Introduction and key concept 1

How identical is identical?

Psychologists call twins identical because they have exactly the same genes. Most people use the word in everyday language to mean that twins look identical. But do they really? Look more closely and you will see that even the most 'identical' of twins look a bit different.

Things get even more interesting when you consider behaviour. Even identical twins who have been brought up together in the same home do not behave identically. For instance one might be gay and the other straight. One becomes a scientist, the other an artist.

What this tells us is that, even if you had an identical twin, there will never be someone exactly like you. Your experiences and your environment will affect you in different ways to make you the person you are. It's not 'all in the genes'.

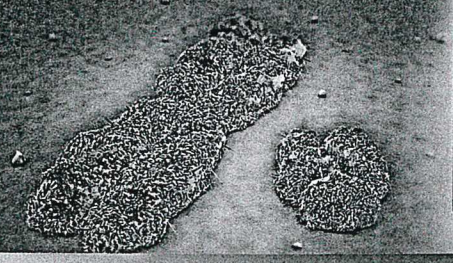
Specification terms

Genes A unit of inheritance. They consist of chemical instructions (DNA) which tell your body what proteins to manufacture – and basically that is what you are, a huge number of proteins. Genes are inherited from parents and contribute to the development of an individual's characteristics.

Genotype An individual's total set of genes.

Phenotype The observable characteristics which result from the interaction between a person's genotype and environmental factors.

SRY gene Sex-determining region Y gene which triggers the appearance of testes in an embryo and the development of that individual into a biological male.



The chromosome on the left is an X chromosome and on the right is a Y chromosome. They are called X and Y because they resemble the shape of these letters. This photograph was taken using a very high-powered microscope.

Influence of biology on behaviour

Biology and behaviour

Biological structures and processes within the body have a profound effect on our psychological functioning and behaviour. Biological psychologists argue that, as the mind basically 'lives' in the brain, our thoughts, feelings and behaviour have a physical basis (everything psychological is first biological).

There are several biological influences we look at on the next few spreads. They all vary slightly between males and females, leading to some *sex differences* in behaviour.

- **Genes** are described below.
- **Neuroanatomy** refers to the *structure* of the nervous system, including the brain. Different parts of the structure have different functions such as one area controls what we see (the visual area) and another area controls movement (the motor area).
- **Neurochemistry** concerns the chemical processes that occur within the brain and nervous system. Messages are sent around the brain and body via nerves (also called *neurons*) but also via chemical messengers *(neurotransmitters)*.
- **Evolution** concerns the way animals change over millions of years. At one time the only life on Planet Earth was small one-celled organisms. Over time these life forms have evolved into all the species you see around us today. The process of *evolution* explains how this happened.

Key concept: Genes

What are genes?

Genes are located on chromosomes and humans have 46 chromosomes (23 pairs). Each gene is made up of strands of DNA (deoxyribonucleic acid). Genes carry 'instructions' relating to the physical and non-physical characteristics of living organisms, such as the colour of your hair and whether you have a calm temperament. Typically each individual inherits two copies (called *alleles*) of every gene, one from each parent.

Genotype and phenotype

Genotype refers to an individual's actual genetic make-up. It is what you inherit from your parents.

However, your genotype doesn't determine your physical and non-physical characteristics directly because the genes have to be expressed through an interaction with your 'environment'. Even within your body the environment has an influence, for example the food you eat affects your body's internal environment.

A person's *phenotype* is how their genes are actually expressed. A phenotype is therefore an interaction of genotype and environmental influences.

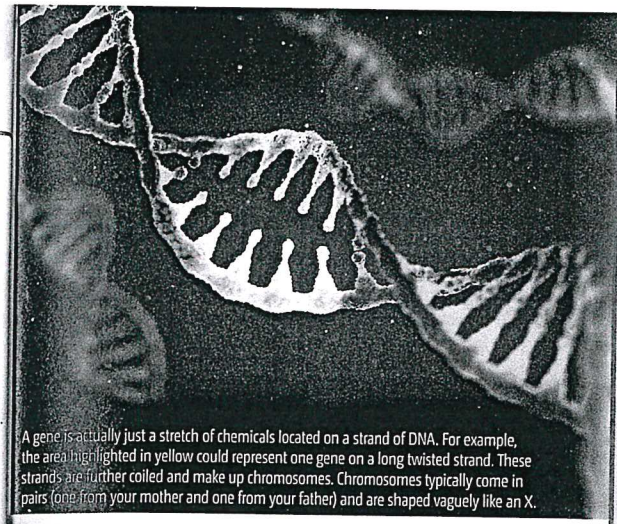
Identical twins have the same genotype because they have inherited exactly the same genes. But the expression of their genes (phenotype) differs. They may look physically different because, for example one twin goes to the gym and the other doesn't and therefore one twin has developed bigger muscles. The other twin might develop bigger muscles too – but only if their environment changed.

The distinction between genotype and phenotype strongly suggests that most human behaviours are due to an interaction of inherited (nature) and environmental (nurture) factors.

The *SRY* gene

One pair of chromosomes determines biological sex – XX for female, XY for male. The so-called Y-chromosome is in reality just a stunted X-chromosome, missing some of the genetic material.

Located on the Y chromosome is a gene called the sex-determining region Y gene (*SRY* gene). In typical development before birth, the *SRY* gene switches on other genes causing an XY embryo to develop testes. In adult males the testes produce sperm but during development the testes produce male *sex hormones* and these hormones cause the embryo to become biologically male. Without the *SRY* gene, other genes remain switched off so the embryo develops into a female.



A gene is actually just a stretch of chemicals located on a strand of DNA. For example, the area highlighted in yellow could represent one gene on a long twisted strand. These strands are further coiled and make up chromosomes. Chromosomes typically come in pairs (one from your mother and one from your father) and are shaped vaguely like an X.

Evaluation

An interactionist approach

One strength of understanding genotype and phenotype is that these concepts support interactionism in psychology.

For example, one version of the *BRCA1* gene has been linked to breast cancer risk in women. But not every woman who has this version of the *BRCA1* gene develops breast cancer, so clearly other factors (e.g. stress) interact with the genotype to produce the observable outcome (phenotype).

Taking into account the interactions between nature and nurture provides a much fuller and richer explanation of human behaviour.

Risk of oversimplification

One weakness is that some research oversimplifies the influence of genes.

It is very rare that only one gene determines a behaviour. We talk about one version of the *BRCA1* gene causing cancer but what it causes is an increased risk. Not everyone with the abnormal version develops cancer. The same is true for 'a gene for depression' or 'a gene for blue eyes'. This is not an accurate view of how genes operate. No human behaviours are caused by single genes. Instead, many genes (sometimes hundreds or thousands) make small but important contributions in complex interactions with each other. Also genes do not produce effects in isolation. They interact with environmental influences to produce a phenotype.

The danger is that oversimplified explanations of how genes work exaggerate the role of nature and present a misleading view of the causes of behaviour.

GET ACTIVE

We have seen that genetically identical twins are not identical in their behaviour or even their appearance (even their fingerprints are different). This is why we make a very important distinction between genotype and phenotype.

For example, the ability to taste phenylthiocarbamide (PTC), a bitter-tasting chemical) in food is genetically controlled by a single gene. But even people in whom the gene is 'switched on' will not always taste it.

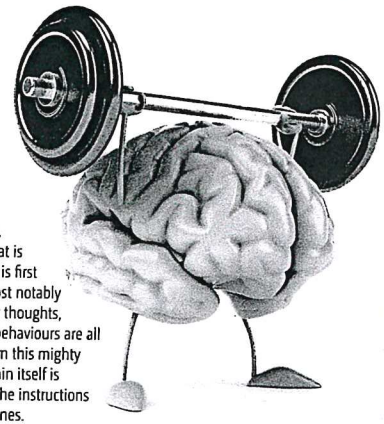
1. ***How can the concepts of genotype and phenotype explain this?***
2. ***What environmental factors could influence the genotype?***

Exam-style questions

1. State what is meant by the term 'genes'. (1)
2. Using at least **one** example, explain how biology influences behaviour. (3)
3. Explain **one** difference between genotype and phenotype. (2)
4. Describe how the SRY gene influences behaviour. (3)
5. Wanda is pregnant and having her second ultrasound scan (at 20 weeks). She wants to know the biological sex of the baby. 'It's a boy,' the doctor tells her.

