

The angler fish, a sexual curiosity. Find out why on page 9. David Shale/Naturepl.com



## Slugs and snails and puppy dog tails.

Boys and girls, according to the nursery rhyme, are very different.

Biologically, the origins of these differences are obvious. Males have one type of sex organ, females another. Only very rarely are people somewhere between the two.

But how far can we take this distinction? How different are boys and girls in other characteristics, such as intelligence or kindness? What effect does puberty have? How different are adult men and women?

And do our everyday views of the sexes reflect biological reality or do they owe more to the way we are

brought up and what is expected from us? From pink blankets for girls to blue for boys, the idea of two distinct sexes is deeply ingrained and reinforced in culture.

If there are genuine sex differences, what should we do about them? Do we play to each sex's strengths with specific gender roles or attempt to create an even playing field?

From genes to gender stereotyping, this *Big Picture on Sex and Gender* tries to find out whether, and why, boys will be boys and girls will be girls.

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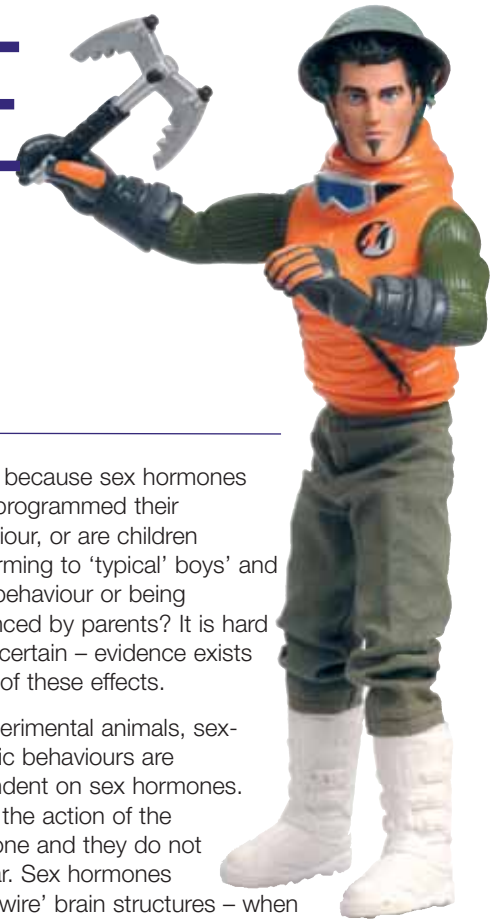
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# THE NATURE OF SEX



“The animals went in two by two”: the Noah’s Ark story reminds us that animals come in two sorts – males and females. And to create new ones, you usually need to start with one of each.

The sex we are depends on our genes and the hormones that we make. Normally, these turn us either into a male or into a female. But some people – those with an intersex condition – fall somewhere between the two, and are not easily classified as one or the other.

Even so, sex is usually considered ‘either/or’ – boy or girl, man or woman, male or female. Our gender, by contrast, is a more complex concept that includes social roles, degrees of masculinity and femininity, and how we think about ourselves and are seen by others.

## Hormones at work



The X and Y chromosomes dictate our sex, but it is hormones – sex hormones produced by the gonads – that actually make us male or female.

Thanks to the **SRY** gene – the maleness gene on the Y chromosome – males develop testes.

These produce **testosterone**, as well as **anti-Müllerian hormone**, which suppresses the development of the female reproductive system. In females, the sex hormones **oestrogen and progesterone** drive the formation of female body structures. Females also make testosterone, but it is converted into oestrogen.

The most obvious effects of the sex hormones are on reproductive organs, but in fact they act throughout the body.

The period we spend in the womb, exposed to sex hormones, is therefore critical to our later development. From about 18 months onwards children show sex-specific differences in behaviour. Girls, for example, typically go for more ‘feminine’ toys – dolls rather than trucks – when given a free choice (this has been seen in monkeys, too). Boys tend to go in for more ‘rough-and-tumble’ games.

Is this because sex hormones have programmed their behaviour, or are children conforming to ‘typical’ boys’ and girls’ behaviour or being influenced by parents? It is hard to be certain – evidence exists for all of these effects.

