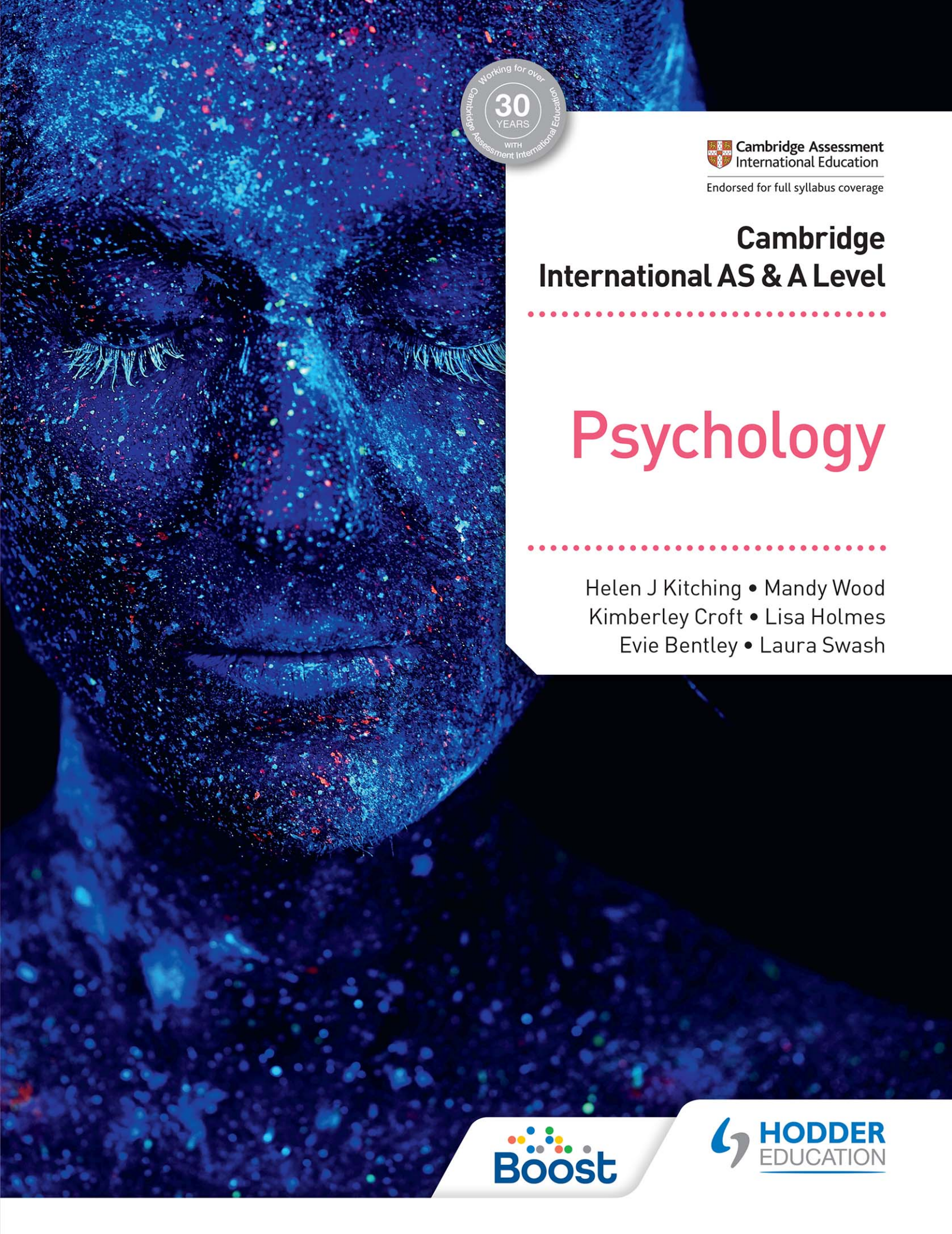

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Contents

Welcome to Psychology!

We are so excited that you are here studying psychology – you now belong to one of the most vibrant, diverse and prodigious communities of students, researchers and practitioners on the planet. Millions of students study psychology around the world and take what they have learned into careers including business, sales, marketing, physical and mental health. Put simply, where there are people, there is psychology!

We hope that you enjoy your time studying and gain the confidence to question the relevance and legitimacy of psychological knowledge, before applying what you have learned to your everyday life. In a thriving, organic subject such as ours, your voice matters! For psychological knowledge to grow and evolve, the discipline requires researchers from every corner of the world – to bring together unique perspectives to challenge and demand a psychology that describes, explains, predicts and celebrates all human minds.

We learn to think critically when we can explore our ideas with others, whether that is face-to-face in a traditional classroom or virtually through online forums. We want you to enter into the dialogue, thinking, sharing, reflecting on and revising your views. This is how psychologists work and we hope it works for you too!

Safe travels and best of luck!

Helen, Mandy, Kimberley, Lisa, Evie and Laura

1 The Biological approach

Learning outcomes

In this chapter, we will discuss:

- the main assumptions, methodology, history, issues and debates of the biological approach
- psychological concepts, theories and research relating to the three core studies:
  - Dement and Kleitman (sleep and dreams)
  - Hassett *et al.* (monkey toy preferences)
  - Hölzel *et al.* (mindfulness and brain scans)
- strengths and weaknesses of the three key studies with reference to ethical issues, **reliability**, **validity**, **objectivity** and **subjectivity**, **generalisations**, issues and debates, including applications to everyday life
- how to plan and evaluate your own investigations using **longitudinal studies**, **correlations** and **questionnaires**.

▲ Figure 1.1 Biological psychologists have studied how mindfulness affects the human brain

Where there are people, there is psychology!

Psychology is everywhere, and this woman is in Germany, the homeland of neuropsychologist Britta Hölzel. You will examine Hölzel *et al.*'s research on mindfulness on pages 29–40 of this chapter. But before finding out how this ancient practice affects the workings of the **brain**, you will learn about Dement and Kleitman's study of sleep and dreams and Hassett *et al.*'s study of monkey toy preferences. First, let us explore the main assumptions of the biological approach.

KEY TERMS
brain
hormones
genetic
evolutionary differences
biological factors

METHODOLOGY
experiment
longitudinal design
self-report (questionnaire and interview)
correlation
observation

1.0 Introducing the Biological approach

Think!

Why do you think the pituitary gland is known as the master gland?

Think!

Imagine you are working in a laboratory conducting research using female rats. Your supervisor suggests a study where you will inject the rats with testosterone. She asks you to create a way of testing the effects of this hormone on their behaviour. What would you suggest?

Think!

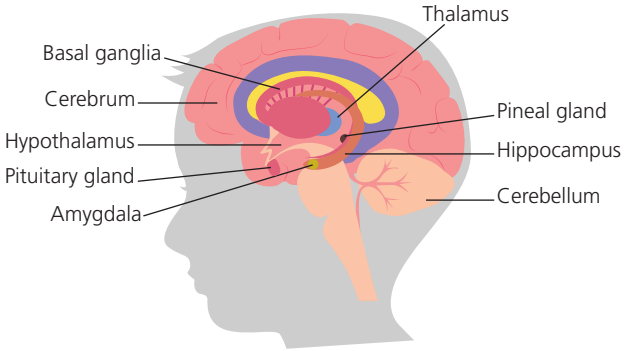
Many animals have evolved to sleep at night when it is dark. Using your understanding of evolution, explain why natural selection has favoured animals that sleep at night and are awake during the day.

