carried an empty bottle of alcohol (appearing to be drunk) (Piliavin, Rodin & Piliavin, 1969).

Women are more likely to receive help than men, and children are more likely to receive help than adults.

social loafing The tendency for an individual to reduce their effort in a group

BYSTANDER INTERVENTION

A bystander is a witness to an event or situation. Bystanders are not involved and do not influence the interactions that take place. An example would be a pedestrian waiting to cross at a set of lights and witnessing a car run into the back of another car.

Bystander intervention is where the witness gets involved in the situation. It is more likely that a bystander will intervene if that person is in the habit of taking control of a situation. Some people in the community are more likely to take charge, and automatically adopt a leadership role; for example, teachers, supervisors, scout leaders and emergency workers. If they do not have the necessary skills, they are more likely to contact someone who has or to motivate people around them to do something.

BYSTANDER EFFECT

Interest in why people fail to help others was sparked by a now-famous incident in New York. Late one night in 1964, Kitty Genovese was walking home. Suddenly she was attacked by a person with a knife. She fought the man off and screamed at the top of her voice. From the safety of their rooms, many people heard her agonised screams. The man found her and attacked her again. Yet again, she managed to get away and screamed for help. She was stabbed nine times and sexually assaulted. This horrific incident caught the attention of the media, as well as the attention of two American social psychologists, Bibb Latané and John Darley. They began research designed to answer the question, 'Why don't people help in an emergency situation?' The first issue they addressed was whether the presence of other people had an effect on people's willingness to help. Their research showed that the presence of others reduces the likelihood of pro-social behaviour. This is known as the bystander effect.

11.6 CHECK YOUR UNDERSTANDING >>

1 The bystander effect is where:
- A a large group of people observe a fight in the crowd at a football match and do nothing.
- B your friend is angry about what another friend said but you do not go to comfort them.
- C someone collapses at the train station and you are the only other person on the platform.
- D people are most likely to act in an emergency if they are alone.

2 Bystander intervention is where:
- A a witness does not get involved in a situation.
- B a witness does not see what happens in a situation.
- C there are no witnesses in a situation.
- D a witness gets involved in a situation.

3 Pro-social behaviour is:
- A helpful, positively valued by society, having expected rewards.
- B helpful, negatively valued by society, having expected rewards.
- C helpful, positively valued by society, having no expected rewards.
- D helpful, negatively valued by society, having no expected rewards.

4 Describe the difference between the bystander effect and bystander intervention.

5 Explain how location and a victim's circumstance can influence whether someone is going to behave pro-socially or not.

11.2 FOCUS ON RESEARCH

LATANÉ AND DARLEY'S RESEARCH INTO THE BYSTANDER EFFECT

In an illustrative experiment of the bystander effect, students were invited to an interview to discuss issues relating to university life. When the students arrived, they were asked to sit in a room and complete a questionnaire. While they were doing this, smoke started to pour through an air vent. The smoke continued to pour into the room for 6 minutes until the room was full of smoke. The researchers wanted to know whether the students would go to get help.

Latané and Darley used two conditions in this experiment: in one condition the students were alone and in the other condition they were in groups of three in the room. They found that 75 per cent of students who were alone went to get help, but only 38 per cent of students who were in the group went to get help (Latané & Darley, 1970) (see Figure 11.13). The students in the group cast their eyes around the room, glanced at each other and looked for clues as to what was happening. Each student was waiting for another student to act. Latané and Darley's research showed that the greater the number of people present, the less likely it is that each person will act to help the person in the emergency situation. The effect is that people are most likely to act in an emergency situation if they are alone. The likelihood of acting decreases as the number of people present increases. It is often described as 'the less leads to more' principle.

To test the generality of their findings, Darley and Latané (1968) conducted another study. Students were placed in cubicles to have a discussion. They were led to believe either that there were two people (themselves and one other) or that there were four or six people in the discussion. They were only able to communicate through microphones. One student told the others that he

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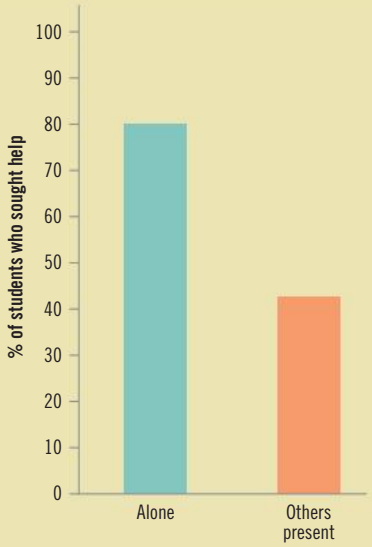


FIGURE 11.13 Students were more likely to seek help when they were alone.

was an epileptic. Suddenly he made choking and gasping noises and sounded as if he were having a fit. Darley and Latané wanted to see how many students would go for help. Their findings showed that the percentage of participants who went for help before the student finished having the fit depended on the number of students they thought were in the group (see Figure 11.14).

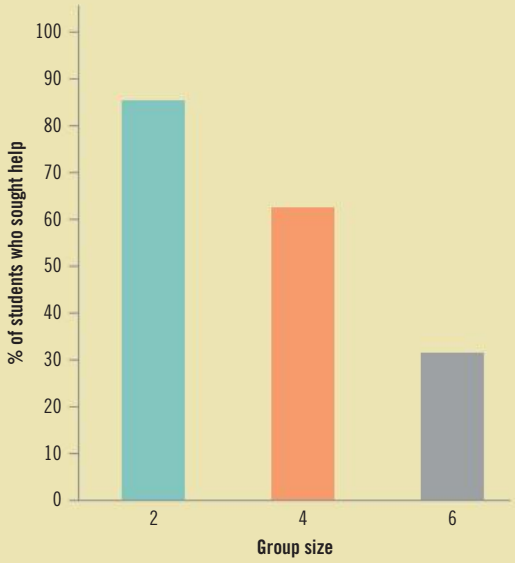


FIGURE 11.14 The number of students seeking help decreased as group size increased.

QUESTIONS

1 What were the independent and dependent variables in Latané and Darley's 'smoke' study (1970)?
2 Looking at the results in Figure 11.14, what effect did the group size have on the percentage of students who sought help in Darley and Latané's study (1968)?
3 Deception was used in both studies. Why was it necessary to deceive the participants in this way? How can the effects of deception be minimised?

SOCIAL FACTORS

Behaviour is influenced by what we believe we should do or what we think that other people who are important to us think we should do. How we behave reflects the groups to which we belong and the norms or beliefs that develop within these social groups.

The broadest norms are referred to as social norms because they are defined by society as a whole to establish 'normal' or acceptable behaviour in most situations. They prescribe what should be done and how it should be done. They influence most aspects of our lives. Norms provide guidance as to how we should dress when we go out, how we wait in queues and the way we eat in a restaurant, for instance. Comparing hairstyles, habits of speech, dress, eating habits and social customs in two or more cultures makes it clear that we all conform to social norms.

Some norms are universal. The best-known universal norm is the taboo against incest. In all cultures, it is agreed that parents should not have sexual relations with their children, and siblings should not have sexual relations with each other. Although this norm may be broken, it is universally accepted (Myers, 1990).

Norms develop within groups. Each group that you belong to will have some expectations about how other members of the group should behave. If you belong to lots of different groups, there may be some conflict between the expectations of one group and those of another. For example, a mother might experience conflict when the norms of her job require her to go to work and the norms of motherhood require her to stay home and care for a sick child.

When norms are required for the whole population they often become codified as laws. If we did not have expectations for our own behaviour and the behaviour of others, life would quickly become chaotic. What would happen if some people in Australia decided to drive on the right-hand side of the road instead of on the left? This particular law is rarely

bystander intervention Where a witness to an event or situation becomes involved

bystander effect If there are more people present in an emergency, help is less likely to be given

social norms Norms defined by society as a whole to establish acceptable behaviour in most situations

universal norm A behaviour expectation that is common to all cultures

law A norm that has become codified and is expected to be followed by all members of the population

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disobeyed. Other laws are taken less seriously. How many drivers are caught driving under the influence of alcohol or speeding? Norms that influence pro-social behaviour include the reciprocity norm and the social responsibility norm.

The reciprocity principle

Reciprocity means to do to others what they have done to you. If people help us, we should help them. The reciprocity principle is as universal as the incest taboo. Sometimes the people we help may be those who directly helped us, and sometimes they may be people who are similar to those who helped us. People who have been helped by others during or after a bushfire are often the first to volunteer to assist another community when it experiences a bushfire. Similarly, people who have been helped in the past by a particular charity are more likely to donate to an appeal by this charity than people lacking personal experience of receiving help.

Social responsibility

The social responsibility norm refers to the belief that everyone ought to help others who are less fortunate. This norm probably accounts for the fact that Australians have the highest rate of volunteering in the world. When motorists drop a few coins in the tins of SES or Red Cross volunteers, this behaviour is an expression of the social responsibility norm.

Individuals vary in the extent to which they adopt the norms of reciprocity and social responsibility. Whether or not a norm is at the forefront of our mind when we are confronted with a situation will influence whether we will act pro-socially.

11.7 CHECK YOUR UNDERSTANDING >>

1 Donating money to charity is an example of:
- A the social responsibility principle.
- B the reciprocity principle.
- C a universal norm.
- D peer pressure.

2 When Sarah was a child she spent months in the Royal Children's Hospital due to a rare medical condition. Doctors were able to treat her and she is fit and healthy today. Since then, Sarah's parents have collected money in fundraising efforts for the hospital each year. This is an example of:
- A social responsibility norm.
- B bystander intervention.
- C reciprocity principle.
- D what most people do during that time of year.

3 Which of the following behaviours is an example of a social norm?
- A Driving on the left-hand side of the road in Australia
- B Marriage between a brother and a sister
- C Drink-driving
- D Going to school at the age of 5

4 Explain how social factors influence pro-social behaviour.

5 Define 'social responsibility norm' and provide an example of one.

PERSONAL CHARACTERISTICS

Some personal characteristics have an influence on pro-social behaviour. People are more likely to help if they feel empathy for the person in need of help, if they are in a good mood, or if they feel competent in the particular situation.

Empathy

The concept of empathy refers to a sharing of another person's emotional state. The sight of another person's distress causes feelings of arousal and often taps into our memories of our own feelings when experiencing a similar event. Some researchers argue that people intervene to reduce the stress they are personally feeling from watching the other person's distress (Cialdini et al., 1987). We are more likely to help people we see as similar to ourselves in age, gender or dress, or because we have experienced something similar, as this causes a greater level of distress for us. The person who was bullied as a child because they are the youngest member of the family will have empathy for other people who are being bullied for the same reason.

Mood

Most teenagers know to wait for their parents to be in a good mood before asking for something. For example, you would not ask to borrow money from your parents if they had just told you off for not cleaning your room. People who are happy are more willing to lend a hand. Studies have shown that a good mood can be induced by seeing a happy film, finding money, receiving good news, listening to soothing music or spending time outside on a fine sunny day (Eagly & Crowley, 1986). After any of these events, people presented with a situation in which someone needs help are more likely to provide help. However, the relationship between a good mood and helpfulness does not always hold. Sometimes if people are faced with an unpleasant situation, especially if it is embarrassing or risky, they

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expect that the experience of the negative situation will destroy their good mood, so they do not help (Baron & Byrne, 1991).

Competence

Our willingness to help others is also influenced by our feelings of competence. This refers to our capacity to successfully complete the task. In some cases, a person with a specific set of skills will be more likely to help. For example, a person who is a good swimmer will be more likely to rescue a person who is drowning than someone who is not a confident swimmer. An off-duty doctor, nurse or paramedic is more likely to help at an accident scene than others who do not think they have the skills to help. A strong, fit person would think they are more able to intervene in cases of physical violence. These people think they have the skills to be useful and are willing to use those skills to benefit someone else (see Figure 11.15).

Altruism

Altruism involves helping other people because they are in need, without any expected benefit for the giver of such help. It is often seen as a characteristic of personality. Altruistic people tend to be generally altruistic across a range of situations and help different types of individuals. It is a characteristic that often underlies the choice to work in the helping professions such as nursing or social work (Sabini, 1992).



JOHN APPLEYARD/NEWSPIX

FIGURE 11.15 People with the appropriate knowledge, skills and equipment are much more likely to help someone in difficulty.

There are other ideas about why we might help others. Evolutionary social psychologists (for example, Barash, 1977) argue that people intervene and respond to the suffering of others in order to maximise the chances of the survival of the species. When we die, the people that we have helped survive, so the species survives. The overall reward is the survival of the species, so altruism occurs in the absence of any individual reward.

11.8 CHECK YOUR UNDERSTANDING >>

1 Altruism is:
   - A the same as empathy.
   - B when you help someone in need without any expected benefit.
   - C when you help someone in need because there are other people to witness your good deed.
   - D when you offer help because you are in a good mood.

2 People are less likely to help if:
   - A nobody else is helping.
   - B they fear making a fool of themselves.
   - C there are more people present.
   - D All of the above

3 Our willingness to help in a situation can be influenced by:
   - A our mood.
   - B our competence.
   - C empathy.
   - D All of the above

4 Empathy and sympathy are often confused. How are they different?

5 Describe how mood can affect a person's willingness to help.

reciprocity principle The belief that if someone does something for you then you should do something for them

social responsibility norm The belief that people have a social responsibility to do something for those in need

empathy A capacity for seeing another's point of view; the ability to feel what another person is feeling

mood A low-intensity, long-lasting emotional state

competence The capacity to successfully complete a task

altruism The tendency to act in such a way as to help others without seeking any personal reward

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11.3

FOCUS ON RESEARCH

ESTABLISHING NORMS IN GROUPS

How do norms develop within groups? Why do we take notice of the norms within our own groups? These questions were addressed in a classic study by Muzafer Sherif in 1937.

Each participant in Sherif's experiments was seated in a darkened room on their own and asked to look at a dot of light on the wall about 5 metres in front of them. The light seemed to move. The participant was not able to see the walls or the ceiling so there was no frame of reference in the room. They were then asked to state how far the light moved. Each one answered, roughly, 'Eight centimetres'. They would make several similar estimates and were then sent home.

The next day they returned to the same room in the company of two other participants. One was asked how far the light moved. She answered, 'One centimetre'. The second person replied, 'Two and a half centimetres'. The third replied, 'Five centimetres'. The group situation was repeated again the following day and the other two people offered similar answers. The third person's response was modified to 'Four centimetres'. After 3 or 4 days, a group norm emerged, with all three people giving similar answers of about 4 centimetres. Each of the participants was asked to return a week later to give a response on their own, but their answer remained at 4 centimetres, retaining the norm that had been established in the group.

It has been shown that participants will retain these norms a year later (Rohrer, Baron, Hoffman & Swinder, 1954). If a new participant is introduced into an experiment, this person will adopt the norms of those already involved in the study, thus passing the norms from one generation of participants to another (Campbell, 1961).

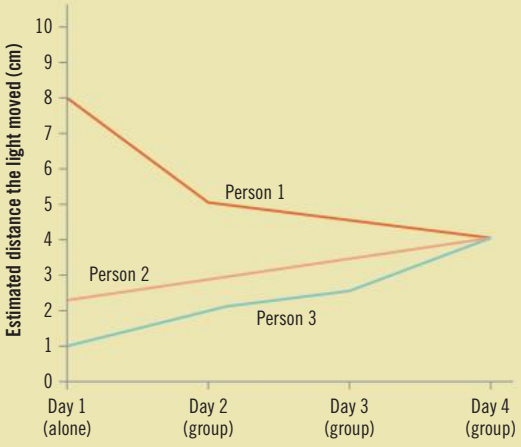


FIGURE 11.16 Typical data from a study using the autokinetic effect

You are probably wondering how far the light did move. In fact, it did not move at all. Sherif took advantage of an effect known as the autokinetic effect, whereby a stationary light appears to move when viewed in a totally dark environment. This effect occurs as the eye is continually moving in order to retain an image. In the absence of cues to depth or distance, the object appears to move.

Sherif demonstrated that when we are in an unclear situation, we are greatly influenced by the statements of others and will come to adopt the standards that they seem to have adopted. The results are relevant to us, because most social situations are similar to the situation used by Sherif in that they are ambiguous and there are often no clear right or wrong answers.

His work also shows why groups are often resistant to change. Within any club or organisation, some members leave and others join, but the group norms are often passed from the old to the new members.

QUESTIONS

1. What was the aim of the Sherif study?
2. What was the conclusion that Sherif made based on the results of the study?
3. How can these results be generalised to other situations?

CHARACTERISTICS OF ANTI-SOCIAL BEHAVIOUR

Anti-social behaviour is the opposite of pro-social behaviour. It involves selfish behaviour that is negatively valued by society and causes harm to another or results in a reward for the person involved. Anti-social behaviour varies in extent from not helping to deliberately harming another person or their property. Anti-social behaviour could be anything from ignoring someone who is calling out for help to physically assaulting someone or even murder. Anti-social behaviour is intentional and does not include accidents. So if you accidentally trip someone over and they fall, this is not considered anti-social behaviour.

FACTORS INFLUENCING ANTI-SOCIAL BEHAVIOUR

The concept of the bystander effect was discussed earlier in reference to pro-social behaviour. The presence of others is sometimes a barrier to action for people and leads them to behave in ways that are anti-social. Some of the reasons for this behaviour include diffusion of responsibility, audience inhibition, social influence and cost–benefit analysis.

Diffusion of responsibility

If everyone thinks someone else will act, meaning that no one does, this is called diffusion of responsibility. If a person is alone, they accept responsibility for taking action. When there are several people present, each

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person assumes that someone else will take action and therefore it is not their responsibility. Think of a situation where two motorists have stalled at the side of the road. If one was on a country road with little passing traffic, the first person to pass is likely to accept responsibility to stop and help. If the other car is on a busy freeway, the passing motorists think that there are lots of other people to help, so they do not need to stop (Figure 11.17). Personal responsibility is diffused, or spread very thinly so no one does anything.



FIGURE 11.17 Personal responsibility is more likely to be diffused when a car breaks down on a busy highway.

Audience inhibition

The presence of other people can also make an individual feel self-conscious and frightened of making a social blunder – an effect often called audience inhibition. In situations in which we are unsure about our interpretation of the situation, we do not want to make a fool of ourselves by interfering. The effect of the audience can vary depending on how well we know the other people present and whether we feel that we have an opportunity to explain our interpretation of the event to them at a later date.

Social influence

Other people may provide role models for our inaction. If a person has collapsed in a shopping centre but no one else is helping them, we use their behaviour as a guide for our own. This social influence is expressed in self-talk such as, 'If they are not doing anything to help the victim, why should I?' Any single factor, or all three of these factors might explain apathy on the part of bystanders.

Cost–benefit analysis

The cost–benefit analysis suggests that when we see someone in distress we go through three stages: physiological arousal, labelling the arousal and evaluating the consequences (Piliavin, Dovidio, Gaertner, & Clark, 1981).

Researchers suggest that before undertaking an action, people calculate what they will gain versus what they will lose if they take action; if the gains outweigh the losses they act and if the losses outweigh the gains they do not act. When you see someone in distress, you experience an increase in physiological arousal. This means that your body is more alert and ready to respond. It can involve increased heart rate and blood pressure. The strength of this arousal influences your behaviour. Arousal is non-specific as it is caused by physiological changes. You look at your environment to find a reason for the arousal and, depending on what is happening around you, you give the arousal an emotional label; for example, fear, love or anger (Schachter & Singer, 1962). When the arousal is caused by seeing another person in distress, the arousal is likely to be labelled as distress or empathy for the other person's distress. The feelings of distress are unpleasant and therefore you are motivated to reduce those feelings by helping the distressed person.