In experimental animals, sex-specific behaviours are dependent on sex hormones. Block the action of the hormone and they do not appear. Sex hormones ‘hard-wire’ brain structures – when levels drop back after birth, the brains retain the male-specific or female-specific wiring and behaviours.

The production of sex hormones undergoes a second major boost at **puberty**.

Puberty has been likened to **human metamorphosis**: it converts us from a juvenile state to an adult, able to survive independently of our parents. It is a period of extraordinary biological change – some 20–30 per cent of the neurons in our brain are rearranged during puberty – and at the end of it formerly similar boys and girls have become physically quite different men and women.

The trigger for puberty remains uncertain. The best bet is that there is a **developmental clock** that senses how long an animal has lived, but **the onset of puberty is influenced by several internal factors** (e.g. body weight) and external influences (e.g. puberty may start earlier in females from disrupted family backgrounds).

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## SEX DETERMINATION IN NATURE

In humans, a chromosomal mechanism determines sex, but there are many other ways to create males and females.



Birds: chromosomal, but many variations.



*Capitella* (a worm that lives in sewer sludge): males turn into hermaphrodites if they don’t find a female.

Slipper limpet: mates in stacks, females at bottom; as stack grows, males in middle turn into females.

*Ophryotrocha puerilis* (a marine worm): when two female worms meet, the smaller turns into a male and they mate; the male grows faster and at a certain point they both swap sex and mate again.



Crocodiles: temperature of egg determines sex.

SPL

# The X and Y of sex

## Human sex is determined by the X and Y chromosomes.

Males and females have 23 pairs of chromosomes. Of these, 22 pairs (the **autosomes**) are the same in both sexes, but the last pair – the **sex chromosomes** – are very different. Females have two X chromosomes, males an X and a Y.

Human X and Y chromosomes evolved from a normal pair of autosomes. At some point in human history, the Y lost the ability to pair up with the X (except at its very ends). As a result, it cannot swap DNA with the X at **meiosis** (cell division to produce sperm and eggs), and it cannot be repaired. The tiny Y chromosome has been whittled away, and now is a fraction of the size of its sister X. It has only about 50 genes on it (the X has about 1000). Some have even

suggested that the Y chromosome will eventually dwindle away to nothing.

For the first few weeks after fertilisation, male and female embryos look identical. In humans, the default sex is female – a trigger is needed to make an embryo become a male. That trigger is the **SRY** gene on the Y chromosome. **SRY** is responsible for switching on a genetic programme that turns the embryo into a male. Most crucially, it triggers the formation of the **testes**, which go on to make the male hormone **testosterone**.

Females have two X chromosomes, but they do not get a 'double dose' of the products of the X genes because one chromosome in each cell is shut down – a process known as **X inactivation**.

The X to be inactivated is chosen by chance in each cell, so different versions of X genes may be active

in different cells. This has a number of consequences – including the characteristic coat patterns of tortoiseshell cats (below).

Recent sequencing and analysis of the human X chromosome has thrown up some surprises. In about 15 per cent of genes, alleles on both Xs are active, and in 10 per cent, gene activity varies between women. This could contribute to variation between individual women or to sex differences.



ABOVE: Tortoiseshell cats are heterozygous for an X-linked coat colour gene, having an orange gene and a black gene; depending on which X chromosome is inactivated in each cell, the orange gene or the black gene may be active. *iStockphoto*

**FAST FACT**

43% of girls and 34% of boys get two or more A levels or equivalent.

## GENDER GAP

Although often used interchangeably, 'sex' and 'gender' have different meanings.

**Sex** is a biological concept based on, for example, the possession of particular types of sex cells and organs. Usually (but not always) two sexes can be identified in animals: males and females. In some **hermaphrodite** species, individuals produce both eggs and sperm.

**Gender** is based on traits or characteristics that may be either **masculine** (strength, courage) or **feminine** (nurturing, caring), and encompasses both what people imagine themselves to be and the social context in which they find themselves.

Gender traits show considerable variation, and each person will be a combination of masculine and feminine traits of varying degrees.