   Explain how a biological psychologist might account for the biological sex of a baby. Use the concept of genes in your answer. (3)
6. Phenylketonuria (PKU) is a rare genetic disorder that can cause severe learning difficulties, seizures and behavioural problems. However, it is relatively easy to detect in newborn babies. A baby with PKU placed on a low-protein diet is very likely to develop normally and never experience symptoms.

   Evaluate the influence of genes on behaviour with reference to this scenario. In your answer you should consider the roles of genotype and phenotype, and relate this to PKU. (9)



According to biological psychologists, everything that is psychological is first biological, most notably the brain. Our thoughts, feelings and behaviours are all controlled from this mighty organ. The brain itself is created from the instructions encoded in genes.

An issue to consider

Given what you have read on this spread, how do you think psychologists use genes in their explanations of behaviour?

Specification content

B4 Biological approach

Key concepts:

- The influence of biology on behaviour.
- Genes, including the role of genotype, phenotype and the SRY gene.

Key concept 2 and key study

Poking around in the brain

If you open up a person's skull you can poke different areas of a person's brain – it doesn't hurt as there aren't pain receptors in the brain. The interesting thing is that if you poke some areas (well, electrically stimulate them), the person being poked may suddenly experience a particular memory. If you poke a different area the person might experience a different memory, hear music, report sensations on their skin or they might move a part of their body.

The brain surgeon who famously did this for the first time in the 1950s was Wilder Penfield. He was treating people with epilepsy and tried to relieve their seizures by destroying small areas of their brains.

But to do this (and because every patient's brain is different) he first of all had to work out which areas to destroy and which to avoid.

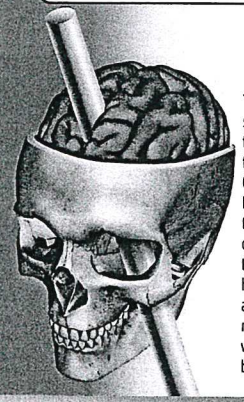
This poking around enabled Penfield and others to draw a map of the brain. Some of the brain areas Penfield stimulated are described on this spread.

Specification terms

Localisation of function Specific brain areas control and regulate specific physical and psychological activities.

Neuroanatomy Structure of the brain and other parts of the nervous system.

Sex differences The ways in which males and females are not the same.



This drawing shows the path the tamping iron took through Gage's skull. Harlow described the iron as 'passing completely through his head...picked up afterwards by his men, smeared with blood and brain'.

Key concept: Neuroanatomy

What is neuroanatomy?

Neuroanatomy refers to the structure of the brain and nervous system. The most basic neuroanatomical feature of the brain is that it is divided into two halves, called *hemispheres* (left and right).

Localisation of brain function

Psychologists generally accept the view that different brain areas perform certain specific functions. This is *localisation*. If a specific brain area is damaged, the function associated with that area is affected (impaired). The brain's outer layer is called the *cortex*. It is a very thin and highly folder layer that covers the inner structures of the brain (like an orange peel). This part of the brain is highly developed in humans. Some major areas of it are:

Motor area Each hemisphere has a motor area which controls the voluntary movements of the opposite side of the body. Damage can cause a loss of control over fine movements.

Somatosensory area This is again in both hemispheres. Sensory information from the skin is represented here (e.g. touch, heat, etc.) in proportion to the sensitivity of the body part (e.g. the regions for the face and hands account for over half of the somatosensory area).

Visual area This is at the back of the brain in both hemispheres. Each eye sends information from the right 'half' of the visual field to the left visual area, and from the left 'half' of the visual field to the right visual area. This is why damage to one visual area can cause partial blindness in both eyes.

Sex differences in brain structure

The 'average' brains of women and men are not identical. Total brain volume is greater (on average) in males, even when body size is accounted for.

More importantly there are also volume differences in specific parts of the brain. For example, the *thalamus* is bigger (on average) in females (Ruigrok *et al.* 2014). The thalamus controls signals from the sense organs (eyes, ears, etc.) to other parts of the brain. Women also have stronger nerve connections between the brain hemispheres (see facing page).

One other consistent sex difference is in the thickness of the cortex. According to Stuart Ritchie *et al.* (2018), brains scans show that the cortex is thicker (on average) in females across almost the whole brain. They also found that cortical thickness varies much more between men than it does between women.

Key study: Harlow (1868) Recovery from the passage of an iron bar through the head

Aims and procedure

To report the unusual case of Phineas P. Gage and the implications for understanding how the brain works. Harlow recorded the details of the case.

Findings

Gage was a foreman working on the railroad in the USA. He was filling holes with gunpowder and pressing down on it with a 'tamping iron', a long iron bar. The powder exploded prematurely, forcing the tamping iron all the way through Gage's skull, fracturing bones and removing parts of his brain (see image on the left). Gage had a seizure but eventually regained consciousness and was able to walk to a cart that took him back to his hotel.

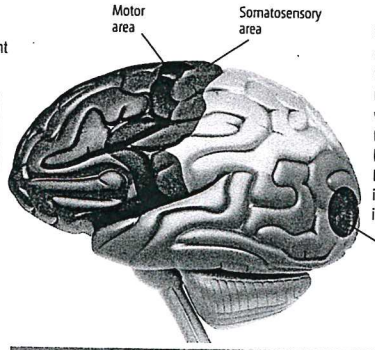
Gage recovered physically, but after seven months the change in his personality was so great that his previous employers would not give him his job back. Gage had been a hard-working and conscientious employee, but now he was often very obstinate. He swore a lot but was 'a child in his intellectual capacity'. He would often make grand plans but then immediately change his mind. His friends said he was 'no longer Gage'. He suffered from epileptic seizures and died at the age of 36, twelve-and-a-half years after the accident.

Conclusions

Harlow believed that Gage's intellectual ability had been severely impaired by the accident but not lost. The accident damaged part of the left side of his brain, affecting its function. The corresponding area on the right side was unaffected but could not completely make up for damage to the left side.

Harlow recognised that some functions and behaviours must be localised in the brain.

Some of the main structures of the brain are shown on the right. The most obvious neuroanatomical feature of the brain is that it is divided into two halves (left and right hemispheres). This image shows the left hemisphere.



Several of these differ between females and males in volume and other ways. For example, the thalamus is bigger in females. It is located deep inside the brain, one in each hemisphere.

Evaluation

Support for sex differences

One strength is evidence that women's and men's brains are structured differently.

Madhura Ingalhalikar *et al.* (2014) used a brain scanning method called *MRI* (*magnetic resonance imaging*). They found that women's brains had stronger connections *between* the brain hemispheres, but men's brains had stronger connections *within* the hemispheres.

Combined with other studies, this means there may be some truth in the *stereotype* that women are more able than men to cope with several tasks at once.

Structure not function

One weakness is that, just because the brains of females and males differ in structure, it does not mean they function differently.

Some *sex differences* in *brain structure* definitely exist, but research has to then show that these are linked to differences in brain functioning (and also behaviour). Research is ongoing and very few conclusions have been reached.

This means that there has been a lot of unjustified speculation about differences between women and men, unsupported by evidence.

Evaluation

Ahead of his time

One strength is that Harlow made careful *observations* of Gage's recovery.

These are not up to modern standards for a thorough *case study* (he wrote just 200 words about the effects on Gage's behaviour). But he did try to link the area of Gage's brain injury to the changes in his personality and intellectual functioning.

This suggests that Harlow was ahead of his time in providing support for localisation as a theory of brain function.

Unjustified conclusions

One weakness is that there is not enough information from the study to draw firm conclusions about localisation.

Harlow insisted that Gage's behaviour and personality had changed out of all recognition so that he was 'no longer Gage'. But little is known about Gage before the accident, so it is hard to judge how much he changed afterwards. He may not have changed that much because he was able to hold down a demanding job later in Chile for at least nine years.

This means it is hard to link brain functions to changes in Gage's behaviour and these changes may have been exaggerated.