Piliavin et al. (1981) conducted studies that show that the greater the arousal, the more likely it is that bystanders will help, and the more rapidly they will help. Their decision depends on the relative costs of helping and of not helping. Costs of helping include the time required, the degree of effort involved, the possibility of personal injury, fear of failure if the help offered is unsuccessful, and fear of feeling stupid if the

anti-social behaviour Selfish behaviour that is negatively valued by society and is carried out to harm another person and/or gain some reward for oneself

diffusion of responsibility The greater the number of people present in an emergency, the less likely it is that each one will act, as each person assumes that another will take responsibility

audience inhibition The reluctance to help when other people are present because the individual is frightened of making a mistake and making a fool of themselves

social influence The effect on an individual's behaviour by observing the behaviour of others or as a result of pressure from others

cost–benefit analysis The three stages we go through when we see someone in distress – physiological arousal, labelling the arousal and evaluating the consequences; an assessment of the relative costs of helping and of not helping

event was incorrectly identified as one in which the person needed help. Costs of not helping include guilt about the person's plight, distress due to empathy with the victim, and ridicule from others if they are present.

11.9 CHECK YOUR UNDERSTANDING >>

1 Anti-social behaviour is best described as:
   - A harmful, positively valued by society, and having no expected rewards.
   - B harmful, positively valued by society, and having expected rewards.
   - C harmful, negatively valued by society, and having no expected rewards.
   - D harmful, negatively valued by society, and having expected rewards.

2 An example of anti-social behaviour is:
   - A tripping someone over by accident.
   - B forgetting your friend's birthday.
   - C swapping your Sunday shift at work so that you can sleep in.
   - D spreading a rumour about a student you dislike.

3 If a passenger on the train you are travelling on collapsed and you do not help because nobody else does, this is an example of:
   - A audience inhibition.
   - B social influence.
   - C diffusion of responsibility.
   - D All of the above

4 Define 'diffusion of responsibility' and give an example of it from everyday life.

5 If a person walking along the street saw someone in front of them trip and fall over, according to cost–benefit analysis, how would they decide whether to help or not?

BULLYING: AGGRESSIVE BEHAVIOUR

When psychologists use the term aggression they are referring to any behaviour with the intent to cause psychological or physical harm to another person, animal or object. Aggression is an example of an anti-social behaviour, and it can vary in degree from mild name-calling to extreme violence such as assault and murder. Two simple examples of aggressive behaviour are when your little sister gets angry and hits you or when somebody at school spreads a rumour about you with the intention of hurting your reputation. The second example is classified as an aggressive behaviour, and more specifically called bullying.

Bullying is repeated, aggressive behaviour by a person or a group directed at a less powerful person or group that is intended to cause harm, distress or fear. Bullying can come in many forms: verbal, physical, social, psychological or a combination of all (see Table 11.2). The effects of bullying can be devastating and long-lasting if appropriate interventions are not put in place to prevent and stop the aggressive behaviour. Schools and workplaces have a duty of care to make sure that they are safe places to learn and work. Bullying can still occur and, unlike other aggressive acts that are short-term or involve only one incidence, bullying typically occurs continually over extended periods of time, leaving the victim in a sustained state of anxiety and intimidation. The victims of bullying can suffer physical and psychological abuse such as bodily harm, isolation, loneliness, insecurity and anxiety, and it can lead to serious mental health issues (Tattum, 1989).

TABLE 11.2 Types of bullying

TYPE OF BULLYING	EXAMPLES
Verbal/emotional	Name-calling, put-downs, threats, teasing, intimidation or stalking
Physical	Punching, hitting, bumping, tripping, kicking Stealing and/or destroying someone else's property Unwanted kissing or touching
Social	Ostracism (being deliberately left out or ignored), spreading rumours about someone
Cyberbullying	Bullying someone using technology; for example, having someone use your screen name or password and pretending to be you to hurt someone else

There appears to be a difference between genders when it comes to bullying. Girls report being bullied by both boys and girls, while boys report being bullied mostly by other boys (Melton et al., 1998; Olweus, 1993). There are also differences in the types of bullying that is experienced between the genders. Boys are more likely to report having been physically bullied by their peers (generally other boys) (Harris, Petrie, & Willoughby, 2002; Nansel et al., 2001) and girls are more likely to report being bullied through rumours and sexual comments (from both boys and girls) (Nansel et al., 2001).

Cyberbullying

Cyberbullying is a form of bullying carried out through a form of technology, be it online or via mobile phone. Cyberbullying can include messaging through text, email or social networking sites. Table 11.3 summarises different types of cyberbullying.

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TABLE 11.3 Types of cyberbullying

TYPE OF CYBERBULLYING	EXAMPLES
Pranking	Repeated calling and hanging up; anonymous, mocking or threatening phone calls
Image sharing (including sexually explicit images)	Forwarding or sharing unflattering, private or sexually explicit images without permission. (People of any age who forward or share images of a sexual nature of a person under 18 need to be aware that this is a criminal offence (child pornography) that may result in prosecution.)
Text and email	Sending insulting or threatening text messages or emails
Personal online information	Publishing online someone's private, personal or embarrassing information without permission, or spreading rumours online
Identity theft	Assuming someone's identity online and negatively representing them in a way that damages their reputation or relationships
Hate sites	Creating hate sites or implementing social exclusion campaigns on social networking sites
Other	A student using technology to run a multi-step campaign to bully another student; for example, setting another student up to be assaulted, video-recording their humiliation, posting the video-recording online and then sending the website address to others

CYBERBULLYING VERSUS BULLYING

Cyberbullying is often more invasive and more difficult for the victim to escape from. It is more likely to occur outside of school and, with the ease of clicking a button, it can occur anytime and reach a far wider audience. Rumours, images and other harmful material can be shared and posted to potentially millions of people at any one time, and may remain online and continue to do harm indefinitely.

Recent research has found that 9 in 10 teenagers have Internet access at home, and that 72 per cent go online more than once a day, mainly to chat with friends. More than 80 per cent of 14 to 17-year-olds consider the Internet as at least very important to them, while 50 per cent say it is extremely important. Eighty-nine per cent of teenagers own a mobile phone, and 56 per cent use their phone to go online (Raco, 2014). These statistics show that technology is being used on a regular basis by most adolescents and that access is important.

The census data from 2013 show that there were nearly 3 million children aged 8 to 17 years in Australia (ABS, 2015). Table 11.4 provides an estimate for the prevalence of cyberbullying. The figure is an estimate, because many cases of cyberbullying are not reported and in some instances cases of cyberbullying that are reported do not meet the criterion of being repeated over time, so there are difficulties collecting data on the full extent of cyberbullying (and other bullying).

TABLE 11.4 Estimated prevalence of cyberbullying in Australia, 2013

AGE (YEARS)	ESTIMATED PERCENTAGE OF AGE GROUP
8	2
9	2
10	5
11	25
12	25
13	25
14	25
15	25
16	15
17	15
Mean estimated percentage of population (8–17 years):	16

Source: Spears, Keeley, Bates, & Katz (2014, p. 40)

CYBERBULLIES

Cyberbullying can provide the bully with a sense of anonymity and distance from the victim, so there is a lack of immediate feedback or consequences. Social media can allow many people, even strangers, to comment and make judgments without even knowing the person they are talking about. This distance or lack of proximity may help explain why some people communicate and do things through technology rather than in person. Because many young people feel a sense of attachment to their technology (phone, computer), they may be fearful about telling an adult (particularly parents) if it could result in greater monitoring of their use of technology or the possibility of having the technology removed for their safety. They would rather 'put up with' the distress and anxiety caused by cyberbullying than give up their phones.

aggression Any behaviour with the intent to cause psychological or physical harm to another person, animal or object

bullying Repeated, aggressive behaviour by a person or group directed at a less powerful person or group that is intended to cause harm, distress or fear

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There are also some behaviours that, although unpleasant or distressing, are not bullying. These include circumstances where there is mutual conflict, perhaps a disagreement between individuals or groups of people, but because the balance of power is reasonably equal, this would not constitute bullying behaviour. This scenario can develop into bullying if one side of the conflict decides to repeatedly target the other side in retaliation (Limber, 2002; Olweus, 1993; Nansel et al., 2001). Sometimes people incorrectly use the term 'bullying' to describe other aggressive behaviours. To be classified as bullying, all criteria need to be met; that is, bullying is repeated aggression from a more powerful to a less powerful person or group aimed at causing distress or harm.

Factors influencing bullying

It is not always clear why a person becomes a bully. There appear to be many factors that can increase the risk and contribute to a person becoming a bully (see Figure 11.18). These factors include family, peer group, school, the individual person and the community (Limber, 2002; Olweus, Limber, & Mihalic, 1999). School-aged children who frequently bully others are more likely to feel disconnected from school, dislike school, get into fights, vandalise property and leave school early. In addition, recent Victorian research has shown that bullying in Year 10 is associated with an increased likelihood of theft, violent behaviour and binge drinking (Victoria. Department of Education & Training, 2013).

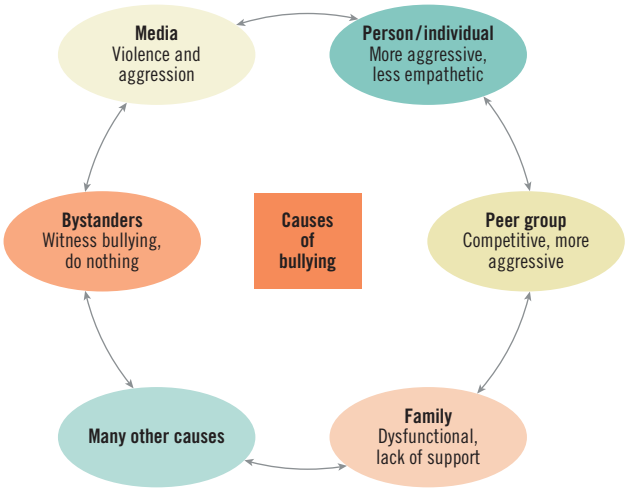


FIGURE 11.18 Causes of bullying

Environmental factors, such as the amount of violent media a person is exposed to, may contribute to bullying behaviour (Berkowitz, 1984; Smith & Donnerstein, 1998). We discuss the impact of the media on aggression later in this chapter. Other environmental factors may include what the people who witness acts of bullying do about it. If the bystanders are passive and do nothing, this may result in the aggressive behaviour being condoned and others being less likely to act in ways to stop it (Salmivalli, 2001). Imagine if for a term at school a student in your maths class kicked the chair out from under you every time you went to sit down, called you derogative names and physically bumped you at every opportunity. If the teacher and other students saw this and did nothing to prevent or stop the behaviour, the person doing this to you would be influenced by the social cues they received and the behaviour would probably not cease until the bully found a new victim or got sick of doing it. Social influence can help prevent bullying – if there is no tolerance for bullying and there are consequences for those that do it, bullying decreases.

Social factors such as family situations can also be a factor in bullying behaviour, with some studies reporting that children from dysfunctional families are three times more likely to bully than children who come from stable and caring families (Stephenson & Smith, 1989). Studies have also shown that children who have a positive relationship with their parents are less likely to exhibit bullying behavior (Rigby, 1993; Bowers et al., 1992). Peer groups have been found to be where many incidents of bullying occur. While individuals are more likely to perpetrate bullying than groups or people (Rigby & Slee, 1999), bullies often have support from a group. Some studies have suggested that up to 85 per cent of bullying incidents occur within peer groups (Atlas & Pepler, 1997).

While these are some factors that may influence bullying behaviour, not all bullies come from dysfunctional families, watch violent forms of media, or have their behaviour condoned at school or work. Some cases of bullying may be influenced by the bully's own predisposition. Many children who have exhibited bullying behaviour have been reported as being low in empathy and sensitivity to other people's situations, and more aggressive and manipulative (Endresen & Olweus, 2001; Menesini et al., 1997).

Social stereotypes may be used to give an impression that some cultures or ethnic groups are more likely to bully than others and commit violent acts; however, research has found that there is no significant link between racial differences and rates of bullying (Nansel et al., 2001).

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The impact of bullying

The experience of being a victim of bullying is different for everyone. Victims may exhibit a wide range of symptoms, including low self-esteem, depression, anxiety, feelings of loneliness, suicidal thoughts and higher rates of school absenteeism (APA, 2004).

Victims of bullying may feel angry and frustrated at their inability to stop or prevent the bullying. They may feel that there is no escape from the bully, and this may affect the normal enjoyment they would get from life and impact on relationships with others. Confidence and performance at school, work and other pursuits can drop, and many people who experience bullying suffer from symptoms of depression (lowered mood and affect) and anxiety.

Students who are bullied are more likely to:

- feel disconnected from school and not like school
- have lower academic outcomes, including lower attendance and completion rates
- lack quality friendships at school
- display high levels of emotion that indicate vulnerability and low levels of resilience
- be less well accepted by peers, avoid conflict and be socially withdrawn
- have low self-esteem
- have depression, anxiety, feelings of loneliness and isolation
- have nightmares
- feel wary or suspicious of others
- have an increased risk of depression and substance abuse
- in extreme cases, have a higher risk of suicide; however, the reasons why a person may be at risk of suicide are extremely complicated (Victoria. Department of Education & Training, 2013).

What can be done to prevent bullying?

Raising awareness of the issue and the potential harmful effects of bullying so that individuals take responsibility for the way they treat others is a big step forward in the prevention of bullying. Schools and workplaces need to ensure that bullying behaviour is not tolerated and that there are comprehensive policies in place to deal with bullying issues when they arise. Bullying is not just a problem for the bully and the victim, bystanders play a role in condoning this aggressive behaviour if they do nothing.

Many forms of bullying (particularly cyberbullying) can result in police involvement and criminal charges.

11.2 TRY IT YOURSELF >>

RAISE AWARENESS OF BULLYING

Using your knowledge of bullying, design an informative brochure that your school could use to reduce bullying and alert people to the problem. In the brochure you should outline:

- what bullying and cyberbullying are
- the effects of bullying on victims
- three ways individuals can act to prevent bullying (you may investigate your school's bullying policy to assist you)
- who to speak to if you are experiencing bullying in your school.

MEDIA: POSITIVE AND NEGATIVE INFLUENCES ON INDIVIDUAL AND GROUP BEHAVIOUR

Media are communication channels through which information, news, education and promotional messages can be passed on to others. There are many different types of media, including print (newspapers, magazines, direct mail) and electronic (TV, film, radio, videogames, Internet, smart phones). Most of the research studies into the effects of media on behaviour have focused on the influence of television, and more recently on the effects of violent video games and unrestricted Internet content. For example, in Australian households there are approximately 18.7 million working televisions. This means that, on average, each household has 2.2 televisions, and this suggests that television is one of the largest media sources (ACMA, 2012).

AGGRESSION

The impact of various forms of mass media, in particular the effects of visual media such as television, film and video gaming on aggressive behaviour, has been a controversial area of research. Researchers have found it difficult to remove potential extraneous and confounding variables from studies because the causal link between viewing violence and behaving aggressively is difficult to establish. However, it is clear that watching violence on screen, whether it is television or video gaming, has the potential to influence aggressive behaviour.

There are a number of cases reported where individuals have behaved in a 'copy-cat' manner after watching something on the screen and have gone on to emulate the behaviour in an almost identical way, such as committing assault, murder or rape. However, the majority of us have watched some violence or played a violent video game at some point, and do not go on to behave in such a way. Nevertheless, this is still cause for concern, as watching violence on a screen appears to be one of a number of factors that influence this type of behaviour in some people. There is also the concern over whether the general population is being desensitised by watching excessive amounts of violence on screen and how this could affect society.

In the 1980s, Peter Sheehan demonstrated a link between Australian children's television viewing habits and aggressive behaviour. His longitudinal study (over a number of years) showed that a number of factors impact on whether viewing violent behaviour on a screen leads to a child becoming more aggressive or not. These factors include a child's aggressive behaviour over time, parental characteristics (income, rejection of child, use of punishment, viewing habits), and the use of aggressive fantasy by the child (Sheehan, 1986). Many other studies have indicated that the short-term effect of media violence increases the likelihood of physical aggression, verbal aggression, aggressive thoughts, and aggressive emotions in both children and adults (Anderson et al., 2003). Clearly, when predicting whether a child is more likely to behave aggressively after viewing violence, these factors need to be considered (Vaughan & Hogg, 1998).

According to social learning theory, children will learn aggressive behaviour by observing aggressive behaviour in others (see Figure 11.19). Furthermore, even though the child may not behave aggressively straightaway, the behaviour is learned and stored in their memory. American psychologist Albert Bandura's famous Bobo doll experiments in the 1960s showed that when children watched adults behaving aggressively towards the Bobo doll and they were rewarded for their behaviour, the children, when given an opportunity, would mimic this behaviour. Girls were not as aggressive as boys, except when they were offered an incentive (lollies and praise), then they exhibited aggressive behaviour to almost the same level as the boys. Initially it seemed the girls had not learned the behaviour, but Bandura suggested, because they acted violently when offered an incentive, this showed the behaviour was learned and stored for future use (Bandura, Ross, & Ross, 1961).



FIGURE 11.19 Children learn aggressive behaviour by observing aggressive behaviour in others, particularly parents.

STEREOTYPING

Television programs and commercials are a source of gender-role socialisation. Television moulds our expectations of how males and females should look, think and behave, and it has been identified as a dominant source of social influence on children's gender concepts (Leaper, 2000). When gender is depicted in a highly stereotypical manner, where women are often portrayed as submissive, passive and emotional, and men as more independent, assertive and competent, this can lead to confusion and can be limiting as role models in a child's life (Furnham & Mak, 1999).

Research that explored the relationship between televised media and gender stereotypes suggests that with more exposure to television, there is a higher correlation with more traditional ideas of gender roles (Frueh & McGee, 1975; Williams, 1981).

The media portrayal of all groups of people, not only based on gender, influences our understanding of the social world. The media can influence our attitudes and person perception, and lead us to form inaccurate views of others if the information we receive is stereotypical behaviour. For instance, television programs often show teenagers engaged in antisocial behaviours such as drug taking, vandalism, fighting and arguing. Teenagers who watch these programs may follow the 'expectation' and behave in a similar way, because they form the

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schema of teenage behaviour. Other people viewing the programs also form a schema for teenagers based on the stereotypes depicted. This biases their expectation of how teenagers behave and influences their behaviour towards teenagers.

ADVERTISING

Advertising is used to persuade an individual or a group of people to behave in a certain way and to continue repeating the newly acquired behaviour. This may mean that it aims to persuade someone to go out and buy a particular product, or change behaviour such as quitting smoking or driving while drunk or tired. Most forms of advertising use persuasive techniques that are very subtle, so that we are encouraged to adopt a new behaviour or change an old behaviour with minimal conscious effort. In order to shape our behaviour in a particular way, advertisers make extensive use of the classical conditioning theory of learning.

Classical conditioning is a form of learning based on the repeated association of two different stimuli that are not normally related. One of these stimuli normally produces no specific response in an individual; it is neutral. However, if it is repeatedly presented before a stimulus that does produce a specific response, then we make an association between the two stimuli. We then begin responding to the previously neutral stimulus in the same way we would respond to the stimuli that produced the specific response. Advertising uses classical conditioning principles extensively so that consumers form an association between a product and something they find desirable that is not normally linked to the product. For example, models who are fit, attractive, successful and famous are often used to advertise a product. The advertisers intend that, after repeated viewings, we will link the model with the product and, because we want to be like the model, we will purchase the product in the future. In this way, by adding emotional value to a product, advertising conditions us to see tangible value that is not necessarily there.