Main assumptions

1 Behaviour, cognitions and emotions can be explained in terms of the working of the brain and the effect of **hormones**, **genetics** and **evolution**.
2 Similarities and differences between people can be understood in terms of **biological factors** and their interaction with other factors.

(Cambridge International, 2021)

Figure 1.2 shows the position of the hippocampus, a brain structure associated with memory, which underwent neuroplastic changes following Mindfulness-Based Stress Reduction in the study by Britta Hölzel and colleagues. Dr Hölzel conducted an experiment, but how would you convince her to let you conduct a case study on the role of the hippocampus?



▲ **Figure 1.2 The central nervous system is made up of the brain and spinal cord**

The workings of the brain

Together with the spinal cord, the brain is part of the central nervous system, which controls all our bodily functions and thoughts, both conscious and unconscious. The human brain is a highly complex organ made up of billions of neurons (nerve cells), which work together in specialised neural networks. In this chapter, you will learn about localisation of function, which refers to the idea that specific structures in the brain are responsible for specific

behaviours and processes. You will also learn that experience can cause changes in our neural networks, including increasing and decreasing the number of connections (synapses) between neurons. This process is called neuroplasticity and is a good example of an interaction between nature and nurture.

Throughout this course, you will learn about various brain structures, some of which are subcortical structures. This means they are buried deep within the brain, below the outside layer called the cortex (see Figure 1.2 for some of the structures you will learn about in your course). The brain is also divided into five areas, or lobes, each of which has been linked to different areas of human functioning – for example, visual (occipital lobe) and auditory processing (temporal lobe).

The effect of hormones

The endocrine system is made of glands throughout the body which produce and release various substances, including hormones. Hormones are sometimes called chemical messengers as they travel through the blood to the various bodily organs. Hormones bind to specially shaped receptors, signalling the organs to bring about important changes to help the organism to develop and respond to their environment. The most important gland in the body is called the pituitary gland and it is situated in the brain. This gland controls the release of hormones from all the other glands in the body. For example, adrenocorticotropic hormone is released by the pituitary gland and signals the adrenal glands (at the top of the kidneys) to release the stress hormone cortisol. The pituitary gland also releases oxytocin, another hormone that you will learn about in the study by Perry *et al.* (2015) in the social approach (page 143).

In this chapter, you will learn about toy preferences in monkeys (page 16). Hassett *et al.* (2008) claim that male and female monkeys prefer different types of toys due to differences in sex hormones (e.g. testosterone and oestrogen).

The effect of genetics

Genes are the basic units of heredity. They are responsible for transmitting specific characteristics from one generation to the next, e.g. from parents to their children. Genes are stretches of DNA, large chains of molecules that code for the creation of amino acids, which make up all the proteins needed to create a living organism. When psychologists talk about genetics, they are referring to the branch of biology that is concerned with the effect of genes on not only our physical development but also our behaviour and mental processing.

It is also important to understand that the way genes are expressed – that is, the way that the instructions are carried out – is affected by environmental factors, such as stress and diet. These **interactions** between nature and nurture are called epigenetic effects.

The effect of evolution

The term evolution refers to the biological process whereby the characteristics of a species gradually change over several generations. This relies on the process of natural selection: genes which code for characteristics associated with survival become more common and genes that decrease the chance of survival become less common (Darwin and Kebler, 1859).

Biological psychologists believe that behavioural differences between species depend on the amount of shared DNA. For example, humans and chimpanzees share more DNA than any other species (98.8 per cent), meaning that a small proportion of DNA (1.2 per cent) is responsible for all of the differences between these species. However, even when non-human animals and humans share the same genes, they are not always expressed in the same ways, leading to great diversity between the species.

Understanding similarities and differences between people

Similarities between people can be explained in terms of the fact that human brains typically include the same brain structures which are localised to specific behaviours

and skills. Likewise, hormones typically have the same effect on their target organs for the majority of people leading to similarities in behaviour and cognition. On page 6–14 you will learn about the REM and nREM stages of sleep, which have evolved to help us to function effectively, and ultimately to survive. The majority of people exhibit similar patterns of brain activity during sleep, which is necessary for physical and psychological wellbeing.

Atypical brain development and/or brain damage may lead to differences in behaviour and cognition and may lead to loss of function. This said, cortical remapping, whereby unaffected brain structures become localised to the lost skills may mean that skills can be regained. Experiences within the environment and practice in certain skills can also lead to differences in the grey matter concentration in certain brain structures and this can account for differences in behaviour. You will learn more about this in the study by Hölzel *et al*. (mindfulness and brain scans).

As you learn more about the three core studies in the biological approach, you will begin to understand that human behaviour and cognition result from the interaction between biological factors and events within our physical and social environment. On pages 15–28 you will learn how monkey toy preferences may be shaped in part by hormonal differences between the sexes (a biological factor), however interactions with toys are also affected by the social rank of individual monkeys within the group (a social factor).

Methodology in the Biological approach

Biological psychologists generally collect quantitative data, often as part of an experiment where two groups or conditions are compared. Blood, urine, saliva, cerebro-spinal fluid and faecal matter can be tested to find out about an organism's genetic make-up and/or levels of certain hormones and other substances. Other objective measures may be taken, such as heart rate or electrodermal activity, which monitors changes in sweat glands as a measure of emotional arousal.

MRI scans can be used to monitor structural changes in the brain and techniques such as voxel-based morphometry (VBM) may be used to measure the relative size of specific structures. fMRI and/or PET scans can be used to observe the activity in different brain structures while participants complete a task. This is done by monitoring neural blood flow. The more active a brain structure is, the quicker oxygen is consumed. This means blood flow to that region is increased to cope with the increased demand. On page 6, you will learn about a final imaging technique called electroencephalography (EEG), which measures changes in electrical activity (brain waves) as neurons communicate with each other.

Biological psychologists also conduct experiments on non-human animals, for the reasons discussed on page 16, and they sometimes conduct ethological studies, which means studying animals in their natural habitats.

Bonobos and chimpanzees share almost 99 per cent of their DNA with humans and, as you might expect, show many human-like behaviours, including aggression (Figure 1.3). Why do you think aggression is a common trait in these three species?

▶ **Figure 1.3 Aggression is a trait shared by bonobos, chimpanzees and humans**

ISSUES AND DEBATES

Applications to everyday life

A better understanding of the impact of biological factors has led to the development of treatments to help people with sleep disorders and hormonal imbalances (see congenital adrenal hyperplasia, page 18) and to manage stress through practices such as mindfulness, which can trigger neuroplastic changes.