GET ACTIVE Read all about it

Here are two headlines from different newspaper websites:

- **Men take a fact-based approach to the work environment, while women take a more intuitive approach.**
- **Can we finally stop talking about 'male' and 'female' brains?**

There is a huge gender pay gap in workplaces in the UK. Men consistently earn more than women, often when doing the same job. Some people think it's because men's and women's brains are different. What do you think?

Which of the two headlines best matches your own view? Explain your answer based on your knowledge of sex differences in brain structure.

Exam-style questions

1. State what is meant by the term 'neuroanatomy'. (1)
2. Reg had a stroke which affected his speech. He found it hard to find the right words and was very slow in speaking. A brain scan showed damage to a small area in the left side of Reg's brain.

   Explain what Reg's experience tells us about localisation of function. (3)
3. Jerry and Ruby are arguing about the differences between women and men. 'Our brains are bigger,' says Jerry. 'Yes well, size isn't everything,' replies Ruby.

   Outline sex differences in brain structure with reference to this argument. (3)
4. Give **one** finding from the key study by Harlow (1868). (2)
5. Explain what the key study by Harlow (1868) can tell us about localisation of function. (3)
6. Explain **one** strength or **one** weakness of the key study by Harlow (1868). (3)
7. Sam was stabbed with a knife through the front of his brain's left hemisphere. He survived the attack and recovered, but his friends noticed that his personality had changed and his college work was nowhere near as good as before.

   Evaluate neuroanatomy with reference to this scenario. In your answer you should consider: (a) basic localisation of function, and (b) the key study by Harlow (1868). (9)

An issue to consider

Does it matter if men's and women's brains are different?

In your experience, how different are men and women anyway?

Do you think difference can be traced back to the brain, or are other factors more important?

Specification content

B4 Biological approach

Key concept:

- Neuroanatomy, including basic localisation of function and sex differences in brain structure.

Key study:

- Harlow (1868) Recovery from the passage of an iron bar through the head.

Key concept 3 and key study

Caster Semenya

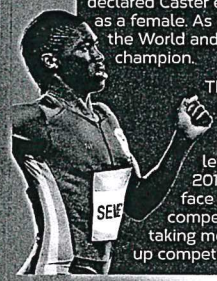
Caster Semenya is a South African runner who won the 800m at the 2009 World Championships. But within a few weeks an Australian newspaper published allegations that Caster was not 'really' female.

In fact, she is *intersex*. She has external female genitalia but no ovaries or uterus. She has undescended testes within her body.

An outcry followed with some accusing her of 'cheating' and calling for her to be stripped of her medal. It was suggested that Caster's undescended testes produced testosterone which enhanced her running performance.

However, although most intersex people do produce large amounts of testosterone, their bodies fail to make use of it.

The governing body of athletics (the IAAF) investigated and eventually declared Caster eligible to compete as a female. As of 2019 she was the World and Olympic 800m champion.



The IAAF decided to place restrictions on women with 'high testosterone levels'. So from 2019 such individuals face the choice of competing against men, taking medication, or giving up competition.

Specification terms

Neurochemistry Relating to substances in the brain and other parts of the nervous system that regulate psychological functioning.

Neurotransmitters Chemicals (e.g. serotonin) in the brain and nervous system that transmit signals from one neuron to another across synapses.

Sex hormones Chemicals circulating in the bloodstream that affect the physical development, sexual development and behaviour of females (oestrogen) and males (testosterone).

Maternal instinct.

Key concept: Neurochemistry

What is neurochemistry?

Neurochemistry concerns the activity of substances in the nervous system. Psychologists are interested in how these substances affect the functioning of the brain and how this in turn influences our thinking, emotions and behaviour.

Neurotransmitters

Neurotransmitters allow communication between nerve cells (called *neurons*) in the brain and nervous system. Neurons are tiny cells not physically connected to each other but separated by gaps called *synapses* (see diagram on facing page). Neurons use electrical signals but at the gaps between neurons chemical substances (neurotransmitters) pass the signal on.

Serotonin is one of the main neurotransmitters in the body. It has been linked to a number of behaviours and disorders including depression. It is thought that depressive symptoms are associated with abnormally low levels of *serotonin*. Because neurotransmitters are chemicals their activity can be altered by drugs. Some drugs that treat depression (antidepressants) work by increasing the levels of serotonin in the synapses between neurons.

Sex hormones

Sex hormones are chemicals produced by testes (in males) and ovaries (in females). They circulate in the bloodstream and target specific organs, affecting physical and sexual development and behaviour.

Oestrogen is the main female sex hormone. It controls the development of female reproductive organs, female secondary sexual characteristics (e.g. development of breasts) and the menstrual cycle. It causes the physical changes associated with the menstrual cycle and pregnancy but it is also linked with greater emotional reactivity (e.g. irritability) in some women.

Testosterone is the main male sex hormone, produced in the testes (and at lower levels in the ovaries in females). It controls the development of male reproductive organs and male secondary sexual characteristics (e.g. deeper voice). *Testosterone* has been linked to *aggression* in both males and females. Animal studies have shown that increasing levels of testosterone leads to more aggressive behaviour in the males of many species. Castration (removing testes) reduces both testosterone and aggression (Giammanco *et al.* 2005).

Key study: Deady *et al.* (2006) Maternal personality and reproductive ambition in women

Aims

Denis Deady *et al.* wanted to see if there was a link between testosterone levels and maternal personality traits (e.g. broodiness) in women.

Procedure

27 female college students completed the *Bem sex-role inventory* (BSRI), a measure of how masculine or feminine a person perceives themselves to be. Participants also answered questions about their 'maternal personality' (e.g. how important it was for them to have children), reproductive ambition (e.g. how many children they wanted) and career orientation (how important a career was). Finally, the level of testosterone in their saliva was measured.

The BSRI includes 20 'masculine' adjectives, 20 'feminine' adjectives and 20 neutral 'adjectives'. You rate yourself on a 7-point scale (from 'never true of me' to 'always true of me') on each one. Here are some examples:

Masculine	Feminine	Neutral
Ambitious	Affectionate	Adaptable
Aggressive	Flatterable	Friendly
Dominant	Gentle	Helpful
Forceful	Loves children	Moody
Independent	Sympathetic	Truthful

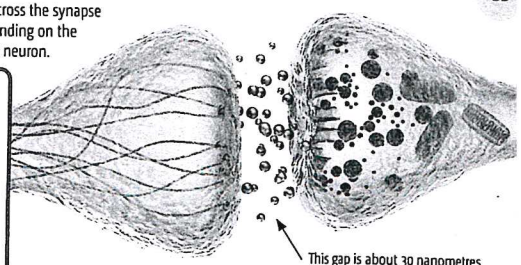
Findings

BSRI findings showed that women who perceived themselves as more masculine had higher testosterone than those who considered themselves less masculine. Higher levels of testosterone were correlated with lower maternal personality scores and reproductive ambition. Neither perceived femininity nor career orientation were related to testosterone.

Conclusions

The researchers concluded that women's maternal tendencies (e.g. desire to have children) are moderated partly by the male sex hormone testosterone. This suggests that maternal personality and reproductive ambition have a biological basis and are not just due to psychological or social factors.

The picture on the right illustrates the gap between two neurons, known as a *synapse*. Molecules of the neurotransmitter (in purple) are released from one neuron into the synapse. They drift across the synapse and attach to special receptors on the next neuron, rather like a key fits into a lock. Depending on the neurotransmitter, this process will either activate or deactivate (excite or inhibit) the next neuron.



This gap is about 30 nanometres whereas a sheet of paper is about 100,000 nanometres in width.

Evaluation

Support for sex hormones

One strength is that many studies demonstrate the importance of sex hormones.

For example, in a study by Stephanie Van Goozen *et al.* (1995) *transgender* women (male to female transition) receiving female sex hormones showed decreases in aggression and visuo-spatial skills (transgender men showed the opposite effect).

These findings illustrate the very significant impact that sex hormones can have on behaviour.

Contradictory research

One weakness is that other studies have produced conflicting findings.

In a follow-up of the above study, Ditte Slabbekoorn *et al.* (1999) found that sex hormones did not have a consistent effect on visuo-spatial skills in transitioning people. Many studies use transitioning people as participants, but they are probably not representative of the population as a whole.