While most use of classical conditioning in advertising is relatively harmless, there are instances when it can be harmful. For example, in Nazi Germany (1933–1945), the Nazi Party used similar techniques to promote the idea that Jews and members of other ethnic groups, such as the Romani, were inferior and that the Aryan race was superior (see Figure 11.20). They did this through advertising propaganda, which would repeatedly pair disgusting, repulsive images with stereotypical images of Jews. The Nazis commonly used images of rats and cockroaches crawling over filth and garbage and paired them with pictures of stereotypical Jewish faces. The aim of the propaganda was to promote a negative emotional reaction to Jews and to associate them with rats and cockroaches (vermin) that need to be exterminated. At the same time, the people of Germany were shown images of the 'superior' Aryan race, depicting them as intelligent, beautiful and strong (Weiten, 2007).



GETTY IMAGES/GALERIE BILDERWELT/HULTON ARCHIVE

FIGURE 11.20 A Nazi propaganda poster used to promote the 'superior' Aryan race

Classical conditioning is rarely used as the only method of persuasion in advertising. Other persuasive tactics include careful targeting of intended audience, and timing and location (when and where the advertising will appear).

classical conditioning A form of learning based on the repeated association of two different stimuli that are not normally related

Part of the process in making an advertising campaign is deciding who the target audience will be. If it is young people, then more than likely the models or actors used to promote the message in the campaign will also be young. However, they may also be chosen on the basis of gender and attractiveness. For example, advertising targeted at smokers wants to convince the smoker to quit smoking. The models used rarely look healthy, and the message that every cigarette smoked is doing you damage, is usually delivered by a doctor or authority figure. These models are used because people trust them and are therefore more likely to believe that smoking is harmful when this model tells them so.

In the case of timing, there would be little point in producing a campaign targeting children to buy a toy or fast food if the advert was shown on television at 10 pm when most of the target audience is asleep. In fact, the campaign would probably fail because it would likely irritate adults and therefore produce a negative attitude towards the product. It would make more sense to advertise children's toys before and after school times, when more of the target audience will be watching television. For this reason, advertising is regulated so that there are rules governing when some advertisers are allowed to show TV commercials such as fast food.

Advertisements, television programs, film and even video games often portray the models as having the 'ideal' body size and shape for both males and females. These models are not representative of the general public. The portrayal of the 'ideal' body or the 'thin ideal' can have negative impacts on both genders. Body dissatisfaction and emotions such as depression, stress, guilt, shame, unhappiness and low self-esteem (Stice & Shaw, 1994) can lead to a negative change in eating behaviour (Almond, 2008).

Eating disorders are caused by a range of factors, including the influence of family and peers. However, although the media's promotion of the 'ideal' body is not solely responsible for body dissatisfaction and eating disorders, it does contribute to these behaviours. Women in particular are targeted by these 'ideal' body advertisements, because they are more likely than men to perceive themselves as bigger than they actually are. Advertising can exacerbate this issue by using models with 'ideal' body size and shape to promote products in the hope that it will enhance the products and create body dissatisfaction. This is also true of products targeting young males that promote a muscular and strong body shape as the 'ideal' shape that all males should aspire to. This is a concern because during adolescence young people are particularly vulnerable to the influences of the media. Their bodies are in the process of changing anyway and they are attempting to define themselves, so their thoughts about who they are and who they would like to be are more open to manipulation.

Advertising as a means of influencing behaviour can also have benefits. For instance, in the field of health promotion, advertising is used to target individual and group behaviour that may be unhealthy or pose a risk. The same advertising techniques are used as those for targeting people to buy products, but in reverse; that is, the techniques are used to stop individuals behaving in a particular way or to promote a healthier lifestyle. For example, advertising aimed at smokers, bullies, people who have a poor diet and people who drive when they are tired or are alcohol or drug affected aims to decrease negative behaviour and replace it with positive behaviour.

So is advertising a positive or a negative influence on individual and group behaviour? The answer to this question must be both. Advertising can definitely have negative impacts; some have been discussed here, but there are many more. People of all ages need to be aware and conscious that advertisers manipulate and promote messages that may not be all that healthy. Advertising can also be used to positively influence people and groups, such as advertising campaigns that educate and inform about health and the benefits of healthy lifestyle choices.

VIDEO GAMES

Exposure to violent video gaming has a similar impact on behaviour as other media sources. Increases in physical aggression, verbal aggression, aggressive thoughts and aggressive emotions in both children and adults, plus an increase in cardiovascular arousal and a decrease in helping behaviour, have all been linked to video gaming (Anderson, 2004) (Figure 11.21). In addition, parental involvement in children's media use has been found to be a consistent moderating variable in children's aggressive responses. Research suggests that children whose parents are highly involved in their children's media choices and use are less affected by violence in video games than children whose parents do not monitor their video game exposure (Anderson, Gentile, & Buckley, 2007).

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FIGURE 11.21 Children playing violent video games can contribute to aggression in 'real life'.

Research evidence indicates that behavioural changes, such as increased aggression and aggressive thoughts, will occur as a result of exposure to the game even if the story line, the nature of the aggression (for example, first-person shooter, driving and hand-to-hand combat) and the humanness of the target are different (Anderson et al., 2004; Bushman & Anderson, 2002).

It has also been shown that violent video games that include some on-screen blood, appear to affect the level of aggression in players after the game. Games showing less blood decrease aggression both during and after the game (Barlett, Harris, & Bruey, 2008). The type of reward given in a game situation also impacts on aggression levels (Carnagey & Anderson, 2005). Games that reinforce aggressive behaviour or violence during play tend to increase player aggression, except for individuals who are punished within the game for violence or who play a non-violent version of the game. Games that punish violent actions within the game lead to a dramatic decrease in the number of such actions (Anderson, Bailey, & West, 2009).

More males generally play video games than females, and males play the games for longer periods of time. However, the effect is not the same for everyone. For example, the violent video game effect is sometimes stronger for males than females (Bartholow & Anderson, 2002), although violent video games clearly lead to increased aggression in females (Anderson & Murphy, 2003).

By playing violent video games, do individuals become more prone to violent behaviour and see it as the norm? In one experiment to investigate this, participants had their heart rate and GSR (galvanic skin response) measured while they played either a violent or non-violent video game and again when they were exposed to scenes of real violence afterwards. The results showed that participants who played the non-violent game had an increased physiological response level to the scenes they were exposed to. Those who played the violent game did not (Carnagey, Anderson, & Bushman, 2007). A similar study using the same basic procedures exposed participants to a mock fight outside the lab room they were in, instead of watching real violence after the gaming. Those participants who played the non-violent game were more likely to provide help to the victim. Those who played the violent game were less likely to help, and took longer to help if they offered at all (Bushman & Anderson, 2009). These findings suggest that exposure to violent video games does change behaviour and desensitise individuals to violence in the real world.

Other research into the desensitising effect of video games suggests that exposure to video games affects the brain, particularly the developing brains of young people. Research findings indicate that playing video games activates the reward processing and addiction networks of the brain (Koepp et al., 1998; Mathiak & Weber, 2006). Scanning the brains of players has shown significant activation of parts of the frontal cortex when individuals played a computer game that involved capturing territory from an opponent (Hoeft, Watson, Kesler, Bettinger, & Reiss, 2008). Males showed more activity in the frontal cortex and other brain regions than females, indicating that they may have found the competitive aspects of the game more rewarding. The release of dopamine, a neurotransmitter involved in the brain's reward systems, was shown to increase during video gameplay. This is similar to the effects of drugs such as amphetamines, which are known to activate the reward system (Koepp et al., 1998). Some parts of the brain were shown to deactivate during gameplay, such as the amygdala, which is an important part of the brain when evaluating emotional content of stimuli. This suggests that by deactivating some brain regions, desensitisation of the violence in the game may occur (Mathiak & Weber, 2006).

While some of the effects of video gaming are a concern, not all video gaming is bad. In fact, video gaming has been found to improve visuospatial attention (Green & Bavelier, 2003), and may produce positive outcomes for children in educational settings. Many children like to play video games, so if they can be adapted to suit an educational setting (that is, they are not violent), this could be an excellent tool for educational and health-related messages. Research has found some improvement for the outcomes of children using video games as tools for education in the treatment of cancer, diabetes, obesity, foetal alcohol syndrome and asthma (Anderson, Bailey, & West, 2009).

Video games may also play a positive role in improving the obesity problem in many Western countries. As children are becoming increasingly more sedentary, in part because of a lifestyle that includes many hours of playing video games and passive viewing of television and the Internet, video games may actually offer a solution. Active games that promote movement, such as interactive sports and dance games, can help children to be more active, particularly if children do not like traditional sports, or cannot participate for some reason (Anderson, Bailey, & West, 2009).

SOCIAL MEDIA

The Internet changes quickly, and new programs and applications are being made at such a rate it is difficult to remember that it was once mostly a passive tool used as a source of information. Today the Internet still provides links to enormous amounts of information, but it also provides a means of creating content so that individuals are producers of social media.

Social media has radically changed the way we communicate. Now, we are able to communicate at an amazing speed with people anywhere on earth who are connected to the Web. While studies indicate that social networking has a positive impact on social connectedness and wellbeing (Valkenburg & Peter, 2009), the increased use of social media has also exacerbated problems such as cyberbullying (see earlier in this chapter), online identity theft, and children using social networking without appropriate adult supervision becoming potential victims of unwanted attention from some members of society (Australian Psychological Society, 2015).

As a means of communication, social media differs from the more traditional media methods of television and advertising, which create one-directional messages (they expose individuals to a message created by others). Social media, on the other hand, allows individuals to both create (send) and consume (receive) messages, thus providing a multi-directional relationship. For example, a person can post an image of themselves or a profile online that others can view and comment on. For adolescents in particular, this ability can be a major influence on their behaviour. The impact of social media combined with other major influences, such as their peer group, can lead to enormous pressure to post things online without consideration of who can access them or what can be done with them.

Some social media sites give individuals an opportunity to 'try on' identities and different ways of expressing themselves. Sites such as Facebook cater to some of the needs of adolescents in that they allow users to create a profile that can be real, fake or a projection of what they want to be. This may have a positive impact on the adolescent's sense of self, as it allows them to connect and interact with others in the 'safety and comfort' of the virtual world. Individuals can 'meet' other like-minded people or they may join a discussion group of people who share their interests.

11.10 CHECK YOUR UNDERSTANDING >>

1 Violent video games have been found to:
   - A desensitise players so that viewing violence has more effect than normal.
   - B desensitise players so that viewing violence has less effect than normal.
   - C decrease competition in players.
   - D promote positive mental health and wellbeing in players.

2 Factors affecting aggression include:
   - A media violence.
   - B parental characteristics.
   - C use of punishment by caregivers.
   - D All of the above

3 Bullying is:
   - A annoying behaviour that is repeated over time; that doesn't have to be particularly distressing, but is just an annoyance.
   - B friendship groups having an argument over who will sit with whom at the formal.
   - C a student who is talking in class being repeatedly asked by the teacher to be quiet.
   - D repeated aggressive behaviour by a more powerful force towards a less powerful force that intends to cause harm, distress or fear.

4 What is a similarity and a difference between bullying and cyberbullying?

5 Explain both a benefit and a negative impact of playing video games.

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CHAPTER SUMMARY

Status and power in groups

- Status systems are universal. People of high social status exert more social power than people of low social status.
- The importance of status was demonstrated in Zimbardo's (1973) prison experiment in which the warders and prisoners took on allocated roles and behaved accordingly.
- There are five bases of social power: reward, coercive, legitimate, referent and expert. People exert influence through one or more of these social powers.

Factors influencing obedience

- Milgram's (1963) studies of obedience showed that most people would obey direct commands to give a person a shock of 450 volts. Later studies showed that obedience was lower when the learner was closer to the teacher; the study was conducted outside a university environment; commands were conveyed by an assistant rather than given directly by the experimenter; or teachers chose the level of shock to administer.

Factors affecting conformity

- When people conform in the presence of members of a group, this is called public conformity. When people adopt the values and behaviours of the group, this is called private conformity.
- In the Asch (1952, 1955) studies, most people conformed to group pressure and gave an incorrect response to a perceptual judgment task. Conformity decreased as group size decreased and when there was a non-conforming ally.
- Smith and Bond (1998) showed that culture has a significant impact on conforming behaviour. People from collectivist cultures are more likely to conform than those from individualistic cultures.

Characteristics of pro-social behaviours

- Pro-social behaviours are helpful. The provider does not expect a personal reward and the behaviour is likely to involve some risk to the provider. The action is positively valued by society.

Factors influencing pro-social behaviour

- If a person is used to having a leadership role, they are more likely to behave pro-socially and intervene.
- The presence of others can lead to the bystander effect where, although many people are present, no one helps.
- Pro-social behaviour is influenced by group norms. Pro-social behaviour is more likely to occur when people adhere to the reciprocity principle and the social responsibility norm.
- Pro-social behaviour is influenced by personal characteristics. People are more likely to exhibit pro-social behaviour if they feel empathy for the victim; are in a good mood and do not fear that intervention will destroy their good mood; have the relevant knowledge and skills; and/or are generally altruistic.

Characteristics of anti-social behaviour

- Anti-social behaviour is harmful to the recipient. The perpetrator is at low risk of harm and the behaviour is viewed negatively by society.

Factors influencing anti-social behaviour

- People are less likely to help if more people are present because there is a diffusion of responsibility. The presence of others can also lead to an audience inhibition effect whereby they fear making a social blunder in front of other people.
- They also may use other people's behaviour as a model for inaction.

Factors influencing bullying (and cyberbullying) behaviour

- Bullying behaviour is influenced by family, personal characteristics, social factors and many other possible factors.
- Cyberbullying involves bullying via the use of technology and can feel like an anonymous means with which to bully someone.
- Bullying can have devastating effects on a person's confidence, mental state, relationships with others, and school and work progress.

Positive and negative influences of media on individual and group behaviour

- Media include advertising, television, video games and social media.
- All media can have both positive and negative effects on the individual and group behaviour.
- Advertising can lead to stereotyping and promotion of positive and negative products.
- Watching aggression on television and playing violent video games have been linked to aggression in 'real life', but it is not the only cause of aggression.
- Television may be used positively to promote behaviours that are pro-social and to be informative. Video games may be used as educational tools and to do things such as exercise and promote good health. There are few positive aspects of violent video games.
- Social media is a means with which to communicate more readily with people in a fast, efficient manner. It is also the cause of cyberbullying and social comparison between individuals and groups, which may not be a positive aspect.

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APPLY YOUR KNOWLEDGE AND SKILLS

SECTION A: MULTIPLE-CHOICE QUESTIONS

Answer the following questions by writing the correct letter in your workbook. Only one answer is correct for each question.

1 One of the main lessons to be learned from the Milgram studies is that:
- **A** people are naturally aggressive.
- **B** ordinary people can act aggressively in some situations.
- **C** being accepted by others is a strong human motive.
- **D** people do the opposite of what they are told.

2 The Milgram studies were controversial because:
- **A** teachers enjoyed shocking the learners.
- **B** learners were perceived to receive painful shocks.
- **C** the results were inconclusive.
- **D** the teachers showed stress.

3 If you have car problems, you are more likely to be helped if:
- **A** you are in the country, the next motorist is travelling alone, and you are with a friend.
- **B** you are in the city, the next motorist is travelling alone, and you are alone.
- **C** you are in the country, the next motorist is travelling alone, and you are alone.
- **D** you are in the city, the next motorist is travelling alone, and you are with a friend.

4 Helping out a neighbour who has helped you in the past represents:
- **A** a universal norm.
- **B** the social responsibility norm.
- **C** the reciprocity principle.
- **D** a status norm.

5 You are more likely to help someone if you are:
- **A** in a good mood, empathic, incompetent and altruistic.
- **B** in a bad mood, empathic, incompetent and altruistic.
- **C** in a bad mood, competent, empathic and altruistic.
- **D** in a good mood, empathic, competent and altruistic.

6 A police officer stopping a motorist is exercising _____ power, whereas a person styling their hair like that of a footballer is influenced by _____ power.
- **A** coercive; legitimate
- **B** coercive; referent
- **C** legitimate; referent
- **D** legitimate; reward

7 In the Asch studies, the participant:
- **A** was less likely to conform if there was an ally.
- **B** knew the other people were confederates.
- **C** conformed only if the experimenter was watching.
- **D** was more likely to conform if there was an ally.

8 Which psychologist studied deindividuation?
- **A** Asch
- **B** Milgram
- **C** Sherif
- **D** Zimbardo

9 What is the process whereby individuals lose social identity, ignore norms and social responsibility, and engage in anti-social behaviours?
- **A** Conformity
- **B** Social influence
- **C** Non-conformity
- **D** Deindividuation

10 Personal characteristics that influence pro-social behaviour are:
- **A** empathy, mood and competence.
- **B** empathy, competence and sympathy.
- **C** mood and friendliness.
- **D** conformity and empathy.

11 The 'rules' or expectations for appropriate behaviour in a particular social situation are called:
- **A** social categorisation.
- **B** stereotypes.
- **C** social norms.
- **D** prejudicial thinking.

12 Asch's classic experiment in which participants judged a standard line and comparison line was arranged to test the limits of:
- **A** obedience.
- **B** social contract.
- **C** reward power.
- **D** conformity.

13 Etienne is at a party when someone makes a sexist joke and everyone laughs. Even though James thought it wasn't funny, he laughed because he didn't want to stand out. James' behaviour is an example of:
- **A** obedience.
- **B** compliance.
- **C** coercive power.
- **D** conformity.

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14 When people interact, they almost always affect each other's behaviour. This refers to:

- **A** social interaction.
- **B** conformity.
- **C** obedience.
- **D** social influence.

15 In Milgram's study, a teacher gave varying degrees of 'shocks' to a learner. This was designed to test the limits of:

- **A** external elements.
- **B** power.
- **C** group think.
- **D** obedience.

SECTION B: SHORT-ANSWER QUESTIONS

1 Distinguish between social power, status, conformity and obedience.

2 Why is it important to study both situational and individual factors that relate to a given behaviour?

3 Distinguish between the reciprocity principle and the social responsibility norm.

4 Name and describe the processes that might explain the bystander effect.

5 Describe a situational, personal and a social factor that may influence pro-social behaviour.

6 Describe the Zimbardo prison study. Identify the independent and dependent variables.

7 Explain a positive and a negative impact that television has on you.

8 What are three possible factors that may make someone more likely to be a bully?

9 The Asch and Milgram studies both used deception. In your opinion, was it justified?

10 Outline the factors that affect conformity.

SECTION C: EXTENDED-RESPONSE QUESTION

AUSTRALIAN TEMPERAMENT PROJECT (ATP)

The Australian Temperament Project (ATP) is led and managed by the Australian Institute of Family Studies (AIFS) in collaboration with the University of Melbourne, Deakin University and the Royal Children's Hospital. It is a longitudinal research study that looks at the development of children in the context of the personal, family and environmental influences that contribute to wellbeing.

The ATP started in 1983 with a representative sample of 2443 infants and families from both urban and rural areas of Victoria. Data have been gathered using regular mail surveys completed by maternal and child health nurses, parents, teachers and the children since 1983. The surveys ask respondents to consider the personal characteristics of the children (now adults), their relationships with family and peers, and other environmental influences.