Individual and situational explanations

An understanding of the interaction between genes and environment is helpful in understanding individual differences, but an understanding of the way the brain responds to stress through the release of hormones, for example, can help explain the impact of situational factors.

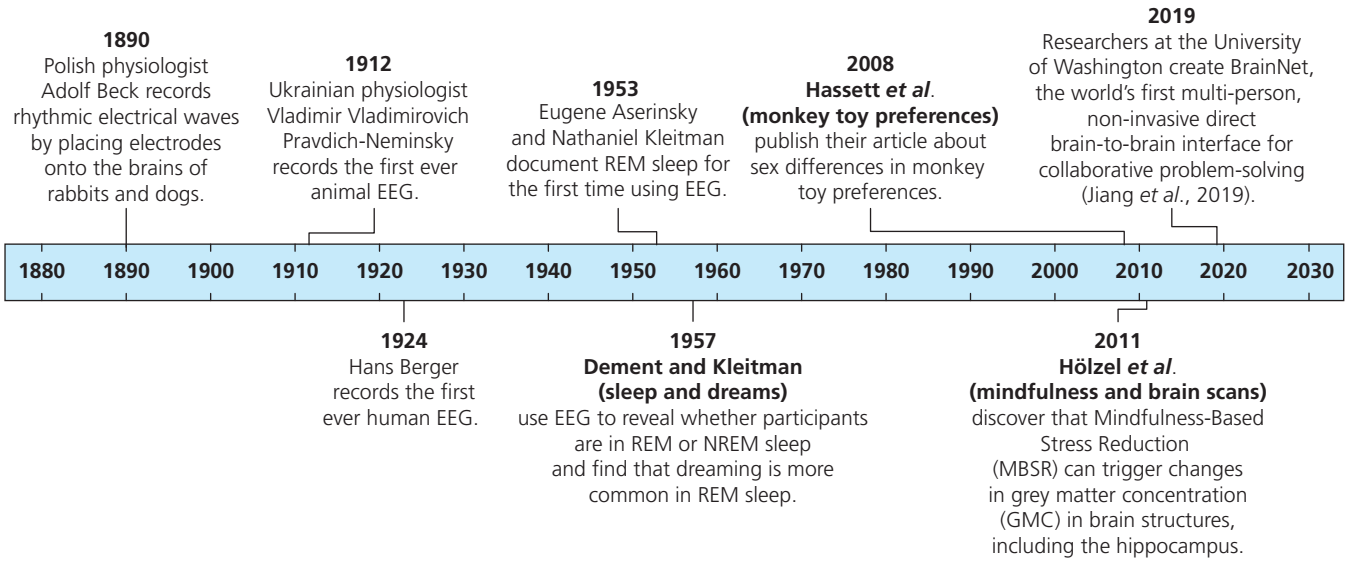
Nature versus nurture

Although the biological approach is clearly allied with nature (i.e. the impact of genes on the brain and behaviour), advances in our understanding of neuroplasticity and epigenetics help to explain how nurture (experience) changes our behaviour.

The use of animals in psychological research

The biological approach often favours the use of non-human animal experiments – for example, with rodents or primates – due to biological similarities with humans.

The history of the Biological approach



▲ Figure 1.4 Timeline of the biological approach

STUDY TIP

As you learn about each of the studies in the biological approach, think about how the results support the main assumptions of the approach. What has the study told us about the causes of behaviour and how they link to the workings of the brain, hormones, genetics and/or evolution? Does the study tell us anything about the interaction of these biological factors and environmental factors?

Do you remember Rohan and Polina from page xii? They were discussing an internet news story about a voluntary project where people from many cultures came together to collect and deliver aid to people affected by the COVID-19 pandemic. Rohan was surprised by how generous people were in terms of helping strangers. Polina says she feels it is understandable as people generally want to help others.

- How might biological psychologists explain the high levels of generosity and helpfulness observed during the pandemic?
- Use what you have learned in this section as a starting point, but you may also wish to conduct some research of your own.
- After you have learned about all three studies in the approach, you may like to revisit your answer and add some more ideas.

1.1 Dement and Kleitman (sleep and dreams)

1.1.1 Background

Think!

What are the main differences between REM and non-REM **sleep**?

Think!

How have your sleep patterns changed throughout your lifetime so far? Have you noticed any changes in the amount of time you sleep, or the time you wake up, as you have got older?

Think!

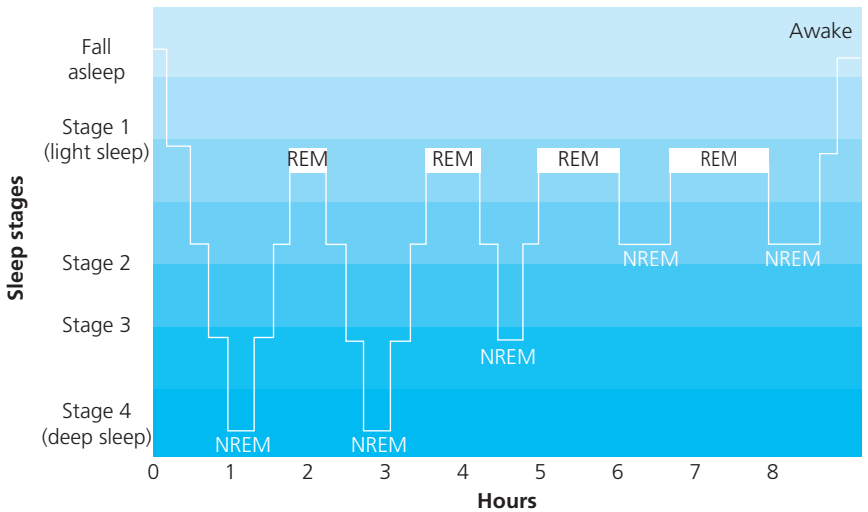
While the use of scientific equipment such as EEGs to record physiological processes can make measurements more objective, what are some disadvantages of their use?

Introducing William Dement and Nathaniel Kleitman

Nathaniel Kleitman, Professor Emeritus in Physiology at the University of Chicago, is known as the founder of modern sleep research. He was also an academic supervisor of William Dement. Kleitman used many of his relatives in his sleep research and had his daughters sleep on special beds designed to track their sleep for many years. He was also interested in the effects of sleep deprivation and once spent over a month in an underground cave to record his sleep and body temperature. In 1953, another of Kleitman's graduate students, Eugene Aserinsky, discovered that periods of eye movements during sleep correspond to sudden increases in brain activity after monitoring his eight-year-old son's sleep with an EEG machine (Aserinsky and Kleitman, 1953). This was an important finding as, before this discovery, it was believed that the brain was in a restful state only during sleep.

▲ Figure 1.5 Professor Nathaniel Kleitman

How do the stages of sleep change throughout the night (Figure 1.6)? When you have slept for a longer period of time than normal, are you more likely to remember your dreams?