Therefore, the overall picture suggests that the effects of sex hormones are real but limited because other biological and non-biological factors are also influential.

Evaluation

Support from other research

The finding that testosterone plays a role in female behaviour is supported by other studies.

James Dabbs and Marian Hargrove (1997) found that female prisoners who used aggression to enforce dominance within prison had higher testosterone levels than other prisoners.

This means that we can have greater confidence that the effect of testosterone on female behaviour is a real one.

Correlation not causation

One weakness is that the researchers found several *correlations* in their data.

Variables were linked with each other (e.g. maternal personality and testosterone). But a correlational relationship is not the same as a causal one. The study does not show that testosterone *causes* women to have an unmaternal personality. Other factors may be involved (see page 113).

This means that the study needs to be supported by non-correlational data before firmer conclusions can be drawn.

Exam-style questions

1. State what is meant by the term 'neurochemistry'. (1)
2. Rolando went to his doctor because he was very depressed. But since taking the antidepressant medication his doctor prescribed he has been feeling quite a bit better.

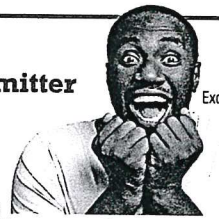
   Outline the role of neurotransmitters in behaviour with reference to Rolando's experience. (3)
3. Sofia has a very regular menstrual cycle but each month just before her period she becomes irritable and experiences severe abdominal cramps.

   (a) Explain what Sofia's experience tells us about the role of sex hormones. (3)

   (b) Explain **one** weakness of the key study by Deady *et al.* (2006). Refer to Sofia's experience in your answer. (3)
4. Describe **one** finding from the key study by Deady *et al.* (2006). (2)
5. Explain what the key study by Deady *et al.* (2006) can tell us about the role of sex hormones. (3)
6. Jess is holding a baby and says to her friend, 'I've always wanted a baby – in fact I'd like five. I think I'll be a really good mum.' Tess replies, 'Babies don't appeal to me at all, and being a mother is my idea of a nightmare!'

   Analyse neurochemistry with reference to this scenario. In your answer you should consider: (a) the role of sex hormones, and (b) the key study by Deady *et al.* (2006). (9)

GET ACTIVE Types of neurotransmitter



Excited.

Some neurotransmitters are called *inhibitory* because their main effect is to reduce (inhibit) the electrical activity of nerve cells (neurons). An example is serotonin. At normal levels serotonin dampens and calms brain activity, which stabilises our mood.

Other neurotransmitters are *excitatory* because they stimulate (excite) neurons and make them active. An example is *noradrenaline*.

Some neurotransmitters are inhibitory in some parts of the brain and excitatory in others. A very important example of this type is *dopamine*.

1. ***Find out what effects noradrenaline and dopamine have on behaviour.***
2. ***Like serotonin, noradrenaline and dopamine are thought to play a role in depression. Find out what they do and how they relate to each other and to serotonin.***

An issue to consider

The research discussed on this spread suggests that we are controlled by our hormones.

What are the implications of this for a criminal's behaviour?

Specification content

B4 Biological approach

Key concept:

- Neurochemistry, including the role of sex hormones and neurotransmitters.

Key study:

- Deady *et al.* (2006) Maternal personality and reproductive ambition in women is associated with salivary testosterone levels.

Key concept 4 and key study

Stressed out

Modern life can be stressful. So many things to do, so little time. Homework, part-time job, Instagram updates... Today you may have to cope with any or all of these. But I can (almost) guarantee that running away from an attacking lion will not be something you have to worry about.

It wasn't always like this. Our evolutionary ancestors were much more concerned about attacking lions than they were about dealing with their overdrafts. The problem is, the body's stress response is still stuck in those days (referred to as the *environment of evolutionary adaptation*).

Our body is great at helping us cope with short-term emergency situations that are over (one way or another) almost as soon as they've begun. But long-term drawn-out stress, of the type so common in modern life, is much more damaging. We have not evolved to deal with that kind of stress.

Specification terms

Environment of evolutionary adaptation (EEA) The habitat in which a species evolved its most recent adaptations. In humans this ended about 10,000 years ago.

Genome lag Changes to the environment occur much more rapidly than changes to our genes.

Sexual selection Attributes or behaviours that increase reproductive success are more likely to be passed on and may become exaggerated over succeeding generations of offspring.

Survival of the fittest Natural selection selects the genes giving rise to characteristics that promote survival and reproduction so they are retained in the population.

Key concept: Evolutionary psychology

Survival of the fittest

The word *evolution* means change. The form and behaviour of all living things change over time through the process of *natural selection*. When life is hard those individuals who possess characteristics that help them to stay alive (and reproduce) are the ones who pass their *genes* on to the next generation. In this way they are 'selected'. This idea, proposed by Charles Darwin (1859), is often called the *survival of the fittest*. Fittest in this context refers to the characteristics that best match ('fit') the demands of the environment.

Environment of evolutionary adaptation (EEA)

When we look at the living things around us today we see the outcome of natural selection – all plants and animals are what they are because their traits enabled them to survive in a particular environment.

In the case of humans, the environment during 99% of our evolutionary history was during the Pleistocene era which ended about 10,000 years ago. At that time humans lived on the African savannah (warm grasslands) as hunter-gatherers. During this time we changed from apes moving around on four legs to upright hairless animals who could use tools and language. Our behaviour and minds have changed to ensure we could survive in that habitat. Therefore, what we are today is largely based on the evolutionary pressures in that environment.

Genome lag

Our minds are still adapted to the EEA. It takes thousands of years for evolutionary pressures to change the human genome (collection of genes). But the world around us changes much more quickly than that. Most of the population no longer lives in small groups but in vast cities alongside countless others – but we still have a 'small group' mentality.

Sexual selection

Evolutionary pressures also act on reproductive success. Darwin noted that some characteristics continued to exist even when they threaten an organism's survival. He realised that such characteristics must confer an advantage, and suggested that the advantage was that they make the individual attractive to potential mates.

An example is the peacock's tail. It is hard for the male bird to carry around (and a big target for predators), but it is attractive to females. So possessing a burdensome tail actually increases the male bird's chances of reproducing and passing on the genes that led to his success.

Key study: Buss *et al.* (1992) Sex differences in jealousy: Evolution, physiology and psychology

Aims

David Buss *et al.* wanted to see if males and females experience different forms of jealousy (sexual or emotional) in response to thoughts of infidelity.

Procedure

Male and female participants (American students) were asked to think of a current or former partner becoming involved with someone else (person X). Which would be more upsetting – their partner forming a deep emotional attachment with X or having passionate sexual intercourse with X? Some participants imagined the two scenarios while their physiological responses were measured (e.g. pulse rate).

Findings

60% of men (17% of women) were more distressed by the sexual infidelity scenario than the emotional infidelity one. 83% of women (40% of men) were more distressed by the emotional infidelity scenario than the sexual one. Men showed more physiological activity in the sexual infidelity scenario compared with the emotional one. Women showed the opposite but the differences were not as strong as they were for men.

Conclusions

The findings support an evolutionary explanation of jealousy.

Male sexual jealousy defends against raising another man's child which would not enhance their own reproductive success. Therefore, sensitivity to sexual infidelity is a trait that would be selected in men.

Female emotional jealousy defends losing a male partner to another woman, and the loss of support raising a child. Emotional infidelity would reduce successful reproduction and thus would be selected in women.

Evaluation

Support for genome lag

One strength is support for the concept of *genome lag* from research into partner preferences.

Our preferences have changed hugely over the last 100 years. Women have a greater role in the workplace that has made many less dependent on men to provide for them (despite ongoing inequalities in earning power). So women's partner preferences are now less dictated by resource considerations.

This shows that a behaviour important to survival – choosing a mate – has been influenced by cultural changes while the genome has changed hardly at all.

Problems with the EEA concept

One weakness is that the concept of the EEA implies that significant evolution of human characteristics halted about 10,000 years ago.

However, there are some evolved changes that suggest this is not the case. For example, most humans are lactose intolerant but some are not. The gene that allows us to digest milk was selected and passed on because it conferred a survival advantage. But this happened less than 10,000 years ago. Other changes are occurring now.