One of the areas that the research measured was aggression and anti-social behaviour. Those children who showed high levels of aggression and anti-social behaviour (measured by fighting, destructiveness, lack of respect, rudeness, bullying other children and lying) at around the ages of 11 to 13 years had early patterns of aggression that had been identified by parents, teachers and the children themselves. Most of these children were boys and most also had learning difficulties. So this research points to the fact that early aggression and anti-social behaviour is a predictor for later aggression and anti-social behaviour. This supports international research that says that early intervention with children and their families is essential to avoid entrenched aggressive behaviour patterns.

QUESTIONS

1 The ATP uses a representative sample. Describe what this means.

2 Explain the meaning of the term 'longitudinal study'. What are the benefits of this type of research? What are some limitations of this type of research?

3 What has the research found out about aggression and anti-social behaviour?

4 Can these results be generalised? Why or why not?

This question is worth 10 marks.

SECTION D: ASSESSMENT TASK

Present a poster on obedience.

In the poster include:

- Milgrams's study – aim, method, results, conclusions
- the factors affecting obedience – social proximity, legitimacy of authority, group pressure.

Research another example of a study conducted on obedience and provide the aim, method, results and conclusions.

GLOSSARY

absolute threshold The minimal amount of stimulus energy an individual requires to be conscious of a sensation

abstract principles Thinking in terms of concepts that cannot be necessarily seen

accommodation A monocular cue involving muscles attached to the lens in each eye altering the lenses' shape to enable the eye to focus on nearby objects; (in Piaget's theory) the modification of existing mental patterns to fit new demands (that is, mental schemes are changed to accommodate new information or experiences)

acquired brain injury (ABI) Brain damage that occurs as a result of injury or physical trauma to the brain; results in some form of dysfunction

action potential The electrical impulse that travels down the axon

adaptive behaviour Behaviour that allows a person to competently meet and adapt to the demands of everyday living

adaptive plasticity The ability of brain neurons to alter the connections between the synapses to best suit the environmental conditions when learning something new or when relearning something after brain injury

adolescence The period in the lifespan that begins at 12 years of age and ends at 18 years of age

adoption studies Research into the effects of hereditary and environmental influences on development using adopted and non-adopted siblings and children

affective component Consists of feelings or emotions towards the object or person – how you feel

afferent neurons Sensory neurons located in the spinal cord that receive information from the PNS and carry it up towards the brain

age-related macular degeneration An eye condition associated with ageing that causes gradual loss of sight in which the macula in the middle of the retina breaks down or becomes damaged as a result of leaking blood vessels

ageism An attitude that is a mixture of negative thoughts (stereotypes), feelings of fear, envy or hostility, and actions of discrimination based on age

aggression Any behaviour with the intent to cause psychological or physical harm to another person, animal or object

aim The purpose of the study; what you intend to investigate

altruism The tendency to act in such a way as to help others without seeking any personal reward

ambiguous figure A stimulus that can be interpreted in more than one way

Ames room illusion An illusion caused by an intentionally distorted room, viewed through a peephole, disrupting perceptual constancies and misleading the viewer to perceive people changing size (shrinking or growing) as they cross the floor from one corner of the room to the corner diagonally opposite

amygdala An almond-shaped cluster of neurons found deep within each temporal lobe; responsible for the physiological experience of emotions, especially the emotional response of fear

anti-social behaviour Selfish behaviour that is negatively valued by society and is carried out to harm another person and/or gain some reward for oneself

anxiety Feelings of apprehension, dread or uneasiness as a response to an unclear or ambiguous threat

apoptosis Programmed cell death to remove extra, weak or unused neurons so that neuronal transmission is as efficient as possible

apparent-distance hypothesis A prediction that an apparently more-distant object that has the same-sized retinal image as an apparently nearer object will be perceived as the larger

arcuate fasciculus The bundle of nerve fibres connecting Broca's and Wernicke's areas

ascending tracts The chain of sensory neurons in the spinal cord that send information from the PNS up to the brain for processing

assimilation In Piaget's theory, the application of existing mental patterns to new situations (that is, the new situation is assimilated to existing mental schemes)

association areas All the areas of the cerebral cortex that do not have a specialised sensory or motor function; they integrate information received from different brain areas and structures to enable complex mental behaviours

astigmatism A visual impairment that results in distorted vision because the eye has two focal points

astrocytes CNS glial cells that provide physical support and nutrition to neurons; also engage in phagocytosis

attachment A close emotional bond shared usually between mother and child, or primary caregiver and child

attitudes Learned ideas we hold about ourselves, others, objects and experiences

attribution The process of attaching meaning to behaviour by looking for a cause or causes to explain the behaviour

atypical behaviour Behaviour that does not represent the behaviour of the population of interest

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audience inhibition The reluctance to help when other people are present because the individual is frightened of making a mistake and making a fool of themselves

authoritarian personality A personality characterised by rigidity, inhibition and prejudice

autonomic nervous system (ANS) The division of the PNS that transmits motor messages from the brain to the body's internal organs and glands, which results in involuntary activity of internal organs and glands, and transmits messages back to the brain about the activity level of these organs and glands

autonomy Independence; doing things for oneself

axon The fibre that carries information away from the cell body of a neuron

axon terminal The end (or terminal button) of the pre-synaptic neuron's axon fibre that forms a synapse with the dendrite of the post-synaptic neuron; also releases neurotransmitters into the synapse

bar graph A graph that shows how frequently a particular group or category of data occurs by representing the data using bars that do not touch

basal ganglia Clusters of nerve cells located in the forebrain whose function is to regulate motor control

behavioural component Refers to a person's actions towards various people, objects or institutions – what you do

binocular cues A group of depth cues that require both eyes to work together to provide the brain with information about depth and distance

biopsychology A field of psychology that examines how the brain and neural processes influence our behaviour, thoughts and feelings

bipolar cells The layer of cells in the retina that receive information from photoreceptors and transmit it to ganglion cells

blind spot The opening in the retina through which the optic nerve exits the brain and hence there are no light receptor cells

blood–brain barrier A layer of tightly packed cells that make up the walls of brain capillaries and prevent potentially harmful substances in the blood from diffusing freely into the brain

bradykinesia Slowness of movement and gradual loss of spontaneous and voluntary movement

brain plasticity The brain's ability to modify its structure and function as a result of experience

brightness constancy A perceptual constancy whereby an object's perceived level of brightness relative to its surroundings stays the same under changing light conditions

Broca's aphasia An impairment in the ability to produce articulate speech, caused by damage to Broca's area

Broca's area An area in the left frontal lobe of the brain that controls the muscles responsible for the production of articulate speech

bullying Repeated, aggressive behaviour by a person or group directed at a less powerful person or group that is intended to cause harm, distress or fear

bystander effect If there are more people present in an emergency, help is less likely to be given

bystander intervention Where a witness to an event or situation becomes involved

case study An in-depth focus on all aspects of a single person

categorical approach A method of categorising mental illness that groups psychological problems into broad categories or groups that share common symptoms

cell elaboration The process by which neurons form synapses with other neurons to enable the transmission of information

cell migration The process by which newly formed neurons determine what their function will by by travelling to their final location within the nervous system

cell production A process by which cells divide and multiply to create neurons

central nervous system (CNS) A major division of the nervous system consisting of all the nerves in the brain and spinal cord

central tendency The tendency for a majority of scores to fall in the mid-range of possible values

cerebellum A hindbrain structure attached to the rear of the brain stem that helps coordinate voluntary movement and balance

cerebral cortex The thin layer of tissue that forms the outer layer and surface of the brain's cerebrum; responsible for basic sensory and motor functions, as well as higher mental processes

cerebral hemispheres The two halves of the cerebrum that cover the upper part of the brain

cerebrum The two large hemispheres that cover the upper part of the brain

change blindness A perceptual anomaly or form of perceptual blindness involving a failure to notice large changes in a visual scene

child rearing The parental values, beliefs and practices that contribute to attitude formation

childhood The period in the lifespan that begins from 2 years of age and ends at 12 years of age

classical conditioning A form of learning based on the repeated association of two different stimuli that are not normally related

closure A Gestalt principle involving the viewer's tendency to perceptually complete an incomplete figure by filling in an imaginary contour line so that the figure has a consistent overall form

cognition Thinking, knowing or mentally processing information; our mental processes that allow us to acquire and understand knowledge through thought and experience

cognitive component What a person thinks about the object or person – what you believe

cognitive dissonance When the thoughts and actions of a person do not match their attitude, causing a clash

cognitive interventions Learned skills and behaviours that can be used to combat prejudice

collectivist culture A culture that values the group over the individual

commonalities Things people share or have in common, increasing cooperation with others and sharing joys and suffering

competence The capacity to successfully complete a task

computerised tomography (CT) A brain neuroimaging technique that takes clear X-rays of the brain at different angles to produce a computer-enhanced 2-D image of a cross-section of the brain

conclusion A statement that makes a judgment about whether or not the results of a study support its hypothesis

concrete thinking Refers to the thought processes that rely on experiences in the real world

cones A group of photoreceptors, located mainly in the centre of the retina, specialised to detect and respond to bright light; responsible for day vision, colour vision and visual acuity

confidentiality A participant's right to privacy in terms of access, storage and disposal of information related to research

conformity Bringing one's behaviour into agreement with norms or with behaviour of others in a group

confounding variable Any variable, other than the IV, that does change the DV in an unwanted way, making it impossible to determine the cause of the change in the DV

conservation The concept that the weight, mass and volume of matter remain unchanged (are conserved) even when the shape or appearance of objects changes

construct validity Whether scores on a questionnaire are consistent with the trait (or construct) being measured

content validity Whether or not the test measures what it claims to measure by looking at the kind of questions it contains

context The information that surrounds a stimulus and contributes to perceptual set

control group In a controlled experiment, the group of participants exposed to all conditions or variables except the independent variable (or treatment)

convenience sampling Participants are selected because they are readily available to the researcher

convergence A binocular depth cue that involves both eyes simultaneously turning inwards as an object moves closer (within approximately 7 metres) in order to maintain focus on the object

coping The process of adapting to manage specific external and/or internal stressors that are appraised as taxing or exceeding the resources of the person

corpus callosum A thick band of nerve fibres in the middle of the brain that connects the left and right hemispheres and transfers information registered in one hemisphere to the other hemisphere for processing

corpus striatum A midbrain structure composed of white and grey matter that contributes to the production of smooth, purposeful muscle movement

cost–benefit analysis The three stages we go through when we see someone in distress – physiological arousal, labelling the arousal and evaluating the consequences; an assessment of the relative costs of helping and of not helping

counterbalancing Used to control order effects in a repeated measures experiment by exposing participants to different orders of treatment conditions

criterion validity When there is significant positive correlation between the test score and a similar actual performance on a task

critical period A short period of time in the lifespan to be exposed to certain environmental stimuli for development to occur; if exposure does not take place within this time, learning will be difficult and most likely not be achieved

cross-sectional study A study performed at one set period in time

cultural awareness Awareness of cultural backgrounds different to your own

cultural bias The tendency for people to perform more poorly on a test developed and standardised for a different cultural group

culture All the beliefs, values, customs, traditions and behaviours transmitted from one generation to the next that underpin a group's way of life

debriefing Where participants are informed of the study's true purpose once an experiment has ended

deception Withholding information from participants about the true nature of and procedures used in a study in cases where giving them this information beforehand might influence their behaviours and affect the results' accuracy

deep brain stimulation (DBS) A surgical procedure involving the implantation of a neurostimulator into the brain so electrical impulses can be delivered to specific parts of the brain to activate them

defence mechanisms Emotion-focused coping used to reduce the effects of stress

defensive attribution A thought process that explains the causes of an individual's misfortune by blaming the victim

deindividuation The loss of social identity and inhibition, causing a person to lose responsibility for their own actions and causing them to ignore possible consequences

dendrite A neuron fibre connected to the soma that receives incoming messages

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dependent variable The variable that is measured in an experiment. It is dependent on the independent variable, as indicated by the results of the experiment

depth cues Messages that are sent from the environment or our own body and provide information to help us perceive depth or distance so that we can perceptually locate objects and perceive how far away they are

depth perception The ability to see three-dimensional space and to accurately judge distances

descending tracts The chain of motor neurons in the spinal cord that receive motor messages from the brain and transmit these to the PNS and the rest of the body

descriptive statistics Statistics used to describe, summarise and organise data; includes tables and graphs

despair Heartache or remorse

developmental norms A period of time in which the majority of people develop certain skills or abilities

developmental plasticity Changes in brain neurons and their synaptic connections that occur as a specific consequence of developmental processes

Diagnostic and Statistical Manual of Mental Disorders (DSM-5) The fifth edition of a manual published by the American Psychiatric Association that groups psychological problems into categories based on similar symptoms, in order to try to diagnose and treat mental disorders

diffusion of responsibility The greater the number of people present in an emergency, the less likely it is that each one will act, as each person assumes that another will take responsibility

direct contact Personal experience with an object contributes to the attitude that will form as a result of the contact

discrimination Unequal treatment of people who should have the same rights as others

distress A negative psychological response to stress

dopamine An excitatory chemical neurotransmitter produced in the brain; has a number of roles including producing feelings of pleasure and is associated with smooth, coordinated movement

dopamine agonists Drugs that mimic the effect of dopamine by activating dopamine receptors in the brain that would normally be stimulated by dopamine

dualism A philosophical theory that says mind and body are separate entities that interact and influence each other

dyskinesia A condition characterised by abnormal involuntary muscle movements

efferent information The motor information carried by motor neurons from the brain to the neurons in the PNS

efferent neurons Motor neurons located in the spinal cord that receive motor commands from the brain and carry them towards the PNS

electrochemical energy An energy form where minute electrical charges travel through and between neurons with the help of neurotransmitters (chemical substances)

emotion-focused coping Refers to strategies used to reduce the negative emotional response caused by the stressor

emotions Complex and intense physiological and psychological reactions to a particular event

empathy A capacity for seeing another's point of view; the ability to feel what another person is feeling

endocrine system A network of glands that produce and secrete hormones into our body, through the bloodstream, in order for us to achieve a specific physiological state

equality Social interaction that occurs at the same level, without obvious differences in power or status

ethical considerations Moral standards and guidelines that govern research

ethics Moral principles and codes of behaviour that must be abided by

eustress A positive psychological response to a stressor

experiment A process by which we seek to find a cause-and-effect relationship between two variables

experimental group In a controlled experiment, the group of participants exposed to the independent variable (IV) or experimental condition

experimental hypothesis A broad and general prediction, based on prior knowledge, about the direction of the relationship between variables in an experiment

experimental method A method whereby a formal trial is undertaken to confirm or reject a hypothesis

external validity The quality a study has when it is conducted in a similar setting to the population from which the study population was taken or generalised to

extraneous variable Any variable, other than the IV, that might change the DV in an unwanted way

extrasensory perception Sensory information that comes from outside the normal five senses and provides an individual with information from the past, present or future

extrinsic cues (for food) Any characteristics that are external to a (food) stimulus but are associated with the stimulus

feature detectors Neurons specialised to respond to specific features of a stimulus pattern and ignore other features of the pattern

figure–ground A Gestalt principle involving the viewer perceptually grouping and separating some features of a stimulus so that part of a stimulus appears to stand out as an object (the figure) against a plainer background (the ground)

forebrain Located above the midbrain, it is the largest and most highly developed part of the brain and responsible for our most complex processes; it consists of the hypothalamus, thalamus and cerebrum

fraternal twins Siblings who develop in the womb at the same time, but come from separate eggs and sperm

frontal lobe The upper front half of each cerebral hemisphere; associated with complex mental abilities and the control of voluntary movement

functional approach Defines normality by the level of one's ability to interact and involve oneself in society

functional MRI (fMRI) A brain neuroimaging technique that detects changes in oxygen levels in the blood flowing through the brain and combines this data into a detailed computer-enhanced 3-D representation of the active brain

fundamental attribution error Overestimating personal factors and underestimating situational factors when explaining causes of behaviour

ganglion cells The layer of cells in the retina that receive information from bipolar cells and transmit it to the optic nerve

generalisability The extent to which research findings can be applied to settings other than that in which they were originally tested

generativity Caring about oneself, one's children and future generations

genes Contained within the DNA of each cell in chromosomes, provide pattern for RNA to produce the protein molecules called amino acids

genotype A set of genes that are inherited from biological parents

Geschwind's territory (inferior parietal lobule) Assists Wernicke's area to comprehend spoken or written language by integrating the different properties of a word

Gestalt principles A group of principles that organise visual perceptual features and that integrate them into connected patterns or whole forms

gestation The period of development in the uterus from conception until birth

glaucoma An eye condition that causes gradual loss of sight because of increased pressure within the eyeball, which results in damage to the optic nerve

glial cell A cell that supports a neuron and influences transmission of impulses but does not transmit impulses; a nervous system cell specialised to provide structural and nutritional support to neurons and maintain a healthy environment for neurons so they can transmit information around the body

grapheme–colour synaesthesia A common form of synaesthesia in which numbers, letters or words trigger specific colours

grey matter The darker nerve tissue of the brain and spinal cord, consisting mainly of nerve cell bodies, branching dendrites and unmyelinated axons

group Two or more people interacting with a shared purpose

group membership Association with the people with whom we share common characteristics influences the attitudes we form

group norms Standards set by a group, which group members follow

group prejudice Prejudice held out of conformity to group views

gustation The sensory experience of a food or drink that is perceived as flavour

gustatory hair A tiny protrusion through the opening in a taste pore that helps chemical molecules of food and drink dissolved in saliva bind to the gustatory receptor's surface

gustatory receptors The receptor cells for taste; located on the surface of taste buds

hallucination A perceptual error resulting in the perception of an object or event that has no external reality

health A state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity

height in the visual field A monocular pictorial cue whereby the height of objects in the visual field (either above or below the horizon) acts as a depth cue, so that objects close to the horizon appear further away than objects located below the horizon

hemispheric specialisation Refers to the functional differences between the left and right cerebral hemispheres

hindbrain An area located at the base of the brain near the back of the skull; often called the brain stem; includes the cerebellum and medulla

historical approach Defines normality by the period of time, century or era in which the judgment is made

homeostasis The body's balanced and healthy state

homologous model An experimental model that uses animal participants that duplicate the same origin, symptoms and outcome of a human disorder

hormones Chemical substances that are released into the bloodstream from glands so that any imbalance in the physical system can be overcome

hyperopia A visual impairment that results in an inability to focus on nearby objects

hypochondria A preoccupation with minor bodily problems and the presence of illnesses that appear to be imaginary

hypothalamus A small structure located in the forebrain responsible for a variety of functions, including regulation of body temperature, sex drive, appetite and the sleep–wake cycle

hypothesis A testable prediction about the relationship between two variables

hypothyroidsim A disorder causing underproduction of the thyroid hormone, resulting in imbalance of the physiological systems

identical twins Siblings developed from a single fertilised egg that splits into two halves that are genetically identical