▲ Figure 1.6 Sleep cycles

KEY TERMS

sleep
electroencephalogram (EEG)
rapid eye movement (REM)
non-rapid eye movement (non-REM)
ultradian rhythms
dreaming

The psychology being investigated

Sleep

Brain wave activity during sleep can be measured via an **electroencephalogram (EEG)**, which detects activity through electrodes connected to the scalp (see page 10 for more on EEGs). Sleep researchers have identified five distinct sleep stages. Stages 1 and 2 are the lighter stages of sleep, where a person can still be woken fairly easily, and stages 3 and 4 are the deeper stages of sleep. In the deeper stages, brain waves slow down and show a pattern of high amplitude and low frequency. The final stage is **rapid eye movement (REM)** sleep. Here the brain waves are high frequency and low amplitude and are similar to those seen when we are awake. Researchers often refer to stages 1–4 as **non-rapid eye movement (non-REM)** sleep.

When we first fall asleep, we gradually enter stage (non-REM) sleep, before moving through stages 2–4 and then back into the lighter stages of sleep. Instead of re-entering stage 1, the person enters the first episode of REM sleep. During REM sleep, a person's eyes flicker and move beneath their eyelids, but other muscles in the body are paralysed. Figure 1.6 shows how we move from non-REM to REM sleep in a cyclical pattern throughout the night. As you can see, we spend a significant proportion of time in non-REM sleep in the first half of the night, and increasingly more time in REM sleep in the second half of the night.

Ultradian rhythms

Biological rhythms which repeat more frequently than once a day are called **ultradian rhythms** and the sleep stages are a good example of these as, in healthy adults, a full cycle takes roughly 90 minutes.

Dreams

Dreams are subjective memories of what we experience while we are asleep and this study was interested in whether people are more likely to report dreams if woken in certain sleep stages compared with others.

Background

Dement and Kleitman were interested in finding a reliable way to physiologically determine when a person is **dreaming**. They believed that dreaming must have a biological basis and, therefore, there must be a way to objectively measure when it is physically taking place.

Previously, Kleitman had noticed that when people who were asleep were showing rapid eye movements and then woken up, they were often able to recall their dreams. However, when woken up during other parts of the night, they found dreams difficult to remember. Furthermore, when people were showing rapid eye movements during their sleep, this corresponded to a specific pattern of brain activity as measured by an EEG and occurred cyclically throughout the night.

Dement and Kleitman in brief

Dement and Kleitman wanted to see whether there was a relationship between eye movements and dreaming. They used the following three approaches to investigate this:

1. They wanted participants to recall their dreams without a researcher present, to avoid any investigator effects.
2. They wanted to compare a participant's estimate of their dream length to the amount of time their eyes had been moving prior to waking.
3. They wanted to see whether the pattern of eye movements was related to dream content.

Participants were invited to sleep in a sleep laboratory, where an EEG machine was used to monitor their brain waves during sleep. They were then woken up multiple times during the night and asked to report any dream content they remembered, as well as how long they estimated themselves to have been dreaming. Participants were woken up during both REM and non-REM sleep, which the researchers were able to determine by the brain wave patterns on the EEG.

Plan your own... longitudinal study

Dement and Kleitman used **experiments** and correlations to test their ideas about sleep and dreaming but there are lots of other research methods that might be used. Why not try designing a longitudinal study to investigate sleep and dreaming?

Imagine...

Merry is planning a longitudinal study to investigate whether people's total REM sleep changes over their lifespan. She wants to know if the total time spent in REM sleep changes from childhood to old age.

» What advice would you give Merry about how to conduct this longitudinal study?

Planning a longitudinal study

A longitudinal study is an investigation that takes place over a significant period of time and can be part of an experiment. When planning a longitudinal study, it is important to consider the tests or tasks that participants will undertake, how these will be scored, how often participants will be contacted to take part in the research, how procedures will be standardised and what controls will be in place. See page 195 for more information on longitudinal studies.

▼ Table 1.1 Features of a longitudinal study

Main features of a longitudinal study	Consider...
Tests or tasks	Longitudinal studies often require participants to take part in similar tests or tasks repeatedly over a period of time. How might Merry determine the total time a person spends in REM sleep each night?
Scoring	Longitudinal studies need to compare people's data sets over time. How might Merry compare the total time spent in REM sleep per night over time?
Frequency or interval	Longitudinal studies investigate any changes that may occur over a period of time. In order to collect valid data about lifespan changes in REM sleep, how long will Merry's study last and how frequently will her participants need to be tested?
Re-contacting of participants (for repeated testing)	Participants in longitudinal studies need to be re-contacted for repeated testing. How might Merry re-contact her participants for retesting over the years?
Controls and standardisation	In order to compare data over a period of time, procedures need to be standardised and controls put in place. How can Merry ensure that her procedure is the same each time participants attend testing? What controls can she put in place?

Evaluating your plan

Merry shares your ideas with her colleagues. Some of them think it is a great idea; others are not so sure. Think about the practical strengths and weaknesses of your suggestions.

▼ Table 1.2 Evaluating your plan

	Describe	Explain
Strengths	What unique insight might be gained from Merry undertaking a longitudinal study? How would this strengthen the validity of the data?	Would it be possible for Merry to gather this data using another research method? If so, why might a longitudinal study give a more valid insight into time spent in REM sleep over the lifespan?
Weaknesses	What issues might arise with the research taking place over a very long period of time? Why might this compromise the validity of the data?	If the validity of the data is compromised by the study's length, what impact will this have on any findings about time spent in REM sleep over the lifespan?
Improvements	Consider a weakness you gave above. How might you improve Merry's procedure to overcome this issue?	How would this improvement affect the validity and/or reliability of the data Merry collects about lifespan changes in time spent in REM sleep?

Knowing that people are paralysed during REM sleep, how might these sleep trackers determine what stage of sleep a person is in?

Figure 1.7 There are sleep tracking apps for both phones and watches

LEARNING LINK

Similar to Dement and Kleitman, Hölzel *et al.* (mindfulness and brain scans) also used scientific equipment to take measurements of the brain. In Hölzel *et al.*'s study, participants were awake, not asleep and an MRI scanner was used as opposed to an EEG machine. MRI scans are static (still) images of the brain, unlike an EEG machine. An MRI scanner is very restrictive as it requires a person to lie still within a very small space and can be quite claustrophobic, therefore, it is only appropriate to be used for a short amount of time. An EEG, on the other hand, is used by placing electrodes on a person's head. While this is still quite restrictive as a person is still attached to a machine via cables, it allowed Dement and Kleitman to take recordings throughout the whole night while participants slept.

STUDY TIP

A longitudinal study involves collecting and comparing data from the same group of people (or person in a longitudinal case study), on at least three occasions over an extended period. As it is a non-experimental method, there is no independent variable. However, it is also possible to have an experiment with a longitudinal design. Like any experiment, data is collected from different groups or in different conditions in order to find a cause-and-effect relationship between at least one independent and one dependent variable. The only difference is that the data collection periods may be weeks, months or years apart. Understanding that 'longitudinal' can be used to describe the method and/or its use within an experiment is important when you are planning, but also when you are evaluating, your own research or that of other people.