Therefore, some human characteristics may be the outcomes of evolutionary pressures operating much more recently than the EEA. This undermines the significance of the EEA as a main plank of evolutionary psychology.

Evaluation

Physiological and psychological methods

One strength is that Buss *et al.* measured physiological activity as well as feelings of distress.

The question that was posed required a *subjective* answer and assessed the psychological component of jealousy. The physiological measures were *objective* and showed the sex difference in jealousy has a biological basis. This is what we would expect to find if the evolutionary explanation is correct.

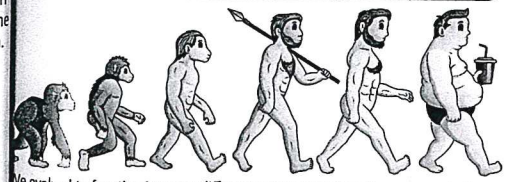
Therefore, the findings are more convincing because they are supported by two lines of evidence rather than just one.

Limited sample of participants

One weakness is that the participants were from a single *culture*.

Evolutionary psychology deals in universals – it claims that all humans must show the same behaviours because they are all exposed to the same selective pressures. But the key study investigated jealousy in American students only and their behaviour may have been determined by shared *social norms*.

This means that, as the study focused on only one culture, it could not fully support an evolutionary explanation of jealousy.



Ve evolved to function in a very different environment from the ones most of s live in today. Perhaps we overeat, become anxious and depressed because ve are trying to cope using a mind better-suited to a much earlier time.

GET ACTIVE Phobias

As we have seen on this spread, evolutionary psychologists argue that we try to cope with the stresses of the modern world with a mind that is better-suited (or adapted) to the pressures of the EEA.

Perhaps this explains the existence of some psychological disorders. An example is phobia, usually defined as an extreme or irrational fear of an object, situation or event. Many people from all sorts of cultures are afraid of snakes and spiders. A lot of these people are afraid of such creatures even though they have never personally encountered one.

How do you think evolutionary psychology explains the existence of such fears?

Exam-style questions

1. State what is meant by the term 'survival of the fittest'. (1)
2. A group of schoolchildren are visiting the zoo. They see a peacock unfurl his magnificent tail. One child says, 'I don't know how he manages to get around carrying that.'

   With reference to the child's comment, explain how the peacock's tail supports the concept of sexual selection. (3)
3. Josef is feeling very stressed because he has so much work to do on top of his part-time job. 'I don't think we're cut out for this kind of lifestyle,' he says to his friend.

   Explain the concept of genome lag with reference to Josef's comment. (3)
4. Give **two** conclusions from the key study by Buss *et al.* (1992). (2)
5. Explain what the key study by Buss *et al.* (1992) can tell us about evolutionary psychology. (3)
6. Explain **one** strength or **one** weakness of the key study by Buss *et al.* (1992). (3)
7. Humans have adapted to live in a very different environment from the ones we live in now. Many behaviours that evolved a long time ago are still helping us to survive today.

   Discuss the view that evolutionary psychology can explain human behaviour. In your answer you should consider at least **two** of the following: (a) the environment of evolutionary adaptation, (b) genome lag, (c) survival of the fittest, and (d) sexual selection. (9)

An issue to consider

Evolutionary medicine is an application of evolutionary principles to the treatment of modern health and disease. It suggests that genetically-based physical and psychological disorders actually must have some selective advantages otherwise they would not continue in the gene pool.

If depression is inherited, what might be the selective advantage?

Specification content

B4 Biological approach

Key concept:

- Evolutionary psychology, including the environment of evolutionary adaptation, survival of the fittest, sexual selection and genome lag.

Key study:

- Buss *et al.* (1992) Sex differences in jealousy: Evolution, physiology and psychology.

Biological approach to explaining aggression in society

Violence in the genes?

In 1978, a group of women from the same family attended appointments at a hospital in the Netherlands. They were planning to have children, but there was something about the male side of their family that worried them – they were thinking of 14 of their brothers, sons, and nephews.

These 14 had two things in common – they were intellectually impaired and also extremely aggressive. One had attempted to rape his sister, another tried to mow down his boss with his car two had set fire to houses more than once. They were all prone to aggressive outbursts, threatening people and constantly getting into fights.

15 years later, Han Brunner took blood samples from these 14 men and another 14 of their male relatives. He identified a defect in one gene. All the violent men had it, but the non-violent men did not.

The gene, described on this spread, became known in the media as the 'Warrior Gene'.

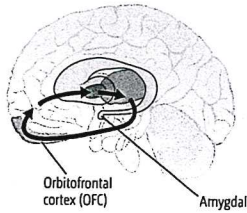
Specification terms

Brain structures Physical components that make up the neuroanatomy of the brain, including the amygdala and the orbitofrontal cortex (OFC).

Evolution The changes in inherited characteristics in a biological population over successive generations.

Genes A unit of inheritance. They consist of chemical instructions (DNA) which tell your body what proteins to manufacture – and basically that is what you are, a huge number of proteins. Genes are inherited from parents and contribute to the development of an individual's characteristics.

Neurochemistry Relating to substances in the brain and other parts of the nervous system that regulate psychological functioning.



A slice through the midline of the brain showing two of the key brain structures related to aggression.

Biological explanations

Evolution of aggression

As we saw on page 36, the origins of sexual jealousy are *evolutionary*, i.e. this behaviour is *naturally selected* because it confers reproductive advantages for males (Buss *et al.* 1992). Men are sexually jealous because, unlike women, they cannot be sure they have truly parented a particular child. They risk using their resources to raise another man's offspring. This would assist the survival of a rival's *genes*, leaving the man with fewer resources to invest in his own offspring (and hence genes).

Sexual jealousy helps to defend against this possibility by promoting aggressive countermeasures. Margo Wilson and Martin Daly (1996) called these *mate retention strategies*. Such strategies often involve *instrumental aggression* because they are intended to achieve a goal – men use them to prevent their partners from 'straying'.

These are two such sexually selected mate retention strategies:

Direct guarding A man may monitor his partner's behaviour and actively prevent her from meeting other men. This could involve him using physical violence.

Negative inducements A man may issue threats of violence or other consequences for infidelity ('I'll kill you if you leave me').

Brain structures in aggression

The amygdala has a central role in how an organism assesses and responds to environmental threats. Amygdala reactivity is a key predictor of human *aggression*. People with *intermittent explosive disorder* (IED) experience outbursts of extreme aggression. Brain scans reveal high levels of amygdala activity when individuals view images of angry faces (Coccaro *et al.* 2007). This links amygdala activity, aggression and a real-life sign of threat.

The orbitofrontal cortex (OFC) is a region of the brain which plays an important role in higher *cognitive* functions such as rational thinking. It regulates impulse control and its activity is reduced in people with psychiatric disorders that feature aggression (Coccaro *et al.* 2007). The OFC's reduced activity disrupts its impulse control function, so the individual cannot inhibit their aggressive behaviours.

Neurochemistry of aggression

Serotonin levels in the OFC are normally associated with a reasonable degree of behavioural self-control. But decreased *serotonin* disrupts this link – self-control is reduced and impulsive behaviours (including aggression) become more frequent. For example, 5-HIAA (a serotonin-related chemical) was found in significantly lower amounts in violent impulsive offenders compared with violent non-impulsive offenders (Virkkunen *et al.* 1994).

Dopamine helps to regulate motivational behaviours and our experience of reward. It interacts with serotonin to influence aggression. Dongju Seo *et al.* (2008) argue that serotonin underactivity stimulates *dopamine* overactivity to cause impulsivity and aggression. So serotonin underactivity is the main cause of *hostile aggression* and dopamine overactivity also contributes.

Genes and aggression

The key gene linked to the inheritance of aggression is the MAOA gene. It controls the production of an enzyme called *monoamine oxidase A* (which is written as MAO-A). MAO-A 'mops up' *neurotransmitters* in the brain after a nerve impulse has been transmitted from one *neuron* to another. It breaks down the neurotransmitters into constituent chemicals to be recycled or excreted. A dysfunction in the operation of the MAOA gene leads to abnormal activity of the MAO-A enzyme, which in turns affects neurotransmitter levels in the brain.