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impossible figure A figure whose features cannot be organised into a stable, consistent or meaningful perception because they cannot exist in reality, even though they appear to do so

imprinting The rapid and early learning of attachment to the first moving object viewed at birth in some species of animal

in vitro Relates to a medical test, experiment or procedure that is carried out in an artificial environment, such as a laboratory test tube

in vivo Relates to a medical test, experiment or procedure that is carried out on a living organism, such as a laboratory animal or human

inattentional blindness A perceptual anomaly involving the failure to notice an object that is fully visible in the environment, because attention was not focused on it

independent variable The variable manipulated by the experimenter

individualistic culture A culture that values the individual over the group

individuating information Knowledge that helps us see a person as an individual, rather than as a member of a group

industry Becoming more active or productive

infancy The period in the lifespan that begins at birth and ends at approximately 2 years of age

inferiority Weakness or inadequacy; low standard

informational influence Where the social environment or situational cues are used by individuals to help them monitor or adapt their behaviour to fit with the behaviour of those around them

informed consent Consent to participate obtained in writing from participants before an experiment; researchers must inform participants of the true nature and purpose of the experiment to obtain it

initiative Using one's own resourcefulness to take control or solve problems

integrity Self-respect; upholding ethical considerations and research standards

intelligence quotient (IQ) A score achieved on a standardised intelligence test relative to how others achieved

inter-group contact Interactions between the holder of the stereotype and the target of the stereotype

inter-rater reliability Reliability that occurs in studies where data are obtained from observations of multiple raters, rather than by questionnaires of self-report rating scales; inter-rater reliability is high when the raters are consistent with their observations

interneurons Specialised neurons located in the spinal cord that relay information from sensory neurons directly to motor neurons

interposition A monocular pictorial cue that occurs when one object partially blocks another object and is perceived as being in front of, and therefore closer than, the object it covers

interpretation The process of assigning meaning to sensory stimuli so we understand what they represent about the external world

interval scale A measurement scale in which data are categorised and ranked; categories are evenly spaced, with no absolute zero

interview A meeting between a participant and an interviewer to collect data for research

intrinsic cues (for food) Any physical characteristics inherent in a (food) stimulus

intuitive Able to make sense of something immediately without using reasoning

isomorphic model An experimental model that uses animal participants who have had a disorder artificially created in them

just-world belief The belief that people generally get what they deserve

Korsakoff's syndrome An organic brain disorder (usually associated with chronic alcoholism) caused by extensive and prolonged lack of thiamine (vitamin B1)

labelling When a certain characteristic of an individual is used as a name or brand to describe them

language acquisition To obtain or acquire the ability to understand language and to use words and sentences to communicate

law A norm that has become codified and is expected to be followed by all members of the population

levodopa (L-Dopa) A drug that the brain converts to dopamine; used to treat Parkinson's disease

lexical–gustatory synaesthesia A form of synaesthesia in which people associate words (or sounds) with tastes

limbic system A cluster of brain structures, including the hypothalamus and amygdala, that is located on both sides of the thalamus, just under the cerebrum; involved in physiological emotional responses

line graph A graph that represents the relationship between two variables by a line that connects each data point so the change from point to point, and the overall trend, can be seen

linear perspective A monocular pictorial depth cue where the apparent convergence of parallel lines creates the illusion of increasing distance

longitudinal study A study that collects data over two or more periods in time, using the same participants

magnetic resonance imaging (MRI) A brain neuroimaging technique that uses a magnetic field and radio waves to vibrate brain neurons and produce a detailed, still, computer-enhanced 3-D image of brain areas or structures

maladaptive behaviour Behaviour that is potentially harmful and prevents a person from meeting and adapting to the demands of everday living

maturation The physical growth and development of the body, brain and nervous system at fairly predictable stages in the lifespan

mean A measure of central tendency, calculated by adding all the scores in a data set, then dividing the total by the number of scores in the set, that shows the average of all the scores in a data set

measure of central tendency A type of descriptive statistic that displays the typical or average value of a set of scores usually in the form of the mean, median or mode

median A measure of central tendency, calculated by arranging scores in a data set from the highest to the lowest, and selecting the middle score

medical approach Defines normality as an individual being physically healthy and abnormality as having an illness that has an underlying physical cause

medulla A hindbrain structure responsible for regulating our internal bodily systems necessary for survival, such as heart rate and breathing

mental health The psychological state of someone who is functioning at a satisfactory level of emotional and behavioural adjustment

mental illness The psychological state of someone who has emotional or behavioural problems serious enough to require psychiatric intervention

microglia CNS glial cells that support the immune system by performing the bulk of phagocytosis in the brain and spinal cord

midbrain Located between the hindbrain and forebrain, it consists of and connects many nerve fibre systems, including the reticular formation

mind–body problem A debate about the relationship between the body, brain and mind

mistrust Established when care is unpredictable or inadequate

mode A measure of central tendency that shows the most frequently occurring score in a data set

monocular cues Depth perception cues requiring information from one eye only

mood A low-intensity, long-lasting emotional state

Moon illusion An illusion where the Moon appears larger the closer it is to the horizon

motion after-effect A perceptual anomaly experienced after viewing a moving object for a period of time and then viewing a static object – the static object appears to move in the opposite direction to the original moving stimulus

motivation An internal psychological state that activates, directs and sustains behaviour in relation to achieving a specific goal

motor neurons Specialised nerve cells that carry motor commands from the CNS to muscles, glands and organs

mouthfeel The way a food or drink feels in the mouth

Müller–Lyer illusion A visual illusion in which two lines of equal length – one capped with inward-pointing arrowheads, the other capped with outward-pointing arrowheads – are perceived as being of different lengths

multiculturalism Giving equal status to different ethnic, racial and cultural groups

mutual interdependence Depending on one another to meet each person's goals

myelin A fatty layer coating some axons that protects the axon and assists with the speedy delivery of the electrical nerve impulse

myelin sheath The layer of myelin wrapped around the axon

myopia A visual impairment that results in an inability to focus on distant objects

naturalistic observation Observing an animal or person in their natural environment

nature The inborn, inherited factors gained genetically from biological parents

nature versus nurture The integrated relationship between someone's genetics (nature) and the environment they are exposed to (nurture)

nervous system A system of networks of specialised cells (neurons) that connect different parts of the body to each other and the brain via electrochemical signals

neuroimaging A technology that provides images of brain structure and function

neurological disorder A disorder of the nervous system that affects cognitive and motor functions

neuron An individual nerve cell that receives, transmits and processes information

neuroscientist A scientist who studies the structure and function of the brain and nervous system

neurostimulator A small battery-powered device that delivers mild electrical currents to specific areas of the brain to stimulate targeted neurons

neurotransmitter Any chemical released into the synapse by a neuron's axon terminals that alters activity in other neurons

nodes of Ranvier The small gaps that occur at regular intervals in the myelin sheath that speed the transmission of the nerve impulse

nominal scale The simplest measurement scale, which involves putting data into categories or groups

non-standardised test A flexible test that allows researchers to change questions depending on participants' responses

non-tasters People who have fewer taste buds than normal and find tastes less intense than others

norm A general 'rule' or standard

normality Patterns of behaviour or personality traits that are typical, or that conform to some standard of proper and acceptable ways of behaving

normative influence The impact of the standards established by the group on an individual's behaviour

number-form synaesthesia A form of synaesthesia in which a person automatically visualises a number map when they think about numbers

nurture The environmental or external conditions that affect an individual's development

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object permanence The concept that an object will continue to exist, even when it is hidden from view

objective data Data that can be directly observed or measured

objective evidence Information that is based on facts that can be proved through analysis, measurement and observation

observer bias A form of bias that occurs when an observer's expectations, past experience and motives or other personal factors interfere with the accuracy of their observations

observer effect Changes in behaviour caused by an awareness of being observed

occipital lobe An area located at the back of each cerebral hemisphere; associated with processing visual information

oligodendroglia CNS glial cells specialised to myelinate axons; also known as oligodendrocytes

operational hypothesis A precisely defined and described prediction about what will happen when an independent variable is manipulated and the effect it is expected to have on the dependent variable

optic nerve The nerve that connects the light receptor cells in the retina to the brain

ordinal scale A measurement scale where data are organised into ranked or ordered groups or categories

organisation The process of reassembling the features of sensory stimuli in a meaningful manner

orientation constancy A perceptual constancy whereby we perceive an object's true orientation (position) as being unchanged despite changes in the orientation of the object's image on our retina

papillae The small bumps on the tongue's surface

parallel forms A way to test reliability whereby the test is given to participants and the responses from the odd-numbered questions are correlated with those from the responses to the even-numbered questions

parasympathetic nervous system The branch of the ANS that maintains an energy level appropriate for normal bodily functioning and physically calms us after high arousal by reversing the changes in bodily functioning caused by the domination of the sympathetic nervous system

parietal lobe An area of each cerebral hemisphere located behind the frontal lobe; mostly associated with processing sensations but also involved in the coordination of senses and movement

Parkinson's disease A progressively degenerative neurological disorder that affects the control of body movements and forms part of a group of conditions known as motor system disorders

participants The people or animals used in an experiment

participants' rights The individual rights of all participants that must be respected by the researcher, as outlined in ethical guidelines relating to psychological research

past experience Our prior exposure to stimuli and previous life experiences

perception The mental process of organising and interpreting sensory stimuli sent from the senses so it achieves a meaningful mental representation or form

perceptual anomaly A perceptual irregularity due to deviation from the normal mental processes used to give meaning to stimuli

perceptual disorder An impaired ability to form a perception of stimuli taken in by the senses

perceptual error An incorrect perception of a stimulus

perceptual hypothesis An educated guess about the correct meaning to be assigned to a particular pattern of sensory stimulation

perceptual set A readiness or predisposition to perceive stimuli in a particular way according to our expectations

peripheral nervous system (PNS) A major division of the nervous system consisting of all the nerves outside the CNS; transmits sensory information inwards to the CNS and transmits motor messages from the brain outwards to the rest of the body

person perception The process of forming impressions about others

personal attributions The factors within the person, such as personality characteristics, motivation, ability and effort that contribute to behaviour

personal prejudice An attitude whereby members of another racial or ethnic group are perceived as a threat to one's own interests

personification A form of synaesthesia (also known as ordinal-linguistic personification or OLP) in which ordered sequences such as numbers, letters, months or days are associated with various personalities

phagocytosis The process whereby specialised glial cells engulf and digest harmful micro-organisms so neurons can function in a healthy environment

phenotype Refers to observable properties of the body and behavioural charateristics

philosophy A set of ideals, standards or beliefs used to describe behaviour and thought that is based on logic rather than scientific evidence

photoreceptors Receptor cells located at the back of the retina and specialised to detect and respond to light

phrenology A technique used to predict human behaviour that involves feeling bumps on a person's skull and using this information to assess their personality and intelligence

pictorial cues A group of monocular cues that create an impression of depth on a flat two-dimensional surface where depth does not exist

placebo effect A change in a person's behaviour due to their expectation that they have been exposed to something that will cause a particular effect

plasticity The ability of the brain to change its structure and relocate functions to different areas and neuronal networks

Ponzo illusion An illusion where two horizontal lines of equal length are drawn inside two converging lines, but the line in the narrower section of the converging lines is perceived to be longer

population The larger group of research interest from which a sample has been drawn

positron emission tomography (PET) A brain neuroimaging technique involving the injection of radioactive glucose into the bloodstream, tracking the blood flow to the brain and combining the data into a series of computer-generated colour-coded images of the level of activity in various brain areas while engaged in different tasks

post-synaptic neuron The neuron that receives the impulse

pre-synaptic neuron The neuron that sends the impulse

predictive model An experimental model that uses animal participants who have a disorder that does not necessarily resemble a human disorder but assists in making predictions about aspects of the disorder

prefrontal cortex An area in the forward part of the frontal lobe responsible for the regulation of emotions

prejudice A negative emotional attitude held towards members of a specific social group

primary auditory cortex The area of the temporal lobes that registers and processes auditory (sound) information

primary gustatory cortex An area deep in the middle of the brain, consisting of the anterior insula and frontal operculum, that is the receptive area for taste

primary motor cortex An area at the rear of the frontal lobe that directs the body's skeletal muscles and controls voluntary movement

primary somatosensory cortex A strip of neurons located at the front of the parietal lobe, adjacent to the primary motor cortex, which registers and processes sensory information from receptors in the body

primary visual cortex The area at the base of the occipital lobe that registers, processes and interprets visual information sent from each eye

private conformity Accepting the behaviours of the group as part of one's own personal beliefs

problem-focused coping Refers to strategies used in an attempt to deal with the cause or source of stress

protective factors Enhance or have a positive effect on the health of an individual

proximity A Gestalt principle whereby stimuli that are close together in space are perceived as belonging together and forming a meaningful single unit or group

pseudoscience A fake or false science that lacks evidence to support its claims

psychological development An individual's emotional, cognitive, social and intellectual development over time

psychologist A professional who specialises in creating, teaching and applying psychological knowledge

psychopathology The scientific and systematic study of abnormal experience, cognition and behaviour; also a term used to refer to psychologically unhealthy behaviour

psychosocial dilemma A conflict between personal impulses and the social world

public conformity Accepting the behaviours of the group when they are present, but not accepting them as part of one's personal beliefs

qualitative data Data that describe the changes in the quality of a behaviour; often written in words

quantitative data Data collected through systematic and controlled methodology; numerical in form

questionnaire A written set of standardised questions about an individual's attitude, beliefs and/or behaviours; can be administered face to face, by mail, by telephone or by way of the Internet

racism An attitude that is a mixture of negative thoughts (stereotypes), feelings of fear, envy or hostility, and actions of discrimination based on race

random sampling A sampling technique ensuring that every member of a population has an equal chance of being selected to participate in the study

random stratified sampling Participants are selected randomly within each stratum (group) to ensure each member of the group has an equal chance of being selected for the sample

rating scale A list of questions that are generally fixed-response statements about different aspects of an attitude

ratio scale A measurement scale in which data are categorised into groups and ranked with even intervals; has an absolute zero

raw data The actual data from a study, collected and recorded in their original form

reception The process of sensory receptors detecting the presence of a stimulus or changes to a stimulus

receptive field The portion of a neuron's surface receiving the stimulus that triggers the neuron to fire

receptor sites That part of a dendrite's surface that absorbs a neurotransmitter

reciprocity principle The belief that if someone does something for you then you should do something for them

reference To acknowledge a concept, definition or idea taken from another source

rehabilitation A therapy or treatment aimed at helping a person recover from injury and return to the normal or near-normal level of physical, psychological and social function they experienced before they were injured

relative size A monocular pictorial depth cue where the smaller retinal image of two objects is perceived as being further away, and the larger retinal image of two objects is perceived as being closer

reliability Whether a questionnaire or scale measures consistently what it is supposed to measure; research must be able to be replicated and the same results found

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representative sample A small, randomly selected group that accurately reflects the characteristics of a larger population from which it is drawn

research investigation A formal scientific report that explores and presents information on a topic of interest

reticular formation A network of neurons extending from the top of the spinal cord up to the thalamus; modulates incoming sensory stimuli and redirects them to the cerebral cortex, thereby activating the cortex and influencing our state of physiological arousal and alertness

retina A light-sensitive membrane composed of a number of layers of specialised neurons at the back of the eye

retinal disparity A binocular depth cue that refers to small discrepancies between an image that reaches the right eye and one that reaches the left eye

retinitis pigmentosa A genetically related degenerative retinal disease that causes night blindness and gradual vision loss

reversibility of thought Recognition that relationships involving equality or identity can be reversed (for example, if A = B, then B = A)

risk factors Impede or have a negative effect on the health of an individual

rods A group of photoreceptors located mainly in the outer ends of the retina specialised to detect and respond to dim light; responsible for night vision, black-and-white vision and peripheral vision

sample A group of participants selected from a population of research interest

sampling The process of selecting participants for a study of the population

satellite cells Specialised PNS glial cells that support neurons by covering their cell bodies and supplying them with nutrients

scapegoating Blaming a person or a group for the actions of others or for conditions not of their making

schema An idea or concept used to organise information into categories or groups; contains both abstract knowledge and specific examples about a particular social object

Schwann cells PNS glial cells specialised to myelinate axons and to assist PNS nerve regeneration

scientific method A series of sequential, scientific steps used when planning, conducting, interpreting and reporting research

selection The process of feature detector cells responding to specific features of a stimulus pattern and ignoring the rest

selective attention A voluntary or involuntary tendency to focus on a particular stimulus (or part of a stimulus) and ignore other stimuli

selective specialisation The process of pruning excess synapses to allow the remaining cognitive networks to become specialised and efficient in their function

self-fulfilling prophecy An expectation that prompts people to act in ways that make the expectation come true

self-report method A method asking participants to report what they are thinking or feeling

self-serving bias A tendency to attribute our own behavioural success to personal factors and our failures to situational factors that are outside our control

sensation A physiological process involving sensory receptors detecting and responding to the presence of stimuli

sensitive period The ideal period of time to be exposed to certain environmental stimuli for development to occur; if exposure does not take place within this time, learning will be more difficult to achieve

sensory neurons Specialised neurons (afferent neurons) that carry information inwards towards the CNS

sensory receptors Specialised neurons located in sense organs that detect and respond to physical energy (stimuli)

sexism An attitude that is a mixture of negative thoughts (stereotypes), feelings of fear, envy or hostility, and actions of discrimination based on gender

shape constancy A perceptual constancy whereby the perceived shape of an object remains constant despite changes in the size of the image the object casts on the retina

signal behaviours Behaviours that physically maintain proximity to a caregiver (e.g. crying, smiling, following)

similarity A Gestalt principle involving a viewer's tendency to perceive stimuli that have similar visual features (such as size, shape, colour or form) as belonging together and forming a meaningful single unit or group

situational approach Defines normality by the social situation, behavioural setting or general circumstances in which the behaviour occurs

situational attributions The factors within the environment that are external to the individual that contribute to behaviour

size constancy A perceptual constancy whereby the perceived size of an object remains constant despite changes in the size of the image the object casts on the retina

social cognition The way people process, retain and apply information about others and social situations

social competition Rivalry among groups, each of which regards itself as superior to others

social influence The effect on an individual's behaviour by observing the behaviour of others or as a result of pressure from others

social loafing The tendency for an individual to reduce their effort in a group

social nonconformity Failure to conform to societal norms or the usual minimum standards for social conduct

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social norms Norms defined by society as a whole to establish acceptable behaviour in most situations

social power The amount of influence that an individual can exert over another person

social proximity The social distance between one person and another; it is more variable than physical distance, because it includes the degree of opportunity to interact with the other person

social relationships Interactions between people in social settings

social responsibility norm The belief that people have a social responsibility to do something for those in need

social support The close, positive relationships we develop with others

sociocultural approach Defines normality by determining whether behaviour is typical according to the cultural values and beliefs of a particular society

soma The main cell body of a neuron

somatic nervous system The division of the PNS that transmits sensory information received from sensory receptor cells inwards towards the CNS, and motor messages from the CNS to the body's voluntary skeletal muscles; also known as the skeletal nervous system

sound-to-colour synaesthesia A form of synaesthesia in which sound automatically triggers the visualisation of coloured, generic shapes

spatial neglect A tendency to ignore the left or right side of one's body or the left or right side of visual space resulting from damage to one of the cerebral hemispheres (usually the right parietal lobe)

spinal cord A part of the CNS that consists of a cable of nerve fibres stretching from the base of the brain to the lower back; connects the brain to the PNS and transmits sensory information from the PNS to the brain and motor messages from the brain to the PNS

standardised test An exact test with known reliability and validity that follows a specific set of instructions to administer, score and interpret

statistical approach Defines normality according to the experiences and behaviours of the statistical majority

status An individual's position in a group

stem cells Immature cells that are undifferentiated and have not yet acquired a special structure and function

stereotype An oversimplified image of people who belong to a particular group, causing them to appear more similar than they are

stigma Social disapproval of an individual's personal characteristics or beliefs, or social disapproval of a type of behaviour