TEST YOURSELF

1 This study investigated rapid eye movement (REM) sleep. Outline the main features of REM sleep. [2]

2 Identify one reason for using an EEG (electroencephalogram) to record brain activity. [1]

3 Explain why the study by Dement and Kleitman is an example of the biological approach. [2]

4 Dement and Kleitman found that as dream length increased, the number of words used to describe the dream also increased. Explain which type of correlation this is. [1]

5 Dement and Kleitman relied on self-reports to investigate the content of participants' dreams. Explain one disadvantage of this. [2]

6 The study by Dement and Kleitman was conducted in a sleep laboratory. Suggest one disadvantage of conducting a study in this location. [2]

METHODOLOGY
experiment
correlation
interview

1.1.2 Describing Dement and Kleitman (sleep and dreams)

Think!
During which type of sleep did dream recall mostly occur in Dement and Kleitman's study?

Think!
How easy do you find it to recall your dreams when you wake up in the morning? Do you find it easier to remember your dreams when you sleep for longer? If so, why might this be the case?

Think!
Why was it important that participants did not consume alcohol or caffeine on the day of the experiment?

What does an EEG record? How might using this machine affect the participants' sleep?

Figure 1.8 A modern EEG being used in a medical setting

AIMS

The aims were:
1. To see if dream recall occurs during REM or non-REM sleep.
2. To see if there is a link between the estimate of dream length and length of REM period.
3. To see if the pattern of eye movements (vertical/horizontal) is related to dream content.
4. To see if there is a positive correlation between the length of REM and the number of words given in a dream narrative.

RESEARCH METHODOLOGY

The study used the methods of experiment and correlation. Some qualitative data was collected using an **interview** technique. Three of the aims had independent variables, where the researchers were looking for a difference between conditions (i.e. REM vs non-REM). The fourth aim was looking for a correlation between two co-variables (time spent in REM sleep and the number of words in a dream narrative). The researchers occasionally interviewed participants after their dream recall to ask further questions.

Design and variables

The experiments used a repeated measures design, meaning participants took part in both conditions of each independent variable.

Aim 1

- Independent variable: whether woken up during REM or non-REM sleep.
- Dependent variable: whether the participant could recall the content of their dream in reasonable detail (yes or no).

Aim 2

- Independent variable: whether woken up 5 or 15 minutes after the onset of REM.
- Dependent variable: perception of whether they had been dreaming for 5 or 15 minutes.

Aim 3

- Independent variable: eye movement pattern before waking: (a) mainly vertical eye movements, (b) mainly horizontal eye movements, (c) both vertical and horizontal eye movements, and (d) very little or no eye movements.
- Dependent variable: the description of their dream.

Aim 4

- Co-variable 1: the number of minutes spent in REM sleep.
- Co-variable 2: the number of words in the corresponding dream narrative recording.

Sample

The sample consisted of seven adult males and two adult females. Five were studied more intensively, with the data from the other four being used to confirm the results. The study took place in a sleep laboratory at the University of Chicago, in the United States of America.

PROCEDURE

Each participant reported to the laboratory before their usual bedtime. They were asked to avoid consuming alcohol and caffeine on the day of the experiment, but to eat normally. Two or more electrodes were placed near their eyes to record eye movements during sleep. Two or three electrodes were then fixed to the scalp to record brain waves so the researchers knew when a person was in REM or non-REM sleep.

The participant was then taken to a quiet, dark room to sleep, where the wires were carefully tied at the top of the head to avoid becoming tangled in them during the night. An EEG was run throughout the night in the next room. Throughout the night, participants were woken at various times, in both REM and non-REM sleep, by a doorbell that was loud enough to wake them from deep sleep. They were asked to first say whether they had been dreaming or not, and then to describe the content of their dream into a recording device near their bed. After this, they were able to go back to sleep.

Occasionally, the experimenter would enter the room to question them further about an aspect of their dream. Participants were only considered to have been dreaming if they could recall their dream content in detail.

Overall, 21 per cent of awakenings took place in the first two hours of sleep, 29 per cent in hours two to four, 28 per cent in hours four to six and 22 per cent in hours six to eight.

RESULTS

All nine participants showed a regular pattern of sleep and EEG recordings, which were characterised by periods of deep sleep (high-voltage, slow pattern of EEG activity) followed by periods of REM sleep (low-voltage, fast pattern of EEG activity).

Dement and Kleitman found that REM sleep never occurred immediately after the onset of sleep but did occur at regular intervals throughout the night. The frequency of periods of REM was constant for each participant, but the length varied between them (ranging from 70 to 104 minutes, with an average of 92 minutes). The duration of REM varied from 3 to 50 minutes, with an average of 20 minutes. REM periods were also longer later in the night.

Results for aim 1

Dream recall occurred predominantly in REM sleep. Participants had a high incidence of dream recall following REM awakenings (80 per cent) and a low incidence of recall following non-REM awakenings (7 per cent).

Results for aim 2

All participants were able to determine whether they had been dreaming for 5 or 15 minutes with high accuracy (correct 83 per cent of the time from 111 awakenings), with the exception of one participant who was only correct 65 per cent of the time and tended to underestimate the length of time he had been dreaming.

Results for aim 3

- Vertical eye movement dream reports included looking at climbers on a cliff, climbing ladders and throwing a basketball.
- The only dream report following horizontal eye movements involved watching two people throwing tomatoes at each other.
- Little or no eye movement dream reports included driving a car.
- Mixed eye movement dream reports included talking to a group of people, searching for something and fighting with someone.

Results for aim 4

There was a moderate positive correlation between duration of REM and number of words in dream narrative. The average correlation coefficient was +0.58, with individual results ranging from +0.40 to +0.71.

CONCLUSION

Dreaming occurred during periods of REM sleep in distinct episodes throughout the night. The researchers concluded that dreaming can be objectively measured by recording REM cycles during sleep.

LEARNING LINK

Dement and Kleitman included a correlation as part of their research, finding a positive correlation between length of REM period and the number of words used in a dream narrative. Similarly, Baron-Cohen *et al.* (eyes test) found a correlation between 'Eyes Test' score and Autism Spectrum Quotient. The main difference, however, is that this correlation was a negative correlation. Remember that correlations requires the collection of quantitative data, which is always plotted on a scatter graph. When plotting the data for a correlation on a scatter graph, it does not matter which co-variable goes on which axis. Are you confident in explaining the difference between a positive and negative correlation? Would you be able to sketch a scatter graph of each? For more information, check page 192 for correlations and page 220 for scatter graphs.

STUDY TIP

With four aims, there are quite a few operational definitions to learn for the independent variables, dependent variables and co-variables in this study. One way to practise your ability to operationalise variables, as well as strengthen your memory for this study, would be to write down each of the four aims and then attempt to give the operational definitions for each. Keep trying this until you can correctly define them each time with ease.