One variant of the MAOA gene leads to low MAO-A activity in some areas of the brain and is associated with aggressive behaviour. This low-activity MAOA variant was found in the men of the Dutch family studied by Brunner *et al.* (1993, see top left) and is also implicated in intimate partner violence (IPV, Stuart *et al.* 2014).

Evaluation

Support for the evolutionary explanation

One strength of evolutionary explanations is support from studies of intimate partner violence (IPV).

Todd Shackelford *et al.* (2005) found that men who used mate retention behaviours (e.g. direct guarding) in heterosexual relationships were more likely to be physically violent towards their partners (a strong positive *correlation*). Retention behaviour was a reliable predictor of aggression.

These findings support the evolutionary view that predicts a link between risk of infidelity, sexual jealousy and aggression.

Role of the amygdala

A further strength of the biological approach is evidence supporting the amygdala's role in aggression.

Dustin Pardini *et al.* (2014) followed up 56 males who were part of a *sample* of 503 first recruited for a study when they were 6/7 years old. The 56 were selected 20 years later because they had been involved in violent crimes. Brain scans showed that smaller amygdala volumes in both childhood and adulthood were associated with greater aggression. These strong negative correlations continued into a further follow-up three years after the scans. The researchers controlled other factors (e.g. race, substance abuse, earlier aggression levels).

This is strong support for the role of the amygdala because amygdala volume predicted degree of aggressive behaviour.

Correlation not causation

One weakness is that many research studies into biological factors are correlational.

For example, the two studies described above found strong correlations between aggression and the other variables (mate retention, amygdala volume). Correlational research is helpful because it is unethical to conduct experiments on aggression in humans (it would mean actively manipulating biological influences so participants behaved aggressively). But correlation is not the same as causation.

This means we cannot know for sure if a biological factor (e.g. amygdala volume) is a *cause* of aggression, an *effect* of it, or if a third variable is involved.

Role of genes

Another weakness is that the influence of genes on aggression is very complex, with no simple answers.

Studies show that the role of the MAOA gene is important but probably exaggerated. For instance, in the study by Stuart *et al.* (facing page) IPV was associated not just with the MAOA gene but also with the serotonin transporter gene (the 5-HTT gene). Evangelos Vassos *et al.* (2014) reviewed 185 studies but found no single gene was associated with aggression.

The conclusion is that aggressive behaviour is the outcome of hundreds or thousands of genes (*genotype*) all interacting with each other and with environmental factors to produce the aggressive *phenotype*.

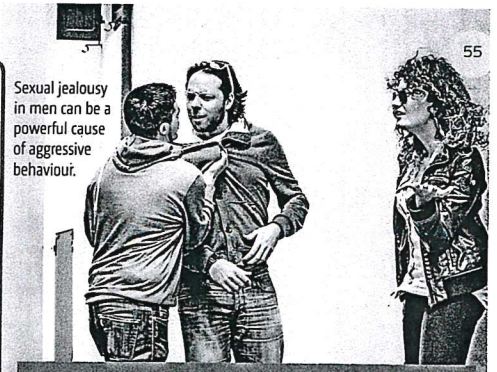
GET ACTIVE A probation officer reflects

Erwin is a probation officer working with high-risk offenders who have been in prison for violent crimes. He has worked in this field for over 20 years and has a lot of experience of criminals and their families.

Erwin has noticed that a high proportion of the people he works with have a medical history that includes brain injury. Others come from families where violent behaviour goes back several generations. Many of the people on his current caseload are addicted to drugs. He has even dealt with cases of murder and attempted murder with a large element of jealousy.

Erwin wonders if there could be a biological basis to a lot of aggressive behaviour.

Write a brief outline of the biological causes of aggression that would address Erwin's question and that he could share with his probation officer colleagues.



Sexual jealousy in men can be a powerful cause of aggressive behaviour.

Exam-style questions

1. Explain how the biological approach accounts for aggression. Use the concept of genes in your answer. (3)
2. Give **three** features of the biological approach that can explain aggression. (3)
3. Harlow's (1868) study of Phineas Gage showed how injury to the brain can change behaviour. Explain how the findings of Harlow (1868) support the view that aggression is linked to neuroanatomy. (3)
4. Explain **one** strength or **one** weakness of the biological approach to explaining aggression. (3)
5. Graham doesn't like his partner Pippa leaving the house. He asks her lots of questions when she returns, such as 'Where have you been?' and 'Who did you see?'. He is planning to install a tracking app on her mobile. Graham has also used physical force to keep Pippa under his control.
   (a) Describe the type of aggression shown by Graham. (2)
   (b) Use **one** aspect of the biological approach to explain Graham's behaviour. (2)
   (c) Discuss the view that aggressive people are born not made. In your answer you should consider: (i) the concept of evolution, and (ii) reference to Graham's behaviour. (9)

Link it

How does Harlow's (1868) study help us to understand the link between neuroanatomy and aggression?

What did Deady *et al.* (2006) investigate that could be relevant to the neurochemistry of aggression?

What is the possible link between Buss *et al.*'s (1992) study of jealousy and the evolution of aggressive behaviour?

Specification content

C1 Use of psychology to explain contemporary issues of aggression in society

Learners should understand and apply knowledge of how psychological concepts and research can be used to explain aggression in society:

- Biological, including evolution, brain structures, neurochemistry, genes.

Biological approach to consumer behaviour

It's a virtual world

Imagine putting on a virtual reality headset and seeing, not a racing car circuit or a battle landscape, but the aisles of a supermarket. Retailers sometimes ask volunteers to do this as part of their neuromarketing, in what is called 'in-store simulation'.

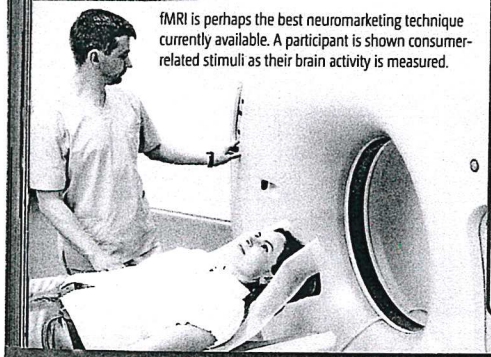
The VR environment allows retailers to see where the virtual shoppers are looking. Which products get most of their attention? Is it something to do with location? It's well-known for instance that the products that become more popular are those placed at eye level because most people ignore the lower shelves. VR is highly interactive, so virtual shoppers can pick products up and put them in a virtual trolley.

VR can also be used in a similar way to assess the impact of adverts and packaging – what do viewers look at most? VR allows researchers to create a 'heat map' showing the most and least viewed areas of a shelf, label or advert (see facing page).

Specification terms

Neuromarketing The application of the scientific study of the brain (neuroscience) to marketing (e.g. advertising).

Scanning techniques Methods used to investigate the brain and other parts of the body. Images are taken of the living brain and sometimes regions of the brain are matched to behaviour by asking participants to engage in particular activities while the scan is done. Brain scans are also used to detect brain abnormalities such as tumours. Examples include CT scan, PET scan, fMRI scan.



fMRI is perhaps the best neuromarketing technique currently available. A participant is shown consumer-related stimuli as their brain activity is measured.

Neuromarketing

What is neuromarketing?

Neuromarketing applies the study of the brain (neuroscience) to marketing (selling products or services), including advertising. Neuroscience is based on technologies that measure brain activity, including *functional magnetic resonance imaging* (*fMRI*) and *electroencephalography* (*EEG*). Neuromarketing uses these to study people's responses to aspects of marketing such as products, brands and adverts.

Neuromarketeers look for insights into consumers' motivations, feelings and decision-making processes in relation to brands etc. The findings of neuroscience are incorporated into campaigns to 'tap into' the brain activity associated with a positive attitude towards a brand or product, for example.

Functional magnetic resonance imaging (fMRI)

fMRI is a form of brain scanning which measures the activity (function) of the brain when it is 'working'. It detects changes in blood oxygenation and flow in specific parts of the brain. An active brain area requires more oxygen so blood flow has to be directed to this area.