Strange Situation An experiment designed to measure the quality of an infant's attachment to the primary caregiver

stratified sampling This sampling technique ensures that the sample group contains the same proportions as found in the population

stress Refers to a state of mental or physical tension that occurs when an individual must adjust or adapt to their environment but they do not feel they have the capacity to do so

stressor The object or the event that causes stress

subjective analysis Analysis based on personal opinions, interpretations, emotions and judgment

substantia nigra A midbrain structure composed of nerve cells that produce dopamine; associated with movement control

superordinate goals Shared goals that groups or individuals cannot achieve alone or without the other person or group

supertasters People who have more taste buds than normal and find tastes more intense than others

surrogate A surrogate is anyone or anything that 'substitutes for' or 'plays the part' of something else

sustained contact Prolonged and involved cooperative activity or interaction

symbolic thinking A cognitive skill that enables us to use symbols, gestures or images to mentally represent people, objects and events that may not be present

sympathetic nervous system The branch of the ANS that alters the activity level of internal muscles, organs and glands to physically prepare our body for increased activity during times of high emotional or physical arousal

synaesthesia A perceptual anomaly where information taken in by one sense is experienced in a way normally associated with another sense

synapse The microscopic gap between neurons, over which messages pass

synaptic pruning The process of removing extra, weak or unused synaptic connections so that neuronal transmission is as efficient as possible

taste The sensory experience of a food or drink that is put in the mouth and perceived as a flavour

taste aversion A learned avoidance of a specific food after it has been associated with an unpleasant experience

taste buds Tiny structures located on the papillae on the tongue's surface

taste pores Tiny openings on the surface of a gustatory receptor through which the gustatory hair protrudes

taste sensitivity The intensity with which we perceive tastes and flavours

temperament Refers to an individual's behavioural style and characteristic way of responding to the environment

temporal lobe An area located on either side of each cerebral hemisphere; associated with processing auditory information; also believed to be involved in memory, facial recognition, object identification and emotion

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test-retest reliability A way to test reliability whereby participants are given a test or questionnaire at time 1 and then again at time 2

texture gradient A monocular pictorial depth cue whereby the surface features of an object become smaller and less detailed the more distant an object becomes

thalamus A forebrain structure that sits on top of the brain stem through which all sensory information, except smell, passes; the thalamus redirects this information to the appropriate sensory area of the cerebral cortex for processing

transduction The process of sensory receptors converting stimulus energy into impulses of electrochemical energy

transmission The process whereby neural impulses leave sensory receptor sites and travel to the areas in the brain that are specialised to receive them

tri-component model of attitudes Proposes that there are three components that contribute to attitude formation: feelings (the affective component), actions (the behavioural component) and thoughts (the cognitive component)

trust Established when an infant is given proper warmth, love, touching and physical care

twin studies Research into the effects of hereditary and environmental influences on development using identical and fraternal twins

two-hit hypothesis A model used to explain the multiple causes of disorders such as schizophrenia

typical behaviour Behaviour that represents what most people do

umami A taste sensation produced by glutamate and several amino acids that is experienced as meaty or savoury

unanimity Agreement among all members of a group

universal norm A behaviour expectation that is common to all cultures

validity Whether a questionnaire or scale actually measures what it is supposed to measure; research must actually measure what it claims to measure

variable Any condition (events or characteristics) that can change and that might affect an experiment's outcome

visible light spectrum The range of wavelengths on the electromagnetic specrum of light to which the human eye is sensitive

vision The sense that detects objects by the light reflected from them into our eyes

visual constancies A group of perception principles that allow us to view objects as unchanging in terms of their actual size, shape, brightness and orientation regardless of changes to the image the object casts on the retina

visual field All the area of the external environment that can be seen when your head is still

visual illusion A consistent perceptual error in interpreting a real external stimulus

visual perception principles Rules our brain automatically applies to visual stimuli to help organise and interpret them in a consistent and meaningful way

vivisection Experimental surgery carried out on a living organism for research purposes

voluntary participation When participants agree to take part in an experiment free from pressure or fear of negative consequences

Wernicke's aphasia An impairment in the ability to understand language and formulate coherent, meaningful speech, caused by damage to Wernicke's area

Wernicke's area An area of the left temporal lobe of the brain responsible for the comprehension of language and the formulation of meaningful sentences

white matter The whitish nerve tissue of the brain and spinal cord, consisting mainly of myelinated axons

withdrawal rights Rights whereby participants are entitled to leave an experiment for any reason at any time or have their results withdrawn without any negative consequences from the researcher

wording effect The effect that question phrasing and order have on how people answer surveys

working memory A subsystem of short-term memory that briefly holds and manipulates information when completing a cognitive task

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SELECTED ANSWERS

CHAPTER 1

CHECK YOUR UNDERSTANDING 1.1

1 An experiment is a process to propose and investigate hypotheses, collect and analyse data, and draw conclusions about the effect of an independent variable on a dependent variable.

2 An aim is a testable research question (e.g. Does music help me study better?), whereas a hypothesis is a testable prediction of the relationship between two variables (events or characteristics) that is developed before the research is conducted (e.g. students who listen to music while they study will score greater marks in their tests than students who do not listen to music while they study.)

3 See Figure 1.1.

4 Data collection techniques include case studies, observation, questionnaires, rating scales, interviews, longitudinal and cross-sectional studies, and experiments.

5 Step 1: d
Step 2: g
Step 3: f
Step 4: a
Step 5: e
Step 6: c
Step 7: b

CHECK YOUR UNDERSTANDING 1.2

1 **a** IV = children exposed to television vs children who are not exposed to television, DV = social interaction in primary school
b IV = frequent episodes of anxiety vs infrequent episodes of anxiety, DV= level of resilience
c IV = high vitamin C intake vs low vitamin C intake, DV = breast cancer incidence
d IV = volume of music listened to in the car (loud vs soft), DV = frequency of headaches

2 Usually there is only one IV in an experiment. It is possible to have more than one, but this leads to a more complex experimental design. For example, in a sleep study, participants may be divided into three groups: those that slept less than 3 hours (IV), those that slept 3–5 hours (IV) and those who are not sleep deprived (DV).

3 C

4 D

5 An extraneous variable is any randomly occurring variable in a study, other than the independent variable, that changes the dependent variable. An EV can be neutral, controlled or confounding. A confounding variable is any variable in a study, other than the IV, that systematically changes the DV.

CHECK YOUR UNDERSTANDING 1.3

1 An experimental group is exposed to a treatment; that is, where the independent variable under investigation is present. For example, in a study to test the effectiveness of music on learning, the experimental group would complete a learning task while listening to music.

A control group is exposed to the control condition; that is, where the independent variable under investigation is absent. For the previous example, the control group would be given the same learning task to complete in silence. The control group provides a standard that the performance of the experimental group can be compared with in order to determine whether the treatment (the independent variable) has had an effect on the experimental group's behaviour (the dependent variable).

2 B

3 C

4 A

CHECK YOUR UNDERSTANDING 1.4

1 **a** qualitative
b quantitative
c quantitative
d qualitative
e qualitative
f quantitative

2 Repeated measures: Mrs King wants to test the children several times and will be able to gauge improvement if she uses the same children each time.

OR

Matched participants: Mrs King will need to match the children on their pronunciation ability so that this variable does not bias a particular group.

3 Case studies lack formal control groups, and it is difficult to generalise case study findings to a whole population.

4 Naturalistic observation

5 C

CHECK YOUR UNDERSTANDING 1.5

1 **a** ordinal
b ratio
c ratio
d nominal
e nominal
f interval

2 See Table 1.1.

3 Why is the man on the left larger than the man on the right? The participant will assume the man on the left is larger, even if he is not.

4 D

CHECK YOUR UNDERSTANDING 1.6

1 **a** Standardised tests compare participant performance or results. They are administered using a set of instructions; for example, VCE exams. Non-standardised tests are more flexible tests; for example, interviews.
b Standardised tests can be affected by inconsistent testing procedures.

2 Longitudinal studies are repeated observations of a group or individual over time. Cross-sectional studies are a snapshot of a sample at one point in time.

3 The government would get information on how children are growing up in Australia, what factors are influencing their development and any risk factors for this group.

4 B

CHECK YOUR UNDERSTANDING 1.7

1 **a** You would use a line graph because this is a study over time.
b The amount of weight lost

2 D

3 B

4 A

5 Raw data is considered meaningless because researchers cannot see any patterns in the data.

CHECK YOUR UNDERSTANDING 1.8

1 A measure of central tendency is simply a number describing a 'typical score' around which other scores fall; that is, the tendency for a majority of scores to fall in the mid-range of possible values.

2 The mean is the average value or measure of central tendency of a set of data. The standard deviation quantifies how the data is spread around the mean.

3 **a** Mode: 27; median: 16.5
b Mode: 87; median: 85.5
c Mode: 40; median: 28.5

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4 B
5 The mode is the most frequently occurring score in a set of data.

CHECK YOUR UNDERSTANDING 1.9

1 Coercion is using pressure to get someone to do something. Coercion removes the participant's right to informed consent or to withdraw from a study at any time.
2 A consent form needs to contain information about the true nature and purpose of the experiment, what participants will be expected to do, their rights and any foreseeable risks.
3 A
4 D
5 B

CHECK YOUR UNDERSTANDING 1.10

1 See Table 1.4.
2 Participants, materials and procedure
3 Smith, J., Smyth, P., & Smithson, J. (2009). Can dogs see colour? *Journal of Animals and Their Perceptive Abilities*, 21, 22–45.
4 Background information, definitions of terms, hypothesis and aim
5 It should be 200 to 600 words long.

APPLY YOUR KNOWLEDGE AND SKILLS

SECTION A: MULTIPLE-CHOICE ANSWERS

1 A	6 A	11 D
2 D	7 C	12 B
3 A	8 C	13 D
4 A	9 C	14 D
5 C	10 B	15 D

CHAPTER 2

CHECK YOUR UNDERSTANDING 2.1

1 C
2 C
3 C
4 Because it is not supported by scientific (empirical) evidence.
5 Theory 1: The brain is the source of all behaviour.

Theory 2: The brain controls behaviour through its connection to the spinal cord and peripheral nervous system.

CHECK YOUR UNDERSTANDING 2.2

1 B
2 C
3 D
4 Subjective analysis is based on personal observation, logic and reasoning. Its conclusions are not supported by reliable or verifiable evidence. Objective analysis is based on unbiased evidence gathered by recording events that can be precisely measured or described and verified under similar circumstances.
5 Lobotomy results in a permanent change in behaviour where the person usually has dramatic changes in personality and emotional behaviour, often becoming lethargic and behaving immaturely.

CHECK YOUR UNDERSTANDING 2.3

1 D
2 B
3 C
4 C
5 The neurosurgeon could electrically stimulate a specific set of neurons known to control a specific behaviour (e.g. neurons in the lower part of the left frontal lobe control the muscles responsible for speech production). The surgeon would then ask the person to perform a specific task (e.g. repeat a sentence). If they can complete the task, they have no loss of function. If they cannot, then there is some functional loss.

CHECK YOUR UNDERSTANDING 2.4

1 D
2 C
3 If the scan showed lower than normal oxygen use in brain areas normally very active during speaking, reading or listening to someone speak, then this may indicate structural damage to specific brain sites involved in language.
4 A PET scan shows brain activity in specific areas, so it helps to identify if an area is damaged.
5 Any one of confidentiality, withdrawal rights, informed consent and debriefing, and an appropriate explanation of how the neurosurgeon would put the principle into practice.

CHECK YOUR UNDERSTANDING 2.5

1 A
2 B
3 D
4 The nervous system is composed of networks of neurons. It has a number of divisions and it is arranged in a hierarchical manner.
5 The spinal cord receives sensory information from the PNS and transmits it to the brain. It receives motor messages from the brain that it transmits to the PNS so we can engage in voluntary movement.

CHECK YOUR UNDERSTANDING 2.6

1 D
2 D
3 B
4 When we perceive danger or have the need for extra physical activity, our sympathetic nervous system prepares our body for action by energising us so we are physically ready to fight the danger (fight response), or we can quickly run away to safety (flight response).
5 The sympathetic nervous system is quicker to activate because of the increase of adrenalin our body receives. Extra adrenalin is still in our bloodstream when the parasympathetic nervous system is activated and it takes a period of time for this adrenalin to be absorbed.

CHECK YOUR UNDERSTANDING 2.7

1 D
2 B
3 The myelin sheath protects the axon and helps it transmit its electrical impulse. If the myelin sheath is damaged, then the axon is easily damaged and this will cause problems with the transmission of information. Loss of myelin will also mean the electrical impulse takes longer to travel down the axon, so overall transmission of information is slowed.
4 Neurotransmitters are a group of chemicals released into the synapse by the pre-synaptic neuron's terminal buttons. They carry information across the synapse and when they attach to a receptor site on the post-synaptic neuron they either activate (excite) or inhibit a neural response in the post-synaptic neuron.
5 Axons receive an electrical impulse from the soma and transmit it to the dendrites of a connecting neuron. Dendrites receive the impulse from the axon and pass it to the soma of their neuron.

CHECK YOUR UNDERSTANDING 2.8

1 B
2 D
3 B
4 Interneurons pass sensory information directly to motor neurons so a person can make a quick response to stimuli.
5 Ascending tracts of afferent, or sensory, neurons receive sensory information from the PNS and transmit it up the spinal cord to the brain for processing. Descending tracts of efferent, or motor, neurons receive motor commands from the brain and transmit it down the spinal cord where it is passed to the PNS.

CHECK YOUR UNDERSTANDING 2.9

1 B
2 C
3 B
4 Microglia support CNS neurons by fighting infection and responding to injury, so they protect the brain and spinal cord from disease-causing micro-organisms.

5 Astrocytes support CNS neurons by forming a matrix around the neuron that helps to keep it in place and protects it from other neurons. Astrocytes filter nutrients out of the blood and receive glucose, and deliver both of these to neurons. Astrocytes also perform phagocytosis to keep harmful substances from attacking the neuron.

CHECK YOUR UNDERSTANDING 2.10

1 A
2 A
3 B
4 Both myelinate the axons of neurons. Schwann cells produce myelin for PNS neurons and oligodendroglia produce myelin for CNS neurons.

APPLY YOUR KNOWLEDGE AND SKILLS

SECTION A: MULTIPLE-CHOICE QUESTIONS

1 C	6 C	11 C
2 B	7 C	12 D
3 D	8 C	13 C
4 C	9 D	14 D
5 A	10 A	15 C

CHAPTER 3

CHECK YOUR UNDERSTANDING 3.1

1 C
2 A person who has sustained damage to their cerebellum may suffer from cerebellar ataxia. As the cerebellum is responsible for coordinating movement, balance and posture, a person suffering from cerebellar ataxia is likely to experience frequent stumbling; impaired coordination of the arms, legs and back; an unsteady way of walking and dizziness.
3 D
4 A
5 It is sometimes referred to as the 'arousal centre' because it is in control of sleeping and waking. For example, research has shown that if the reticular formation in animals is removed, they cannot be wakened because of a lack of arousal. On the other hand, if the reticular formation is electrically stimulated in sleeping animals, they will waken immediately.

CHECK YOUR UNDERSTANDING 3.2

1 A
2 The hypothalamus works with the endocrine system and nervous system to respond to the body's needs and also to achieve homeostasis. For example, if a Year 12 student is about to go into an end-of-year examination, their endocrine system may release the hormone cortisol to respond to the situation they are in. When the student leaves the exam the cortisol release may cease and the nervous system can work to achieve a stable internal state (homeostasis).
3 C
4 B
5 When we are asleep the thalamus may 'switch off' its attention function so that our cortex is not bombarded with sensory information, enabling us to sleep uninterrupted.

CHECK YOUR UNDERSTANDING 3.3

1 The contralateral organisation of the brain involves the left hemisphere of the brain controlling voluntary movement on the right side of the body. It also receives sensory information from the right side of the body. Likewise, the right hemisphere controls voluntary movement on the left side of the body and receives sensory information from the left side of the body.
2 Paul Broca and Carl Wernicke in the mid to late 1800s.
3 D
4 B
5 D

CHECK YOUR UNDERSTANDING 3.4

1 The cerebral cortex is responsible for basic sensory and motor functions as well as higher mental processes. Its overall role is to integrate the brain's cognitive, motor and sensory functions.
2 Thinking symbolically involves the ability to use symbols, gestures or images to mentally represent people, objects and events that may not be present. (Any relevant example)
3 C
4 The primary motor cortex is located at the rear of the frontal lobe. Its role is to control voluntary movement through directing the body's skeletal muscles.
5 B

CHECK YOUR UNDERSTANDING 3.5

1 The primary somatosensory cortex is a strip of neurons located at the front of the parietal lobe, adjacent to the primary motor cortex. It registers and processes sensory information from receptors in the body.
2 The primary somatosensory cortex allocates neurons to specific body parts depending on their sensitivity rather than their size. For example, the lips and mouth have great sensitivity because they are often used to receive sensory information such as taste. In comparison, the back of the trunk is less sensitive and therefore less somatosensory cortex is allocated to this body part because this area of the body is not used as often to receive incoming sensory information.
3 The primary auditory cortex is located in the temporal lobe. Its main function is to register and process auditory (sound) information.
4 D
5 The primary visual cortex, located at the base of the occipital lobe, registers, processes and interprets visual information sent from each eye. If this area is damaged, a person may experience visual impairments.

CHECK YOUR UNDERSTANDING 3.6

1 In the mid-1800s. Broca's area is responsible for the production of speech and Wernicke's area is responsible for speech comprehension.
2 Geschwind's territory. This area assists language comprehension by integrating sensory, auditory and visual speech information and passing this onto Wernicke's area to support comprehension.
3 A
4 D
5 C

CHECK YOUR UNDERSTANDING 3.7

1 D
2 The cerebellum assists a gymnast to perform a routine on a balance beam. The function of the cerebellum is to coordinate posture and balance when carrying out voluntary movements. Without the cerebellum, a gymnast would not be able to maintain stability and equilibrium on the balance beam.
3 The basal ganglia are located deep within the cerebral hemispheres of the forebrain. They surround the thalamus.
4 A
5 C

CHECK YOUR UNDERSTANDING 3.8

1 The three components of an emotion include:
- expressive behaviour – the way in which we respond to emotions, for example through facial expressions
- physiological responses – our biological responses to an event (e.g. increased heart rate for fear, or release of dopamine for pleasure) that are generated by the limbic system brain structures
- subjective feelings – refer to how each individual experiences reactions to emotions differently depending on their evaluation of an event. Evaluation of an event is generated by the thought processes controlled by the prefrontal cortex in the frontal lobe.

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2 Happiness: Passing your learner's test and driving for the first time

Sadness: Getting a bad mark on your first VCE SAC

Fear: Hearing a loud noise in the house when you are home alone

Disgust: When your mum makes something for dinner that you hate to eat and the smell of the dish makes you nauseous

Surprise: When your friends come over to your house unexpectedly

Anger: When your younger sibling has ruined your new smartphone by smashing it on the ground and cracking the screen

Contempt: When you are confronted with a Year 11 student who has been bullying Year 7 students

3 B

4 D

5 We know about the functions of the prefrontal cortex in emotional regulation because research evidence supports this. When participants are asked to use a cognitive strategy to control their emotions, brain-imaging technologies show increased activity in the prefrontal cortex.

APPLY YOUR KNOWLEDGE AND SKILLS

SECTION A: MULTIPLE-CHOICE QUESTIONS

1 C	6 B	11 B
2 B	7 D	12 A
3 C	8 D	13 D
4 A	9 B	14 A
5 C	10 D	15 A

CHAPTER 4

CHECK YOUR UNDERSTANDING 4.1

1 B

2 C

3 D

4 Cell production occurs during gestation. It involves basic cells dividing and multiplying so neurons can be formed. Cell migration also occurs during gestation. It involves newly formed neurons travelling to their final location in the nervous system. Cell elaboration can occur throughout the lifespan. It involves neurons connecting with other neurons to form synapses so information can be transmitted.