There is a tendency to see masculinity as the definition or 'ideal state' of maleness but that may be unhelpful (see page 10). If males show more masculine characteristics (and females more feminine qualities), this could reflect biological sex differences or the impact of factors such as upbringing or pressures to conform to 'expected' gender roles.

There is usually little conflict between sex and gender, but this is not always so. Some people may passionately believe that the sex they feel they are is different from the body that nature has given them. This can lead people to opt for sex change surgery.

Another complexity arises when the normal sex determination processes are disrupted, creating **intersex** individuals.

**XYY – STEREOTYPE OF THE KARYOTYPE:** It is not only people with intersex conditions who experience gender-related stereotyping by society. Men with an extra Y chromosome – XYY – have been characterised as potentially violent, thanks mainly to a misleading study on a prison population.

Sex is usually 'either/or' – either male or female. But females and males both show a mix of feminine and masculine behaviours.

## Intersex biology

People with intersex conditions are not easy to label as either 'male' or 'female'.

Intersex affects about one in 12 000. It arises when the body's genetic or hormonal sex determination processes are disrupted. The nature of the condition will depend on the part of the process affected.

Genitalia may be a mix of male and female, or individuals may have normal external genitalia but abnormalities internally. See pages 12–13 for more on intersex conditions.



ON THE WEB

[www.wellcome.ac.uk/bigpicture/sex](http://www.wellcome.ac.uk/bigpicture/sex)

# THE EVOLUTION OF SEX

**BELOW:** Sex and the gene pool. Sexual reproduction (left) increases genetic variability (represented by the different patterns). If one form is susceptible to a disease, others will survive. In an asexual population (right), all would be doomed.

## Sex is good

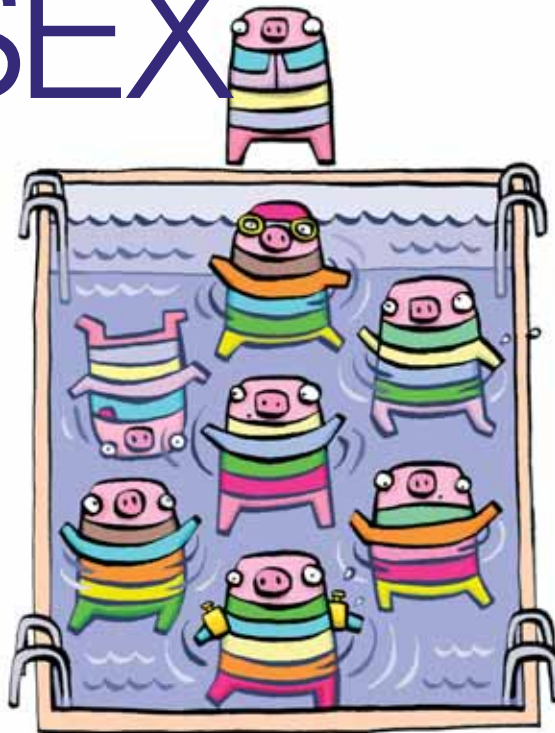
Humans, like all mammals, reproduce **sexually**. Many organisms, though, don't bother. In fact, **asexual reproduction** seems to have many advantages – it's quick and easy (you don't need to find a suitable partner).

Over the long term, however, it is not a successful strategy. If a species is to survive, sexual reproduction is the better option. The reason lies in our genes: sex mixes them up in a way asexual reproduction cannot – but, oddly, we still can't be certain why this is so good for us.

What it does mean, however, is that sex is a big part of many organisms' lives. And it has led to an astonishing diversity of sexual practices in the animal world.

### FAST FACT

Most crime is committed by men: women only account for 18 per cent of offenders.



## Why have sex?

**Sexual reproduction mixes our genes, which over the long term increases our chances of survival.**

Almost all species reproduce sexually, at least occasionally. More than a century ago, August Weismann suggested that this was because sexual reproduction – the marriage of genes from two parents – increases **genetic variation**. By bringing together new combinations of genes, it helps species evolve and adapt to their environment.

But sex has its drawbacks. It takes two organisms to have offspring, while each member of an asexual species can produce young. So an asexual population can grow more rapidly.

On the other hand, every new organism produced by asexual reproduction is genetically identical to the parent – a **clone**. If the environment changes, or a new disease arises, the species is less able to evolve.