TEST YOURSELF

1 Identify the technique used in this study to measure brain activity. [1]
2 Describe the procedure for waking participants during either REM or non-REM sleep. [2]
3 Outline one piece of quantitative data and one piece of qualitative data that Dement and Kleitman collected. [2]
4 Explain what is meant by a 'self-report' using the study by Dement and Kleitman as an example. [2]
5 Describe two different ways that dependent variables can be measured, using an example from this study for each. [4]
6 Describe two of the controls from the study by Dement and Kleitman. [4]

1.1.3 Evaluating Dement and Kleitman (sleep and dreams)

Think!

How might individual differences in Dement and Kleitman's study have affected the validity of the results?

Think!

Imagine that you were a participant in Dement and Kleitman's study. How do you think sleeping in the laboratory might affect your usual sleep? How might this affect the validity of this study?

Think!

The participants in the study were woken up on different schedules. For example, two participants were awoken randomly, using a random number generator. However, another was awoken when the experimenter decided. How might this have affected the reliability of the research?

Research has shown that blue light from screens can disrupt sleep due to their wavelength, inhibiting melatonin release (melatonin is a hormone that is important for sleep) (Zerbini *et al.*, 2020). How might you conduct an experiment into the impact of blue light on sleep? What would your independent and dependent variables be and how would you operationalise these?

Ethical issues

Maintaining confidentiality was a strength of this research. The researchers used participants' initials when discussing their results, which kept their identity hidden. Furthermore, no other personal details about the participants were shared. This prevented any embarrassment due to the participants' personal dream content being revealed publicly.

Methodological issues

Reliability

A strength of this research was the high level of standardisation in the procedure. All participants were fitted with the same equipment, including electrodes near their eyes and scalp, with the wires tied together behind their head. They all slept in a bed in a quiet, dark room, were woken by a doorbell and were required to narrate their dream into a tape recorder. Ensuring such a consistent procedure meant that the study could be replicated to test whether the association between dreaming and REM sleep was reliable.

Validity

Avoiding investigator effects

A strength of this study is that the researchers ensured nobody else was present when the participants recalled their dreams. This was to avoid the possibility of the experimenter influencing a person's dream narrative through prompting or expectation. Although an experimenter *did* enter the room occasionally to question the participant further about their dream content, this was after the participant had given their full recording. This made the research more valid and the dream reports free from experimenter effects.

Some results discarded

In the study, one issue is that the loss of some dream recordings might have affected the validity of the data. Of the 152 dreams recalled, the recordings for six had to be discarded as they could not be understood from the tape. This may have affected the validity of the data, as these poor recordings might have been genuine dream reports during non-REM sleep, with participants simply feeling more tired after waking from deep sleep and giving a mumbled recording; there is no way to know.

Individual differences

One weakness of the operational definition of dream length (number of words used in narrative) is that there may have been significant individual differences in how verbal each participant was. For example, some participants may have a broader vocabulary and thus describe a short dream in much more detail than others. This would affect the validity of the data when correlating the number of words in a dream narrative and the length of REM sleep.

Objectivity and subjectivity

Quantitative data

A strength of this study was its use of quantitative data which can be objectively analysed. This would help to reduce the effects of subjectivity on interpretation of dream content. For example, the number of words in the dream narrative was calculated and correlated against the amount of time spent in REM sleep. This avoided researcher bias in the interpretation of data about dreaming and REM sleep, which increases the validity of the findings.

Scientific equipment

A strength is that an EEG was used in this study, which gave an objective measure of the sleep stage a participant was in. The frequency and amplitude of brain waves for both REM and non-REM can be quantified, allowing little room for subjective interpretation by the researchers. This increased the validity of the data, as the researchers could be confident of the sleep stage in which a person was being woken.

Generalisations and ecological validity

Generalising beyond the sample

One weakness of the sample is that there was a significant variation in the duration of sleep cycles even between the small number of five main participants. One participant averaged one period of eye movement every 70 minutes, while another only had a period of eye movement every 104 minutes. The researchers should, therefore, be cautious when generalising any findings to others, as the study demonstrated individual differences in sleep patterns.

Generalising to everyday life

A weakness is that the study lacks ecological validity as participants were sleeping in a laboratory attached to an EEG with electrodes on their heads. This may have affected their normal sleep patterns, as it may have been difficult to fully relax and sleep as they would normally, especially with multiple awakenings. Furthermore, participants were asked to avoid drinking caffeine and alcohol before bed, which might be a normal occurrence for them in real life. This reduces the ability of the researchers to confidently apply the findings to regular sleep conditions in a person's own home.

On the other hand, Dement and Kleitman believed that their results *were* generalisable for two reasons – firstly, because their results were similar to other studies of uninterrupted sleep and, secondly, because the physiological process of going through cycles of REM and non-REM is the same for everyone (although with individual differences in length). This would suggest that the results relating to REM sleep and dreaming could, therefore, be applied to all people.

ISSUES AND DEBATES

Nature versus nurture

The research findings support the concept of nature, as all participants reported a significantly greater number of dreams during REM sleep than non-REM sleep, indicating that dreaming during REM sleep is an innate biological mechanism. Furthermore, regularly occurring periods of REM were observed in all participants on every night of sleep, indicating that this ultradian rhythm is universal for all humans and is biologically determined. The fact that people had such diverse dreams with differing content demonstrates the role of nurture in sleep and dreams, as our different life experiences will impact what we dream about.

Applications to everyday life

Treating sleep issues

An EEG can be used to determine when a person is in REM or non-REM sleep and can, therefore, be used to support the diagnosis of sleep issues, as some sleep disorders occur in certain stages of sleep only. A psychologist could also look at the output of the EEG and compare brain wave patterns with a 'typical' sleeper to see if there are any differences. This may help psychologists in determining the right course of treatment for an individual.

Monitoring external influences

Another application of the use of EEG in sleep might be to monitor how people's sleep is affected by external influences – for example, environmental changes, stress or drugs. A person's sleep patterns can be recorded before and after a change in order to determine the effects of an external factor on sleep.

Reflections

Dement and Kleitman's research demonstrating that dreaming takes place during REM sleep and that EEG can be used as a reliable measure of a person's sleep stage was pivotal in 1957 when the study was published. William Dement used the knowledge gained from this study to investigate sleep and other health disorders alongside other researchers. For example, he discovered that periods of REM occurring immediately at the onset of sleep was a biological marker for narcolepsy (a chronic sleep disorder causing sudden sleep onset) (Mitler *et al.*, 1979). Furthermore, he found that late onset of the first period of REM sleep was a biomarker for Alzheimer's disease (Bliwise *et al.*, 1989). The research findings from these studies have allowed a deeper understanding of the physiological processes involved in sleep.

LEARNING LINK

When you study the social approach, you will discover that the study by Milgram (obedience) also suffered issues with ecological validity, having been conducted in a laboratory-type setting. The main difference in Milgram's study, however, is that participants were having their behaviour observed covertly while they were awake, rather than awake. Additionally, their external actions were being recorded. In Dement and Kleitman's study, however, internal biological processes were being monitored. Why do you think psychologists observe people's behaviour in controlled laboratory-type settings when the environment and situations presented may be very different from real life?