5 Grey matter consists of the mostly unmyelinated neurons on the surface of the cerebral cortex that process information locally. White matter consists of myelinated neurons located below the grey matter that transmit information between different brain regions.

CHECK YOUR UNDERSTANDING 4.2

1 A

2 D

3 B

4 An excess of neurons allows the infant to learn from their environment at a faster rate. Having more neurons maximises their potential to absorb stimuli and develop their skills.

5 The pruning of weak or unused neurons provides more nutriments and cortical space to neurons in the most important neural circuits, and allow these circuits to expand. The brain becomes more specialised because it creates strong neural networks for information that is important for the person's survival. It also becomes more efficient at transmitting information because there are fewer connections and changes taking place.

CHECK YOUR UNDERSTANDING 4.3

1 C

2 D

3 B

4 Acquired brain injury refers to a form of dysfunction that follows injury or damage to the brain. A head injury is damage to the skull and its outer coverings, but does not involve brain damage.

5 According to psychologists, 'dysfunction' refers to a change in behaviour following physical damage (e.g. to the brain) that prevents a person from carrying out their daily activities.

CHECK YOUR UNDERSTANDING 4.4

1 D

2 A

3 C

4 They would lose sensation in an area on the left side of their body. They may not be able to voluntarily move a body part on the left side of their body.

5 If the prefrontal cortex is damaged, it may not receive the information it needs from other brain areas to formulate a motor command or send a motor command to neurons in the motor cortex that control the movement of voluntary muscles. If this happens, your arms and legs will not receive motor messages, so they will not move.

CHECK YOUR UNDERSTANDING 4.5

1 C

2 A

3 D

4 Adaptive plasticity refers to the ability of brain neurons to alter the connections between the synapses in accordance to best suit the environmental conditions when learning something new or when relearning something after brain injury.

Developmental plasticity refers to changes in brain neurons and their synaptic connections that occur as a specific consequence of developmental processes.

5 Rehabilitation relies on adaptive plasticity processes. It repeatedly exposes the person to stimuli targeted at activating and strengthening brain neurons weakened by brain damage so they will begin transmitting information again. If the neurons were destroyed by the damage, rehabilitation activates neighbouring neurons to train them to take over the function of the damaged neurons. In this way, the brain reroutes its circuits and reorganises its functions so the person can adapt to their loss.

CHECK YOUR UNDERSTANDING 4.6

1 C

2 A

3 In-vitro experiments are conducted in a controlled environment (such as a test tube or petri dish) and do not involve living organisms. In-vivo experiments are carried out on living organisms.

4 Answers may vary.

Possibilities of advantage: Specific cells, enzymes or processes can be isolated; they allow scientists to see the result of a treatment before it is applied to humans.

Possibilities of limitation: In-vivo conditions do not fully correspond to conditions in the human body so the results may not generalise well; molecules created in in-vivo conditions do not have an immune system to protect them, but humans do.

5 A predictive model is best suited to testing the effect of a new medication because it allows scientists to record positive and negative effects of a newly created medication (and make any adjustments) before it is used as a treatment option on humans.

CHECK YOUR UNDERSTANDING 4.7

1 C

2 B

3 A

4 Dopamine is an excitatory neurotransmitter. When it is released it activates neurons in the basal ganglia area that are involved in producing and coordinating voluntary movement. When the brain receives less dopamine, these neurons are not able to function properly so the person has movement difficulties.

5 Answers may vary. Any three of the following: Persistent tremor in hands, legs, jaw or face; poor posture; difficulty coordinating voluntary movements or producing spontaneous movement; bradykinesia; inability to maintain balance; fatigue; muscle stiffness.

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CHECK YOUR UNDERSTANDING 4.8

1 PET images allow neuroscientists to assess the activity of brain areas that produce dopamine.
2 Parkinson's disease is chronic because once it appears it is always present; it is progressive because it gradually gets worse; it is a neurodegenerative disease because it destroys neurons in the nervous system.
3 A person would be injected with a harmless dye and placed in a PET machine. They would be asked to perform a task. While they did so the PET machine would track the blood flow to areas in their brain. This enables the identification of brain structures involved in producing dopamine to be observed to see if they had changed.
4 Early detection of Parkinson's disease is important because patients should receive treatment as early as possible to avoid the progression of the disease.

CHECK YOUR UNDERSTANDING 4.9

1 B
2 B
3 A
4 The blood–brain barrier is a physical structure in the brain that filters what enters the brain from the blood. It is made up of a layer of capillaries whose wall are tightly packed so they stop harmful substances in the blood from entering the brain, but let needed substances in. Medications such as levodopa can be carried in the blood and they can permeate the blood–brain barrier. When they are in the brain they are converted to dopamine, and this alleviates the effects of Parkinson's disease.

CHECK YOUR UNDERSTANDING 4.10

1 A
2 B
3 Neuroscientists are interested in investigating implanting stem cells in people with Parkinson's disease because these immature cells may develop into dopamine-producing cells and this may reduce the effects of the disease.
4 Deep brain stimulation (DBS) is an invasive surgical technique. It involves implanting an electrode deep inside the brain to deliver electrical stimulation to brain cells involved in movement that are inactive. The electrode is connected to a battery-operated device usually implanted in the chest.
5 DBS can help to control and reduce the symptoms of Parkinson's disease, and patients are usually able to reduce their intake of medications. DBS is also reversible and adjustable to the needs of the individual.

APPLY YOUR KNOWLEDGE AND SKILLS

SECTION A: MULTIPLE-CHOICE QUESTIONS

1 C	6 B	11 D
2 D	7 B	12 D
3 A	8 C	13 C
4 C	9 A	14 B
5 D	10 C	15 C

CHAPTER 5

CHECK YOUR UNDERSTANDING 5.1

1 B
2 D
3 The environmental influences on development
4 Hormones change the physical systems to keep the body in balance.
5 A person may inherit genetic material that promotes growth and will therefore have the capacity to be tall. However, if the environment they live in does not provide them with sufficient nurture such as nutrition to grow, they will not reach their height capacity, which is set by genetics.

CHECK YOUR UNDERSTANDING 5.2

1 D
2 B
3 Identical twins have the same genetic material (hereditary influences) and if adopted to different households can then be studied to see the effects of environment on development. Fraternal twins share some genetic material and may share the same environment so that similarities in developmental abilities can also be measured.
4 Adopted children are often placed into homes with similar backgrounds and characteristics of biological parents. If identical twins are placed in different homes, they are often placed in similar settings. Therefore, nurture may be similar in both instances.
5 Hereditary influences set the upper limits and capacity for many developmental abilities. The environment then determines through nurturing (providing exposure to stimulation or not) whether an individual meets their capabilities.

CHECK YOUR UNDERSTANDING 5.3

1 A
2 C
3 Sara's child has not reached a developmental milestone during the same period of time that most children reach that milestone. Most 18-month-old children can walk by then, so a check-up by the doctor will help to determine if the child has any physical or developmental issues. Some children will develop at a different rate from others without any long-term negative effects.
4 To compare children's development against the majority of children of the same age and developmental stage. They are used to monitor 'normal' development.
5 Similarity: They are both ideal periods of time in which to learn something.

Difference: Sensitive periods are longer periods of time than critical periods.

If learning does not occur in a sensitive period, it is possible for it to occur with more effort later, but if learning does not occur in a critical period, it will not occur at a later time.

CHECK YOUR UNDERSTANDING 5.4

1 C
2 D
3 D
4 Attachment refers to the close emotional bond or relationship between an infant and the primary caregiver. Emotional attachment is important for survival and comfort.
5 Imprinting is a form of attachment like those that form between humans and their caregivers, but imprinting is species specific (mainly for some species of bird) and the attachment is complete on first sight, whereas human attachments are not formed at first sight.

CHECK YOUR UNDERSTANDING 5.5

1 B
2 IV: Whether the cloth or the wire surrogate mother contained the feed bottle

DV: The amount of time spent on the surrogate mothers
3 Harlow's procedure:
- He set up two cages with a wire and cloth surrogate in each.
- In one cage the wire surrogate has the feed bottle; in the other the cloth surrogate has the feed bottle.
- Infant monkeys were separated from their mother at birth and placed into one or the other cage.
- He observed the time spent on each surrogate mother.
- He also observed the monkeys' behaviour when frightened.

4 Conclusion: Contact comfort was more important than food in infant–mother attachment of monkeys.
5 When stressed, monkeys would go to the cloth surrogate for comfort instead of the wire surrogate, even if the latter provided food.

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CHECK YOUR UNDERSTANDING 5.6

1 B
2 D
3 Other variables such as family breakdown, separation or divorce of parents and other factors may influence adolescent delinquency.
4 He reported that institutionalised children suffered from 'hospitalism'; that is, they were less advanced mentally and socially when compared to children in other institutions who had been given adequate care.
5 1 Preattachment, 2 Preliminary attachment, 3 Clear-cut attachment, 4 Goal-directed partnership

CHECK YOUR UNDERSTANDING 5.7

1 D
2 C
3 D
4 To test the quality of the attachment to the primary caregiver
5 No. Some cultures do not leave their children with strangers or even on the floor. Some cultures traditionally leave children only in the presence of those they know and the children are not placed on the floor, instead they are carried.

CHECK YOUR UNDERSTANDING 5.8

1 D
2 C
3 The development (changing) of mental processes over time
4 Assimilation: In Piaget's theory, the application of existing mental patterns to new situations (that is, the new situation is assimilated to existing mental schemes)

Accommodation: In Piaget's theory, the modification of existing mental patterns to fit new demands (that is, mental schemes are changed to accommodate new information or experiences)
5 A child sees a car and calls it 'car' after their parent says 'car'. When the child sees a truck, they call it 'car' because they use assimilation. The child uses accommodation when they learn that trucks are different from cars, and they need a new schema.

CHECK YOUR UNDERSTANDING 5.9

1 D
2 C
3 D
4 See 'Piaget's four stages'.
5 Concrete thinking uses real-life experiences to understand the world, whereas symbolic thinking does not – it uses mental processes to understand the world.

CHECK YOUR UNDERSTANDING 5.10

1 D
2 B
3 C
4 A conflict between personal impulses and the social world

APPLY YOUR KNOWLEDGE AND SKILLS

SECTION A: MULTIPLE-CHOICE QUESTIONS

1 B	6 C	11 C
2 C	7 C	12 B
3 C	8 D	13 D
4 B	9 D	14 D
5 A	10 A	15 D

CHAPTER 6

CHECK YOUR UNDERSTANDING 6.1

1 B
2 B
3 D
4 Adaptive behaviours allow a person to competently meet the demands of everyday living. Maladaptive behaviours are potentially harmful and prevent a person from meeting the demands of everyday living.
5 Typical behaviours are those that are considered usual or normal for an individual (or a group), whereas atypical behaviours are those that an individual (or a group) would not usually exhibit.

CHECK YOUR UNDERSTANDING 6.2

1 D
2 C
3 A
4 Using the statistical approach makes it difficult to decide how far from the average a behaviour needs to be in order for it to be abnormal, and it does not allow us to distinguish between abnormal behaviour that is desirable or undesirable.
5 A psychologist may define behaviour as normal or abnormal based on whether the individual can function in the following six domains: understanding and communicating, getting around, self-care, getting along with people, life activities (household, work and school activities) and participation in society.

CHECK YOUR UNDERSTANDING 6.3

1 D
2 B
3 C
4 A mental health problem is a disruption to a person's typical level of social and emotional wellbeing and generally does not pose significant problems or last for a long time, and it does not meet the criteria to make a diagnosis of a mental disorder.

A mental disorder is usually a diagnosable illness that causes distress, dysfunction and deviant behaviours that meet certain criteria in the *DSM-5*.
5 A continuum model is used to show the related but distinct dimensions of mental health and mental disorder. It shows how a concept can change over time or the different levels of the concept.

CHECK YOUR UNDERSTANDING 6.4

1 C
2 B
3 D
4 Social factors may work as protective factors if they provide support and benefit to a person's mental health (such as the love and support of family) or as risk factors if they encourage maladaptive or harmful behaviour and do not support a person's mental health (such as peer support that encourages risk-taking behaviour such as drug-taking).
5 Biological: Relaxation techniques to reduce muscle tension and reduce stress hormone secretion

Social: Friendships or support group to talk about problems and offer support

Psychological: Try to think of stressors as challenges that can be overcome (eustress) instead of becoming overwhelmed (distress) and feeling unable to cope

CHECK YOUR UNDERSTANDING 6.5

1 A
2 C
3 C
4 A problem-focused coping strategy is more effective because it attempts to deal with the cause of the stress and provide ways of removing the stressor. An emotion-focused coping strategy attempts to deal with stress by providing ways to 'feel' better about it, but does not deal with the stressor or the cause of the stress.
5 Too much stress has a negative impact on a person's ability to process information (concentrate, store and retrieve memory). If there is not enough stress to arouse a person, they may find that performance will also be low. For optimal performance, our arousal must be somewhere in the middle.

CHECK YOUR UNDERSTANDING 6.6

1 D
2 C

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3 Social support can be considered a protective factor as it can protect or act as a buffer for stress. It can also cause stress such as a relationship breakdown and therefore become a risk factor.

4 Good physical health (biological factor) may promote a positive self-image and confidence that leads to positive psychological outcomes, which influence in a positive manner the relationships the person has with others and in turn encourage them to continue living a healthy lifestyle.

5 Biological: Poor fitness and imbalance in neurotransmitters in the brain.

Social: Low fitness means an individual cannot socialise in sports with friends. Feel isolated.

Psychological: Feeling 'down' because of low energy levels and lack of social contact. Poor self-confidence and self-image.

Interaction of each factor leads to overall poor mental health.

CHECK YOUR UNDERSTANDING 6.7

1 C
2 A
3 C
4 The categorical approach allows a psychologist to match symptoms to major categories or groups of disorders and make a diagnosis, and therefore treat the disorder. It provides a common language for therapists, researchers, social agencies and health workers.
5 It may cause the individual to feel 'labelled' and therefore may suffer from stigma associated with the disorder.

CHECK YOUR UNDERSTANDING 6.8

1 A
2 D
3 The same brain reward system seems to be affected and there are some similar behavioural symptoms in both gambling and other addictive disorders such as substance abuse.
4 Diagnosable anxiety disorders are different because the anxiety experienced is extreme and the fear is out of proportion to the situation or stimulus.
5 Gambling is a socially acceptable behaviour because it is often thought of as harmless entertainment and people can do it openly. Society encourages the behaviour and rewards the gambler, providing more opportunity to continue and little to discontinue when it becomes out of control.

CHECK YOUR UNDERSTANDING 6.9

1 D
2 D
3 C
4 Benefits: Enables a person to get appropriate treatment and may provide them with information about their symptoms.

Disadvantages: May lead a person to feel stigma and fear others will treat them differently.

5 Personality disorders are characterised by an enduring pattern of inner experience and behaviour that deviates markedly from the expectations of the individual's culture; are pervasive and inflexible; have an onset in adolescence or early adulthood; are stable over time; and lead to distress or impairment.

CHECK YOUR UNDERSTANDING 6.10

1 C
2 A
3 The two-hit hypothesis generally refers to a genetic vulnerability (first hit) that is triggered by something in the environment (second hit). In disorders such as schizophrenia, it appears that there is no one clear cause.
4 There are a number of causes of the disorder, so the model allows for a variety of causes to influence an individual who may be vulnerable to environmental triggers.
5 Cancer

APPLY YOUR KNOWLEDGE AND SKILLS

SECTION A: MULTIPLE-CHOICE QUESTIONS

1 B	6 A	11 B
2 C	7 D	12 A
3 A	8 B	13 B
4 B	9 C	14 A
5 D	10 D	15 D

CHAPTER 8

CHECK YOUR UNDERSTANDING 8.1

1 A
2 A
3 C
4 Photoreceptors receive the light stimulus from the external environment and convert it into individual impulses of electrochemical energy.
5 Transduction of stimulus energy into impulses of electrochemical energy is necessary because the nervous system can only transmit energy in this form and the brain can only process it in electrochemical form.

CHECK YOUR UNDERSTANDING 8.2

1 C
2 C
3 B
4 Sensation occurs before perception. During sensation, a stimulus is received, converted into electrochemical energy and transmitted to the brain. In the brain only the important features are selected, organised into a new whole and interpreted. Without sensation, there would be no perception.
5 Feature detector cells are specialised to respond to specific features of a stimulus. This means they filter stimuli when they reach the brain, because they ignore unimportant stimuli.

CHECK YOUR UNDERSTANDING 8.3

1 A
2 B
3 Photoreceptors receive and transduce visual information. Then they transmit it to bipolar cells, and bipolar cells transmit it to ganglion cells.
4 A receptive field is the area on a photoreceptor's surface (or group of photoreceptors) that receives the stimulus and triggers the neuron (or group of photoreceptors) to fire.
5 Rods are more sensitive to light than cones. Cones are activated by bright light, which is further along the visual light spectrum. Rods are activated by lower levels of light, which is lower down the visual light spectrum.

CHECK YOUR UNDERSTANDING 8.4

1 B
2 C
3 C
4 During selection only the most important parts of stimuli are selected for further processing. Unimportant parts are ignored and receive no further processing. This filtering occurs because there is too much stimulus for the brain to respond to at any one time.
5 The brain automatically relies on visual perception principles to help it organise the constantly changing and incomplete stimuli it receives so it can quickly reassemble them into a form that can be interpreted. This organisation needs to happen quickly, so the brain can interpret the stimuli and form an appropriate response. So, visual perception principles help us to quickly adapt to changes in our environment.

CHECK YOUR UNDERSTANDING 8.5

1 B
2 B
3 B
4 A visual field comprises all the area of the external environment that can be seen when your head is still. A receptive field is the section of a neuron's surface (or group of neurons) that the stimulus falls on to trigger the neuron to fire.

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5 If the optic nerve is damaged, visual information cannot be delivered to the brain for processing. This means the brain does not have the full amount of visual information it needs to form a perception, so some form of visual impairment will occur.

CHECK YOUR UNDERSTANDING 8.6

1 D
2 D
3 When we view a stimulus, our perceptions of it are influenced by the information surrounding it. If we only view the horizontal stimulus line, the middle ambiguous stimulus is surrounded by the letters 'T' and E', so to make sense of the stimulus, we are more likely to view the middle figure as the letter 'H' and perceive the word 'THE'. If we only view the vertical stimulus line, the middle figure is surrounded by the letters 'M' and 'T', so to make sense of the stimulus, we are more likely to view the middle figure as the letter 'A' and perceive the word 'MAT'.
4 A perceptual set refers to a group of psychological factors that predispose us to perceive a stimulus in a particular way because they create an expectation about what the stimulus will be. It affects perception of a new stimulus because, before viewing it, we already have an expectation of what it will be and, therefore, we tend to perceive the new stimulus according to this expectation.
5 Past experience with a stimulus creates an expectation about what a new, similar stimulus will be. This expectation causes us to perceive the new stimulus in the same way we viewed the similar stimulus in the past.

CHECK YOUR UNDERSTANDING 8.7

1 B
2 D
3 D
4 D
5 Monocular cues are depth cues received from one eye only, for example accommodation or any of the pictorial depth cues. Binocular cues require information from two eyes, for example convergence and retinal disparity.