The participant lies in an fMRI scanner and sees an advert or other stimulus as their brain activity is measured continuously in 'real time'. The fMRI scan produces three-dimensional images showing which parts of the brain are active during a mental process (such as deciding whether to buy a product).

In the language of neuromarketing, fMRI helps advertisers understand what features of an advert activate a brain area that 'pushes a consumer's buy button'. So they claim that fMRI can show, for example, whether a person is bored or excited by an advert, or whether they like a product or not.

Electroencephalogram (EEG)

An EEG measures the brain's electrical activity via electrodes attached to the individual's scalp using a geodesic net (skull cap). The EEG recording represents brainwave patterns generated by millions of individual *neurons*, giving an overall picture of brain activity which is presented on a screen.

It tracks changes in brain activity over fractions of a second and is much more convenient than fMRI. But it only measures activity at the surface of the brain (the *cortex*) and not deep in the *subcortical* areas (where emotions are regulated for instance).

Just as with fMRI, the aim is to identify the effects of marketing and advertising variables on brain activity. But because the EEG is portable this can be done in more 'natural' environments.

Eye tracking

Eye movements are intimately linked to brain activity and are therefore of interest in neuromarketing. Researchers use technology to track the consumer's eye movements as he or she views a product or advert.

It helps us to understand the features of an advert that attract the most attention and viewers spend the most time gazing at. This can be associated with brain activity to identify the most interesting, exciting or motivating aspects of the stimulus.

Like EEG, because the equipment is portable, eye tracking can be used in real-life situations such as restaurants, supermarkets or online. It can also be used in a virtual reality environment (e.g. a virtual supermarket).

Facial coding

People's facial expressions are thought to offer a window into their feelings, an idea that goes back scientifically to Charles Darwin (1872).

In neuromarketing, electrodes attached to people's faces detect slight muscle movements as they watch an advert. These movements are correlated with emotional expressions (e.g. smiling) and feelings (e.g. happiness, surprise) to indicate which aspects of an advert the consumer finds appealing.

Because the meanings of facial expressions are to some extent open to interpretation, Paul Ekman and Wallace Friesen (1978) developed a system of coding called FACS, the *facial action coding system*. This is a way of trying to provide some *objectivity* by categorising 'micro' facial expressions from the combined positions of 43 facial muscles.

GET ACTIVE Design your own

Many companies are known to use adverts based on neuroscientific research. The research has helped advertisers to understand what consumers 'like' even when they do not know themselves. The adverts that have been produced use sound, colour and fonts in creative ways. They 'direct' the viewer to the most important parts of the advert. They try to manipulate emotions (e.g. with a voice-over) so viewers feel more positively about the product.

Think about the neuromarketing techniques described on this spread. Explain how you could use them to design an advert for a mobile phone (you could include virtual reality).

Neuromarketeers can now use virtual reality to track consumers' eye movements in a 'virtual' shop. The red hotspots show where the most attention is focused. Retailers can use this information in designing the arrangement of products.

Evaluation

Neuromarketing is not the most effective technique

One weakness is poor evidence that neuromarketing can predict *consumer behaviour*.

Vinod Venkatraman *et al.* (2015) asked participants to watch genuine adverts. The researchers used fMRI, EEG, eye tracking and facial coding to measure participants' responses. They also used *focus groups*, a well-established non-neuromarketing method in which participants discuss their responses to the adverts. The best technique for predicting advertising success was the focus group. fMRI was the only neuromarketing technique that was at all effective.

This shows that fMRI has some usefulness but methods that don't rely on technology (e.g. focus groups) may be better.

More useful than self-report

One strength is that neuromarketing techniques (e.g. fMRI and EEG) can be useful alternatives to *self-report* methods (e.g. *questionnaires*).

This is because sometimes people are not consciously aware of their responses (or at least they cannot describe them). For instance, when Gregory Berns and Sara Moore (2012) used fMRI with adolescents, they found that activity in a 'reward' area of the brain (the *ventral striatum*) was closely correlated with the popularity of songs three years later (measured by sales figures). But the participants' conscious responses (how much they said they liked the songs) did not correlate with sales figures.

This suggests that the techniques of neuromarketing can sometimes reveal more about consumer behaviour than traditional methods.

Ethics of neuromarketing

Another weakness is neuromarketing techniques raise ethical concerns.

As an application, neuromarketing aims to predict consumer behaviour and possibly manipulate it. One ethical concern is that neuromarketing may use neuroscientific findings to manipulate responses that people are not aware of and over which they have no control. There is also concern about the unethical use of neuroscientific findings to make inflated claims in order to sell 'expertise' to companies and advertisers.

This unethical manipulation of consumers worries many researchers who believe neuromarketing should be regulated by law.

Neuromarketing claims are exaggerated

A further weakness is a serious disconnect between research findings on neuroscience and the claims made by neuromarketeers.

For instance, some neuromarketeers have argued that their techniques allow them to 'mind read', that is to directly measure attention, memory, decision-making and emotions in the brain. However, neuroscience researchers do not push their claims anywhere near this far. They measure brain activity in response to stimuli and correlate it with other variables such as expressed feelings about a product or behaviours such as buying. But this is not the same as 'seeing' emotion in the brain, for instance.

This suggests that currently many of neuromarketing's claims are hype, though future research may produce greater support.

Exam-style questions

1. In the context of consumer behaviour, explain what is meant by the term 'neuromarketing'. (2)
2. Explain how the biological approach accounts for consumer behaviour. (3)
3. Explain **one** way in which the biological approach can inform strategies to change behaviour. (3)
4. Describe **one** scanning technique to detect brain changes in consumer decision-making. (2)
5. Kenan and Heather volunteered for a research study into advertising. Kenan had a skull cap with lots of electrodes fitted onto his head. It was attached to a computer screen that showed several wave patterns. The researchers used a scanner with Heather. Both of them were shown brief adverts.
   (a) Identity the neuromarketing technique used with Kenan. (1)
   (b) Explain how the technique used with Heather works. (3)
   (c) Discuss techniques based on the biological approach that are used to change consumer behaviour. In your answer you should consider: (i) neuromarketing, and (ii) reference to Kenan and Heather. (9)

Link it

Harlow (1868) was one of the first people to argue that functions are localised in the brain. Is there any evidence on this spread to support this view?

Deady *et al.* (2006) investigated masculinity and femininity using the BSRI and testosterone levels. How could the BSRI and testosterone levels be used to research effective advertising?

Buss *et al.* (1992) focused on evolutionary explanations of jealousy – do adverts make use of jealousy?

Specification content

C2 Use of psychology in business to explain and influence consumer behaviour

Learners should understand and apply knowledge of how psychological concepts and research can be used to understand and inform strategies aimed to change behaviour.

- Biological – neuromarketing (scanning techniques to detect brain changes in consumer decision-making).

Content area C3: Application of psychology to explain gender

Biological approach to explaining gender

The triumph and tragedy of David Reimer

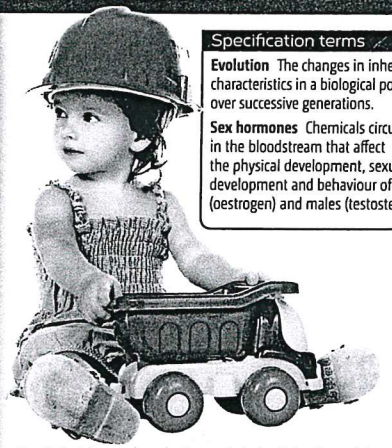
Bruce and Brian Reimer were twin boys born in Canada in 1965. Bruce was left without a penis when he was six months old after a circumcision operation went wrong.

Bruce came to the attention of John Money, a psychologist who was conducting groundbreaking research into gender identity. Money had devised a theory of gender neutrality – that is, gender identity is the result of environmental influences rather than biological sex. Accordingly, Money advised Bruce's parents to raise him as a girl – Brenda – instructing them never to tell her about her gender reassignment. Money continued to monitor Brenda's progress over the years, presenting her case as a great success and confirmation of his neutrality hypothesis.