STUDY TIP

This study included both quantitative and qualitative data. Quantitative data included the number of participants correctly estimating whether their dream duration had been 5 or 15 minutes, for example. On the other hand, qualitative data included the content of the dream reports, which was used to see if a person's dream content matched their eye movements. Make sure that you can give examples of quantitative and qualitative data for core studies where both are collected, as well as explain the advantages and disadvantages of each.

TEST YOURSELF

1 Explain one methodological weakness of this study. [2]
2 Suggest one real-life application from the study by Dement and Kleitman (sleep and dreams). [2]
3 Evaluate this study in terms of two strengths and two weaknesses. At least one of your evaluation points must be about qualitative data. [10]
4 Suggest one disadvantage of the way in which the dependent variable of dream context was operationalised in this study. [1]
5 Explain two advantages of using quantitative data in this study. [2]
6 Explain why measuring the length of an REM period is a valid measure of dream duration. [2]

1.2 Hassett *et al.* (monkey toy preferences)

1.2.1 Background

Think!

Do Hassett *et al.* believe that **sex differences** in **toy preferences** are due to nature or nurture? Why?

KEY TERMS

sex differences
toy preferences
play
socialisation
stereotypical
hormones

Think!

Why might increasing prenatal androgen exposure in a non-human animal experiment (e.g. Goy *et al.*, 1988) lead to different behaviour in the female monkeys compared with untreated controls? Why might female children with congenital adrenal hyperplasia (CAH) not show the same behaviour as male children and/or female monkeys exposed to high levels of prenatal androgens?

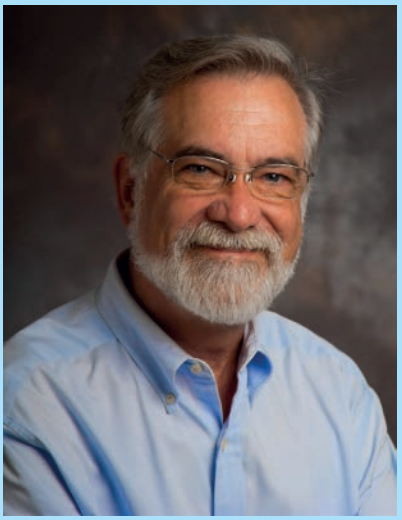
Think!

The theory that toy preferences may be biologically determined is described as controversial. Why do you think this might be? This is a good area to discuss with your peers as there are likely to be differing views and it is important to hear from both sides in order to decide how you feel about the issues.

Introducing Kim Wallen and Janice Hassett-Vick

Professor Wallen, researcher at the Yerkes National Primate Research Center, says:

I have been working with monkeys for over 50 years, first as an undergraduate, then a graduate student, and for the last 43 years as a professor of psychology and behavioural neuroendocrinology at Emory University and the Yerkes National Primate Research Centre.



▲ **Figure 1.9 Professor Kim Wallen**

Drs Melissa Hines and Gerianne Alexander had found that male vervet monkeys interacted longer with male-stereotyped toys and spent less time with female-stereotyped toys. I was interested whether monkeys would show a preference for sex-stereotyped toys if they had a choice between male and female-stereotyped toys. Janice Hassett had joined my lab for a summer internship and was somewhat surprised when I suggested we look at monkeys' preferences for human sex-typed toys. We were both quite surprised when the monkeys' behaviour almost completely paralleled what had been found in children using a human toy-preference task. This suggests that toy preferences may not be primarily the result of socialised preferences but reflect underlying sex differences in preferences for specific activities that are facilitated by toys.

This study illustrates that sometimes investigating wild ideas results in fascinating findings. One should not hesitate to consider studies that seem doomed to failure if the question is important!

(K. Wallen, personal communication, August 2021)

Male rhesus monkeys (Figure 1.10) generally engage in more rough-and-tumble **play** than female monkeys, just like human infants, but do you think wild monkeys like these would behave any differently to monkeys raised in captivity, such as the ones in Hassett *et al.*'s study?

▲ Figure 1.10 Wild rhesus monkeys on the roof of a Buddhist temple in Cambodia

The psychology being investigated

Play

All animals play, including humans, but the concept is hard to define due to the many different types of play seen at different developmental levels. Seashore (1913) defined play as 'pleasure gained in self-expression'. This definition may apply to some forms of human play, but it does not describe non-human animal play very well as animals do not really have a sense of self to express! Bergen (2015) emphasises that play is always *voluntary*, explaining that we play because we choose to, not because we have to. We also choose what we wish to play with, how and with whom. Many psychologists agree that play allows the individual to practise the skills required in adulthood and this is true of both humans and animals. So, play may be adaptive – that is, it helps us to survive.

Sex differences and the role of nature

In mammals, biological sex is determined by our sex chromosomes, typically XX for females and XY for males, although many differences can occur. Typically, these chromosomes determine levels of **hormones** such as testosterone and oestrogen, which cause differences in the development of male and female brains. For example, the sex hormones affect neural development, including neurogenesis (cell birth) and synaptogenesis (creation of connections between neurons), and have been associated with differences in cognitive processes (Overman *et al.*, 1996).

Anyone visiting a kindergarten or nursery might see boys playing with cars and girls playing with dolls, but psychological research has demonstrated that girls are more likely to play with trucks than boys are to play with dolls. These behavioural sex differences are fairly robust and Hassett *et al.* explore the idea that these differences may be hormonal in origin. This said, their views conflict with many psychologists who believe gender roles are primarily learned through **socialisation**.

Socialisation and the role of nurture

In humans, gender refers to the individual's personal sense of their own masculinity and/or femininity. Children learn about gender and societal expectations of how males and females behave through interactions with parents and other children. For example, a little boy who bangs two trucks together may be praised for creating an exciting game, whereas a little girl may be discouraged and offered a more traditionally feminine toy, such as a doll or tea set. Daily interactions like this gradually lead boys and girls to conform to **stereotypical** gender roles and seek out specific toys. The fact that boys play less with stereotypically feminine toys than girls play with stereotypically masculine toys suggests boys may be more actively discouraged from opposite-sex behaviour, whereas opposite-sex behaviour

in girls may be ignored rather than rejected. Psychologists who accept these ideas believe that sex differences in children's play result from socialisation.

Hormones and toy preferences

Hassett *et al.* reject the socialisation explanation for toy preferences. They believe male and female children prefer toys that can be used for activities that suit their specific cognitive abilities. These abilities, as stated above, depend upon the children's differing sex hormone levels. This means that toys are selected according to the different play activities they promote rather than society's attitudes regarding 'gender-appropriate' toys. This view is supported by the fact that children tend to explain their toy preferences in terms of 'what can be done with' a specific toy in contrast to its gender-appropriateness (Eisenberg *et al.*, 1982) – for example, teddies can be cuddled whereas trucks can be moved by pushing them along.