CHECK YOUR UNDERSTANDING 8.8

1 B
2 D
3 A
4 Being able to discern tastes means we can tell the difference between foods that are good or bad for us. Bad foods usually taste bitter or sour so we do not swallow them. This helps us avoid swallowing harmful foods.
5 A gustatory receptor cell is a single cell located on the surface of a taste bud that responds to chemical molecules in food or drink. A taste bud is located in a papilla on the tongue's surface. Taste buds consists of numerous gustatory cells.

CHECK YOUR UNDERSTANDING 8.9

1 B
2 A
3 A
4 Ageusia and dysgeusia are both serious taste disorders. If a person has ageusia, they experience a loss of taste. If they have dysgeusia, they can still taste but their sense of taste is distorted.

CHECK YOUR UNDERSTANDING 8.10

1 A
2 Memory provides information related to past food experiences. We use this information during perception to decide if the food is harmful or not and whether we like it or not based on past experiences.
3 Perceptual set influences perceptions of a new stimulus because it sets up an expectation of what the stimulus will be. If a person who has never eaten black ice-cream and only eaten black foods that made them sick or they found unpleasant, they would automatically perceive black ice-cream to be bad or unpleasant because of its colour.
4 Our emotional state influences how we perceive a stimuli. If we are in a good mood, we are more likely to perceive stimuli as pleasant and harmless. If we are in a bad mood, we are more likely to perceive stimuli as unpleasant and harmful.
5 If you come from a culture that eats a lot of spicy foods and you are given them regularly, then you become used to the taste. Because the cultural influences surrounding you perceive the spicy flavour to be pleasant, you gradually adopt the same attitude.

APPLY YOUR KNOWLEDGE AND SKILLS

SECTION A: MULTIPLE-CHOICE QUESTIONS

1 A	6 B	11 C
2 C	7 C	12 A
3 D	8 B	13 A
4 A	9 B	14 C
5 C	10 C	15 B

CHAPTER 9

CHECK YOUR UNDERSTANDING 9.1

1 D
2 C
3 B
4 We may make a perceptual error when viewing a stimulus because the stimulus itself gives us misleading cues (e.g. illusions) or because of the influence of a range of psychological factors (e.g. perceptual set).
5 A visual illusion is a consistent perceptual error in interpreting a real external stimulus. A hallucination is a perceptual error resulting in the perception of an object or event that has no external reality.

CHECK YOUR UNDERSTANDING 9.2

1 A
2 A
3 D
4 The distorted construction of the Ames room causes the illusion. The room is trapezoid in shape but when viewed through a peephole it appears as a normal rectangle. Viewing the room through the peephole restricts vision to monocular cues and this causes the viewer the maintain shape constancy at the expense of size constancy.
5 A prediction that an apparently more-distant object that has the same-sized retinal image as an apparently nearer object will be perceived as the larger.

CHECK YOUR UNDERSTANDING 9.3

1 B
2 C
3 A
4 C
5 When the Moon is overhead, few depth cues surround it. In contrast, when we see the Moon on the horizon, it is behind houses, trees, telephone poles and mountains. These objects (depth cues) make the horizon seem more distant than is the night sky overhead. This is consistent with apparent-distance theory, which is that an apparently more distant object that makes the same-sized retinal image as an apparently nearer object will be perceived as the larger object.

CHECK YOUR UNDERSTANDING 9.4

1 C
2 B
3 B
4 Inattentional blindness refers to a failure to notice an object that is fully visible in the environment because attention was not focused on it. Change blindness refers to a failure to notice large changes in a visual scene.
5 The motion-after effect is a perceptual anomaly that occurs after viewing a moving object for a period of time and then viewing a static object – the static object appears to move in the opposite direction to the original moving stimulus.

CHECK YOUR UNDERSTANDING 9.5

1 C
2 B
3 C
4 Visual cues arising from a food's colour help us to survive because we use them to judge the freshness of the food or whether a food is potentially poisonous.
5 Intrinsic food cues arise from the food itself, for example colour and sugar content. Extrinsic food cues are associated with the food but are not part of the food, for example packaging and place of origin.

CHECK YOUR UNDERSTANDING 9.6

1 A
2 B
3 D
4 Any three of the following: Synaesthesia requires a trigger; the trigger can be external or internal; the response to the trigger is always the same; synaesthesia is one-directional; it is a unique experience for the individual; it is a vivid experience that is remembered; it is involuntary; it is more common among women and creative personalities.
5 Synaesthesia is considered a perceptual anomaly because the person's perception of a stimulus deviates from the normal perception of the stimulus.

CHECK YOUR UNDERSTANDING 9.7

1 C
2 No. The visualisation of the childhood dog is a result of memory. For it to be a synaesthetic experience, a sense other than vision would also need to be activated by looking at the photo.
3 The theory that synaesthesia is the result of childhood experiences does not explain why siblings with synaesthesia raised in the same or similar environments may experience different colours for the same trigger, or experience different variants of synaesthesia. If their synaesthesia was the result of childhood experiences, their synaesthetic experience would be the same.
4 Synaesthesia is considered a perceptual anomaly rather than a perceptual disorder because the synaesthete is not dysfunctional. Their perceptual abilities are not limited, but their perception is different from the norm.
5 Synaesthesia is common in families, so evidence suggests that there is a genetic link.

CHECK YOUR UNDERSTANDING 9.8

1 D
2 D
3 D
4 Any two of the following: Grapheme–colour synaesthesia is triggered by specific numbers, letters or words; the first letter of a word is usually the trigger; the same trigger will always result in the perception of the same colour.
5 The temporal lobe and the occipital lobe

APPLY YOUR KNOWLEDGE AND SKILLS

SECTION A: MULTIPLE-CHOICE QUESTIONS

1 B	6 A	11 C
2 D	7 B	12 A
3 A	8 D	13 A
4 D	9 A	14 B
5 D	10 C	15 C

CHAPTER 10

CHECK YOUR UNDERSTANDING 10.1

1 B
2 C
3 A
4 Schemas allow us to categorise and group information easily for storage and future use.
5 Pre-existing schemas assist us to make impressions about the behaviour of others.

CHECK YOUR UNDERSTANDING 10.2

1 A
2 B
3 We assign causes to our own behaviour and that of others. Usually we either attribute behaviour to personal or situational factors.
4 Personal attribution looks to internal factors causing a behaviour, such as personality and mood. Situational attribution looks to external or factors outside the control of the individual, such as other people and context.
5 Media: A person watching television programs in which people are having fun drinking a particular soft drink forms the attitude to view the soft drink positively

Child rearing: Parents hold negative attitudes towards a particular race, so their children take on the same attitudes.

CHECK YOUR UNDERSTANDING 10.3

1 D
2 A
3 Stereotypes develop when information about a group of people is oversimplified and then all members of a group are seen to be more similar than they actually are.
4 They allow us to make efficient judgments about others in new situations.
5 They may not be accurate judgments or perceptions because they generally lack information.

CHECK YOUR UNDERSTANDING 10.4

1 D
2 A
3 B
4 Positive: Exercise – A: I feel strong and healthy when I do exercise, B: I do it regularly, C: I think 30 minutes of exercise each day is healthy

Negative: Drink driving – A: I feel upset and sad when people do it, B: I do not drive while drinking, C: I think you are stupid if you drink and drive
5 It cannot give an indication about the strength of an attitude and sometimes there is inconsistency in the three components, making it difficult to use the model to predict future behaviour.

CHECK YOUR UNDERSTANDING 10.5

1 C
2 A
3 Healthy eating – A: I feel good when I eat a balanced diet, B: I eat a block of chocolate and a bag of chips, C: I think you should eat everything in moderation

Experiencing feelings of guilt after consuming junk food, but convincing myself it will be OK as long as I do more exercise.
4 If a person were to answer a survey or questionnaire about a certain thing, we might use this information to predict their future behaviour; however, sometimes what we say and what we do are two different things.

CHECK YOUR UNDERSTANDING 10.6

1 A
2 C
3 D
4 Prejudice is the negative attitude held towards a group of people.

Discrimination is the act of being prejudiced; that is, treating the group you hold the negative attitude towards differently so that they do not have the same opportunity or rights as others.
5 Prejudice is a cognitive process, while discrimination is an action or behaviour.

CHECK YOUR UNDERSTANDING 10.7

1 A
2 A
3 Being labelled a scapegoat is unwarranted so could leave a person feeling powerless to change their circumstances.

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4 Blaming everyone who is unemployed on the crime rates in your area

5 Racism, sexism, ageism

CHECK YOUR UNDERSTANDING 10.8

1 B
2 C
3 D
4 The language people use when referring to older generations; greeting cards; media
5 By encouraging people to get to know and spend prolonged time with people of different races or ages, and giving both groups a task that requires all members to work together to finish it

CHECK YOUR UNDERSTANDING 10.9

1 A
2 D
3 B
4 Sustained contact achieves personal information and lets people see that others are not so different.

Mutual interdependence encourages the group to work together, concentrating on a task instead of their racist ideas.

Equality means that no member of the group should have a higher status than any others so that people see their standing in the social group as fair.

5 It uses all inter-group contact concepts, which means that each person has a role to play to achieve a group goal.

CHECK YOUR UNDERSTANDING 10.10

1 C
2 D
3 B
4 Cognitive interventions attempt to change thought processes, which will in turn hopefully lead to changes in behaviour. They make people aware of negative attitudes.
5 By changing thoughts, which should lead to changes in behaviour

APPLY YOUR KNOWLEDGE AND SKILLS

SECTION A: MULTIPLE-CHOICE QUESTIONS

1 D	6 D	11 C
2 D	7 D	12 A
3 D	8 B	13 A
4 C	9 A	14 B
5 B	10 A	15 D

CHAPTER 11

CHECK YOUR UNDERSTANDING 11.1

1 D
2 D
3 A
4 They are not a group, because even though there two or more people who share a common goal, they do not interact sufficiently to be classified as a group.
5 A group could be the Year 11 class that consists of 20 students and one teacher. The members of the group have different status within the group, with the teacher usually at the top of the hierarchy because they have the most social power.

CHECK YOUR UNDERSTANDING 11.2

1 D
2 C
3 D
4 Zimbardo advertised for participants at Stanford University. Selected 24 'stable' participants. Randomly assigned them to be prisoners or guards. Guards given uniform and prisoners picked up in police car and taken to mock prison. Prisoners went through simulation of real prison. Guards took on the roles and enforced prison rules. Prisoners became depressed and rebelled against guard behaviour. Experiment stopped after 6 days because of the psychological harm it was having on some participants.
5 Reward: Teacher giving a star to students with good grades

Coercive: Ticket inspector giving parking fine

Legitimate: Police officer (given a role with authority in society)

Referent: Favourite actor (want to be like them)

Expert: Doctor (go to them when sick because they know how to treat medical complaints)

CHECK YOUR UNDERSTANDING 11.3

1 C
2 C
3 A
4 To see whether participants would follow the commands to potentially harm another person
5 If there were allies within the group of 'teachers' refusing to shock the 'learner', then obedience decreased; if there were no other 'teachers', the level of obedience increased.

CHECK YOUR UNDERSTANDING 11.4

1 D
2 A
3 D
4 Private conformity refers to behaviour that is consistent with the person's beliefs.

Public conformity refers to behaviour that is inconsistent with the person's beliefs.

5 If all members of a group agree about something, then conformity increases. If not all members of a group agree, the presence of allies can decrease the rate of conformity.

CHECK YOUR UNDERSTANDING 11.5

1 A
2 D
3 C
4 The tendency to put in less effort when working in a group than when alone.
5 The guards wore mirrored glasses and a uniform, increasing the feeling of anonymity, which can lead to a sense of not having the same personal responsibility when in a group. They also acted in ways that they may not have acted if they had been alone in the role of guard.

CHECK YOUR UNDERSTANDING 11.6

1 A
2 D
3 C
4 Bystander effect: When people are less likely to help if there are other people present

Bystander intervention: When an individual helps others in a situation where help is needed

5 Location: If the person in need of help is in a small town or somewhere that has sense of community they will more likely get help than in a larger city (where there are more people and the bystander effect may occur)

Victim's circumstance: If a person in need of help looks like they are not responsible for their predicament, they are more likely to receive help. Children are also more likely to receive help.

CHECK YOUR UNDERSTANDING 11.7

1 A
2 C
3 D
4 Society and the groups to which we belong have 'norms' that are like rules the groups follow (or not). These norms give us some indication to govern our behaviour when we are making decisions about what is 'right' and when we should help others (i.e. act pro-socially).
5 A social responsibility norm is the 'rule' that we help those that are in need or who are less fortunate, e.g helping a small child in a shopping centre to locate their mother when they are lost.

CHECK YOUR UNDERSTANDING 11.8

1 B
2 D
3 D

4 Empathy: Being able to picture yourself in someone else's problem situation because you have memories of experiencing something similar yourself

Sympathy: Feeling sorry or upset about someone else's problem situation even though you have never experienced anything like it yourself

5 If you are in a good mood, you are more likely to help than if you are in a bad mood, although sometimes people fail to help when in a good mood because they do not want to ruin their good mood.

CHECK YOUR UNDERSTANDING 11.9

1 D
2 D
3 D
4 Diffusion of responsibility: When there are more people present in a situation where someone needs help, people are less likely to offer help because they think someone else will; the feelings of responsibility are spread out. If there were only one person to help, they would be the only one to assume responsibility. For example, a man has a seizure in a busy shopping centre. People do not feel they have to help because there are others to do so. However, if you saw the man having a seizure while bushwalking and nobody else was around, you would feel more responsible and therefore would be more likely to help, because there is nobody else to do it.
5 They would evaluate what they will gain versus what they would lose by helping. When they saw the person fall, their body would become aroused. The higher the level of arousal, the more likely they would be to offer help. They would also analyse the cost to the person who fell if they did or did not help; i.e. is the person likely to be OK if they don't help?

CHECK YOUR UNDERSTANDING 11.10

1 B
2 D
3 D
4 Similarity: Both are forms of aggression from a more powerful group or person towards a less powerful group or person aimed at causing harm, distress.

Difference: Cyberbullying uses some form of technology, whereas bullying does not. Cyberbullying is also generally anonymous, and the bully does not necessarily know the victim.

5 Benefit: Video games may give some people an escape and be a way to relax and socialise with others who share similar hobbies. They may also improve coordination.

Negative impact: Playing aggressive video games can lead to desensitisation and contribute to more aggressive thoughts and behaviours in players.

APPLY YOUR KNOWLEDGE AND SKILLS

SECTION A: MULTIPLE-CHOICE QUESTIONS

1 B	6 C	11 C
2 D	7 A	12 D
3 C	8 D	13 D
4 C	9 D	14 D
5 D	10 A	15 D

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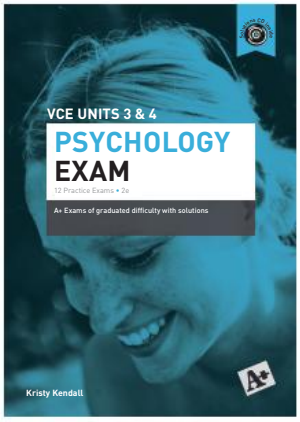
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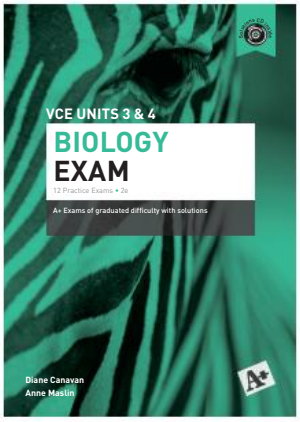
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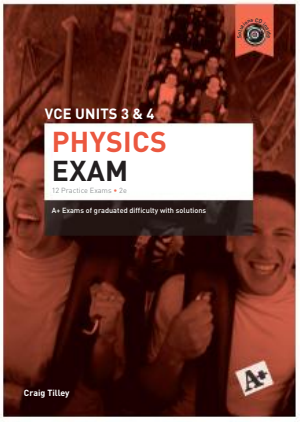
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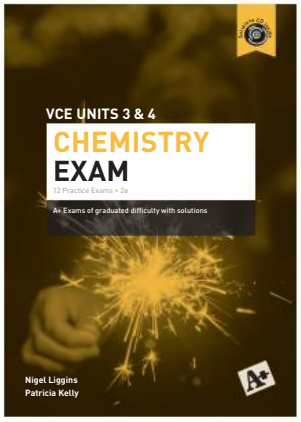
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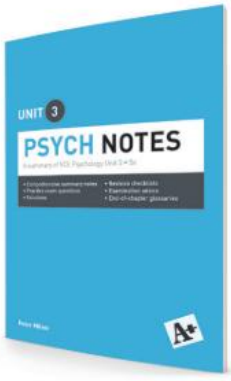
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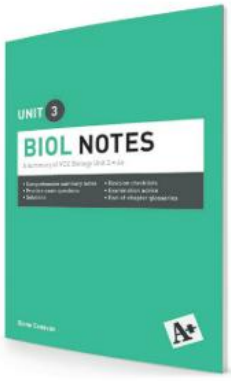
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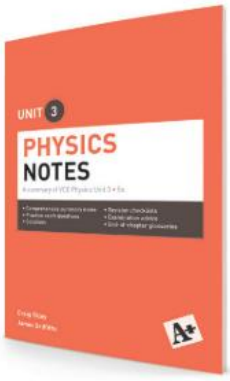
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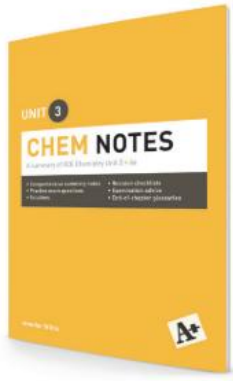
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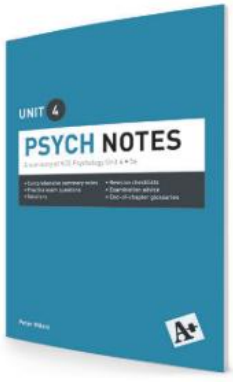
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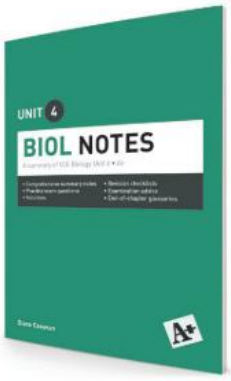
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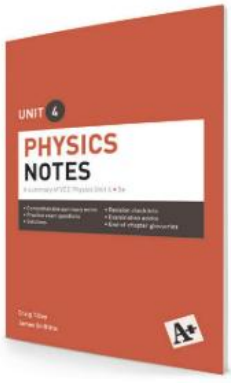
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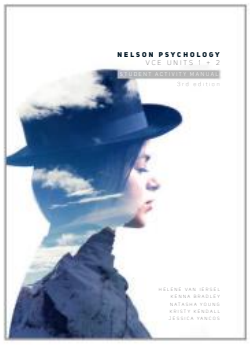
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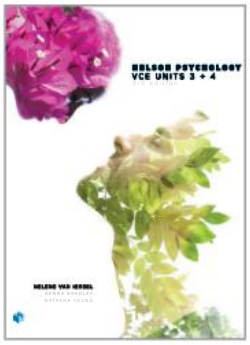
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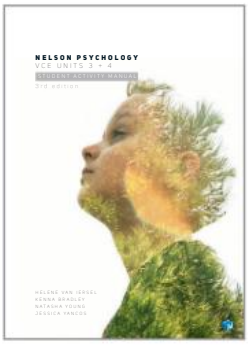
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