Brenda was given female hormones when she reached puberty, to counteract the effects of the testosterone surge boys experience at that time. But she never adjusted to life as a female and experienced severe psychological and emotional problems. It may be that her male hormones exerted a strong influence on her gender identity.

Once she learned the truth, Brenda retransitioned to life as a man, David. He swapped female hormones for male ones, married and adopted children, but continued to struggle with the psychological consequences of his upbringing.

Tragically, David Reimer committed suicide in 2004, two years after his twin brother Brian.



Psychologists compare gender-typical play behaviour with testosterone levels to assess the influence of sex hormones on gender identity.

Specification terms

Evolution The changes in inherited characteristics in a biological population over successive generations.

Sex hormones Chemicals circulating in the bloodstream that affect the physical development, sexual development and behaviour of females (oestrogen) and males (testosterone).

Biological explanations

Earlier in this unit we looked at various biological explanations for behaviour including the role of hormones (see page 34) and the influence of *evolution* (see page 36).

Role of sex hormones in gender

Research highlights the importance of *testosterone* in male and female gende development.

Testosterone and gender High levels of the male *sex hormone* testosterone a associated with development of a masculine-typical *gender* in both males and females. Specifically it is linked with *aggression*, a masculine-typical behaviour.

Testosterone and atypical development Most of what we know about the effects of testosterone on gender identity comes from studies of people with atypical conditions.

Congenital adrenal hyperplasia (CAH) is a condition in which a genetically female foetus is exposed to abnormally high levels of testosterone. The outcome is ambiguous external genitalia that often resemble a penis and for this reason many are identified at birth as a male. Those who are raised as a girl often show play behaviour and toy preferences that are more typical of boys. In adulthood, women with CAH express satisfaction with their female-typical identity. But up to 5% say they want to live as a man (Hines 2006).

Another form of atypical development is *complete androgen insensitivity syndrome* (CAIS). A genetically-male foetus is 'immune' to the effects of prenatal testosterone, so is born with female-resembling external genitals. Boys with CAIS often engage in play that is more typically female. According to Melissa Hines (2006) the core gender identity of men with CAIS is almost always female-typical.

Evolutionary explanations for masculinity/femininity

Sexual selection focuses on behaviours in males and females that enhance their reproductive success. Gender behaviours and identities can be related to this because, for example, human females who are caring are likely to be reproductively more successful (because it is important that they stay and ca for their offspring).

So masculine and feminine identities are hangovers from the adaptive pressures our ancestors faced in our evolutionary history (the *environment of evolutionary adaptation*, EEA).

Dominant male theory Because males must compete for females, the strongest most dominant males mate most frequently (they possess the most resources for raising offspring). The *genes* for whatever qualities that made the male dominant therefore survive into succeeding generations. This also ensures the continuation of masculine-typical traits contributing to dominance (e.g. risk-taking).

So masculine characteristics are ones that proved useful in short-term mating partnerships in competition with other males. The theory is often (ab used to explain why more men than women are found in leadership roles an occupy positions of power.

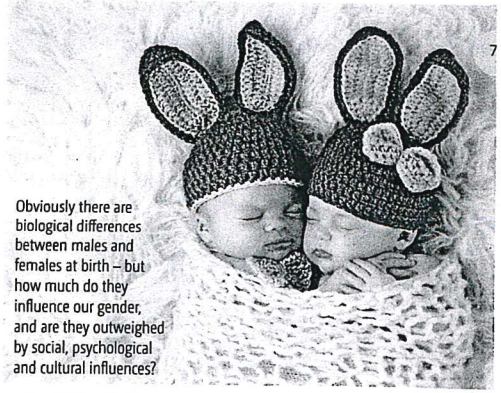
Division of labour in the EEA Men and women in the EEA adopted different roles to ensure reproductive success. Men were hunters and required masculine-typical characteristics such as aggression and athleticism to provid resources for their female mates.

But it was too dangerous for women to hunt because the death or serious injury of a lactating female would deprive offspring of their food source, reducing the female's (and her partner's) reproductive success. A better strategy for the female was to gather (e.g. pick fruit), which meant remaining at home, developing feminine-typical characteristics and skills such as nurturing, caring and providing shelter.

GET ACTIVE Men and women are born different

In 2017 James Damore, a software engineer at Google, wrote a memo which he sent to his colleagues. In it, he argued that men and women have different interests, preferences, abilities and identities that are biologically-determined and rooted in evolution. He wrote, 'On average, men and women biologically differ in many ways. These differences aren't just socially constructed because…They're universal across human cultures… they often have clear biological causes and links to prenatal testosterone…they're exactly what we would predict from an evolutionary psychology perspective.' (tinyurl.com/y4skbzma)

Write a memo in response to Damore's message. You can either support or challenge his arguments, but your memo must be firmly based on the evidence.



Obviously there are biological differences between males and females at birth – but how much do they influence our gender, and are they outweighed by social, psychological and cultural influences?

Evaluation

Support for role of testosterone

One strength is that testosterone is strongly associated with masculine-typical gender identity in females.

Donald Baucom *et al.*'s (1985) female participants completed the BSRI (see page 34) and other measures of masculinity/femininity. High levels of salivary testosterone were correlated with high masculinity and low femininity scores. A feminine identity was associated with low levels of testosterone. Participants with high testosterone saw themselves as independent, active and resourceful.

These findings support the role of a biological factor – testosterone – in gender identity.

Neglects social and cultural factors

One weakness is that gender differs across (or even within) *cultures*.

There are important differences in what are considered to be gender-typical behaviours. For example, Amie Ashcraft and Faye Belgrave (2005) argue that African American girls identify closely with masculine-typical and *androgynous* gender roles and link this to the structure of African American families. This points towards *social context* and learning of gender, which is better explained by *social learning theory* (see previous spread).

Therefore, a more useful way of looking at the origins of gender is as a combination of biological and social/cultural factors, and research should aim to identify how these interact.

Evidence undermining evolutionary theory

Another weakness is that the evolutionary view that gender is binary (male or female) is contradicted by evidence of a third gender in some cultures.

For example, the fa'afafine of Samoa are biologically male but choose to adopt a feminine-typical gender role. They dress as women, perform all domestic tasks and care for the family. A non-fa'afafine man can have sex with a fa'afafine without either of them being considered gay.

This degree of culturally-accepted *gender fluidity* is difficult for the evolutionary theory to explain.

Incorrect assumptions about the EEA

A final weakness is that the evolutionary approach suggests that gender behaviours/identity is inherited from social structures that existed in the EEA.

Men were hunters, women were gatherers (and homemakers) and each developed gender-appropriate behaviours consistent with these roles. However, it is very uncertain that all human societies in the EEA followed this pattern. This is confirmed by studies of existing hunter-gatherer societies, which show a wide variety of gender-appropriate behaviours (Eagly and Wood 1999).

This means that the evolutionary theory of gender is built on assumptions about the EEA that are far from proven.

Exam-style questions

1. In the context of the biological approach, what is meant by the term 'sex hormone'? Refer to gender in your answer. (2)
2. Explain how the biological approach accounts for gender. Use the concept of evolution in your answer. (3)
3. Explain **one** evolutionary reason for traditional masculine gender behaviour. (3)
4. Give **three** features of the biological approach that can explain gender. (3)
5. Explain how the findings of Deady *et al.*'s (2006) study support the biological approach to gender. (3)
6. Sven sees himself as a bit of a 'man's man'. He is extremely competitive and enjoys beating his male friends in various sports and in 'banter'. His approach to work is aggressive and he sees dating as a competition. He believes that women find him very attractive.

   With reference to Sven, analyse the view that gender is biologically determined. In your answer you should consider: (a) sex hormones, and (b) evolutionary explanations of masculinity/femininity. (9)

Link it

How might sex differences in brain structure contribute to gender?

Does the study by Deady *et al.* (2006) support a biological explanation of gender? Explain your answer.

What do Buss *et al.*'s (1992) findings about sexual and emotional jealousy tell us about gender?

Specification content

C3 Application of psychology to explain gender

Learners should understand and apply knowledge of how psychological concepts and research can be used to understand the typical and atypical gender of individuals in society.

The influence of the following on gender:

- Biological – role of sex hormones (before and after birth), evolutionary explanations for masculinity/femininity.