Background

Congenital adrenal hyperplasia

Hassett *et al.*'s thoughts on play, toy preference and the nature versus nurture debate were influenced by **observations** of children with congenital adrenal hyperplasia (CAH), an inherited condition where the foetus (unborn child) is exposed to higher than usual levels of prenatal androgens (male sex hormones). Research shows that girls with CAH show a preference for stereotypically male toys in comparison with their unaffected sisters (Berenbaum and Hines, 1992). Pasterski *et al.* (2005) also found that, while parents encouraged their daughters with CAH to play with stereotypically female toys more than they did their unaffected female siblings, these children still preferred stereotypically male toys. Findings like these have led researchers, including Hassett *et al.*, to favour the idea that toy preferences are shaped, initially at least, by hormones, not socialisation.

Previous research on monkeys

Studying monkeys helps to separate the effects of nature and nurture as monkeys are not socialised to play with any specific type of toys, and so any sex differences that are observed must be determined by biological not social factors.

Evolutionary continuity between monkeys and humans means findings from primates may help to determine the role of biological factors in toy preferences in human infants. Interestingly though, female vervet monkeys exposed to prenatal androgens do not always behave as expected. Although they participated in more rough-and-tumble play than untreated controls (Goy *et al.*, 1988), their interest in infants is unaffected (Herman *et al.*, 2003). Furthermore, Alexander and Hines (2002) found that male vervet monkeys played more with stereotypically male human toys than the female monkeys but, unlike humans, the males spent a similar amount of time interacting with male and female toys. In contrast, females showed a strong preference for female versus male toys.

Hassett *et al.* in brief

Building on Alexander and Hines' (2002) research, Hassett *et al.* examined toy preferences in a troop of captive rhesus monkeys. However, instead of observing the monkeys with just one toy at a time, they presented pairs of wheeled and plush (cuddly) toys, allowing observers to note the sex of any monkeys that interacted with the toys, and which toys they preferred when given a choice. They observed significant sex differences matching those seen in humans and concluded that these differences stemmed from prenatal hormone exposure.

Plan your own... correlation

Hassett *et al.* designed an experiment to investigate sex differences for toy preferences in monkeys. Why not try designing a correlation to investigate the relationship between age and toy preferences?

Imagine...

Aliaa is planning a correlation to investigate whether there is a relationship between the age of a boy and the typical 'masculinity' of his preferred toys.

» What advice would you give Aliaa about how to conduct a correlation to investigate this relationship?

Planning a correlation

Correlation is a non-experimental method. There are no independent variables; instead, the researcher measures two or more co-variables to see if they are related to one another. As there are no manipulated or controlled variables, causality cannot be inferred and all that can be concluded is the strength, direction and significance of the relationship(s). See page 192 for more information on correlations.

▼ Table 1.3 Features of a correlation

Main features of a correlation	Consider...
Two co-variables	Correlations look at the relationship between two measured, quantitative variables. Think carefully about the operational definition of each. How might Aliaa operationalise how typically 'masculine' a toy is seen to be, in particular?
Measure of variable 1	How might Aliaa collect data on a child's age?
Measure of variable 2	How can Aliaa collect data on how typically 'masculine' a toy is seen to be?
Comparison and scatter graph	Correlations involve the collection of quantitative data, which is presented on a scatter graph. How will Aliaa present her data on a scatter graph?

Evaluating your plan

Aliaa shares your ideas with her peers. Some of them think it is a great idea; others are not so sure. Think about the practical strengths and weaknesses of your suggestions.

▼ Table 1.4 Evaluating your plan

	Describe	Explain
Strengths	Think about your data collection techniques. In what way did they ensure that the data collected was valid and/or reliable?	How might this strength affect any conclusions drawn about any relationship between age and perceived masculinity of 'preferred toys'?
Weaknesses	A weakness of correlations is that cause and effect cannot be established. Why is this an issue?	How might this weakness affect any conclusions drawn about any relationship between age and perceived masculinity of 'preferred toys'?
Improvements	Consider the data collection method you suggested to Aliaa for determining how 'masculine' a toy is seen to be. In what way might this be improved to collect more valid/reliable data?	What impact might this have on Aliaa's results and conclusions about any relationship between age and perceived masculinity of 'preferred toys'?

If this little girl had the option of a wheeled toy:

» How likely do you think she would be to play with it?

» What does the research suggest?

The idea that play allows us to practise skills needed in adulthood and therefore has survival value supports Hassett *et al.*'s view that sex differences in play may be biological (Figure 1.11). Just as playful kittens chase and pounce on things, modern humans may also have been practising the skills they needed to survive 300,000 years ago.

» What play activities can you think of that might be linked to survival?

» Can you think of any more modern forms of play that do not link as obviously to survival?

» How might these types of play affect our health and wellbeing?

▲ Figure 1.11 Just like this little girl, Hassett *et al.* found that the female monkeys were drawn to the cuddly plush toys

LEARNING LINK

When you study the learning approach, which is about how environmental experiences affect our behaviour, you will learn about a famous study by Albert Bandura and colleagues where young children observed an adult playing aggressively with a toy (page 90). The researchers then covertly observed the children as they played with a similar style of toy. They found that the boys were more likely to imitate the physical aggression they had observed than the girls. This suggests that the observed aggression may have been seen as more socially acceptable by the male than the female children. The study by Hassett *et al.* also seems to indicate that boys are more likely to show 'sex-typed' behaviour than girls – that is, boys are more likely to show stereotypically masculine behaviours even when they do not know they are being observed, whereas girls are less consistent with regard to sex-typed feminine behaviour, both privately and in public.

STUDY TIP

Hassett *et al*. were investigating the nature versus nurture debate in terms of whether sex differences in play and toy preferences are influenced more by socialisation or hormones. Make sure you understand some of the research that inspired them including studies of congenital adrenal hyperplasia (CAH) and/or any of the previous research with monkeys (e.g. Alexander and Hines, 2002).

TEST YOURSELF

1 Describe the psychology that is being investigated in the study by Hassett *et al.* [4]

2 Outline what is meant by male and female stereotypical toy preferences with reference to examples from this study. [3]

3 Explain one way in which hormones affect play. You must refer to research evidence in your answer. [3]

4 When researching the role of hormones, psychologists sometimes use case studies. Explain one advantage of case studies as a way of investigating the effect of hormones on behaviour. [2]

5 Ashley is investigating gender differences in children's play. He decides to conduct a naturalistic observation. Suggest one way Ashley could ensure that his observations are reliable. [2]

6 For her dependent variable, Bethan asks a group of parents to rate the likelihood that they would give various toys as gifts to a fictional male child. The scale is numbered 0–5, where 0 is very unlikely and 5 is very likely.

a State one weakness of the way Bethan has operationalised her dependent variable. [1]

b State an appropriate measure of central tendency for analysing the data. [2]

METHODOLOGY
experiment
observation
behavioural checklist

1.2.2 Describing Hassett *et al.* (monkey toy preferences)

Think!

Hassett *et al.* used a **behavioural checklist** in their observation of the toy preferences of rhesus monkeys. Can you name three behaviours from the checklist?

Think!

In the culture where you live, are there different expectations for how female and male children should behave? Do you think people's views are becoming more or less fixed regarding what is seen as appropriate for people of different genders?

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