The genetic shuffling (**recombination**) that occurs during meiosis and the fusion of male and female gametes allows new, potentially advantageous combinations of genes to come together, and harmful mutations to be eliminated or masked.

Perhaps the strongest theory is that sex helps species to evolve in response to environmental change or pathogens. Host and intruder are locked in a struggle, each trying to stay one step ahead. This idea is often called the **Red Queen hypothesis**, from Lewis Carroll's book *Through the Looking Glass*, where the Red Queen says: "It takes all the running you can do to keep in the same place."

## Sexual attraction

If a species is to survive, males and females must meet and mate. What attracts us to someone – looks, physique... or even smell?

Symmetrical faces appear to be judged more attractive than asymmetrical ones – possibly because **symmetry** indicates good genes. Men also seem to be attracted to **feminine rather than masculine female faces**. Women seem to be influenced by their hormonal cycle, tending to prefer more masculine-looking males when they are ovulating and more feminine-looking males at other times.

Men seem to be influenced by a woman's **waist-to-hip ratio** – a low ratio (curvaceous body) is most attractive. This, too, might have an evolutionary basis. A low waist size may indicate that a female is not pregnant, while the hip size indicates

fertility and energy storage (as fat). For women to be attractive to men, a small waist relative to chest size seems better.

So what about **smell**? Mice seem to prefer to mate with partners that are different in a genetic region known as the **major histocompatibility complex (MHC)**. This highly variable region is important in our response to pathogens (and it also underlies the tissue matching needed in organ transplantation). By sniffing a fellow animal's urine, rodents can actually judge whether a potential mate has a similar MHC or not. By ensuring a mixing of MHC genes, this may give offspring a better chance at fighting infections.

Using experiments with **unwashed T-shirts**, scientists have also shown that women prefer the smell of men with **dissimilar MHC molecules**.

It remains to be seen how these various cues (and, of course, non-physical factors such as a sense of humour) govern attraction. Things such as **the appearance of material wealth** also seem to have a clear impact on mate choice. In the end it's likely that a whole host of factors influences our choice of mate.



LEFT TO RIGHT: Johnny Vegas, Vicky Pollard, Pete Doherty, Nicole Kidman, Brad Pitt. *Rex Features*

### FAST FACT

Even allowing for size differences, women have disproportionately smaller feet than men.

# Sexual selection

In natural selection, the fittest individuals survive and pass on their genes to the next generation.

Animals' features are therefore highly functional, otherwise the animal wouldn't survive. But what possible function could a peacock's tail have? The answer lies in another of Charles Darwin's great ideas – **sexual selection**.

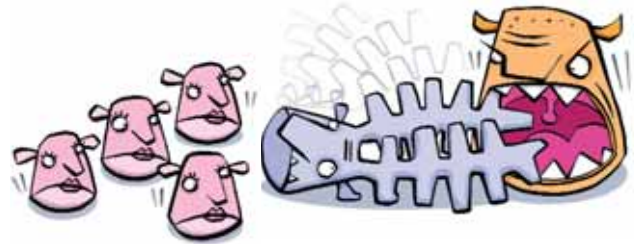
Sexual selection is based on the theory that **competition for a mate** drives the evolution of certain characteristics.

In nature, males typically have to compete to be chosen by females. If females favour some attractive feature of a male, the genes for that feature will thrive, as will genetic changes that enhance it – until the

benefits in the mating game are balanced by the cost of such extravagant and useless features.

But why do females choose decorated males? Possibly, showy features help females to choose a mate with the **best genes**. An extravagant display, in beautiful condition, suggests that the male has managed to acquire plenty of food, and has defended himself well against predators and disease. While he might just have been lucky, more likely he has a fine set of genes.

**BELOW**  
Sexual selection. A fancy decoration may attract the females, but eventually it could become a liability.



## SEXUAL ANTICS

The purpose of mating is to bring egg and sperm together. The way in which this is achieved is astonishingly varied. Try matching animal and strategy in our special quiz:

### Who am I?

I deliver sperm in a huge 1m long football that explodes in the female reproductive tract.

I find the stress of copulation so great that I die straight after.

When I have sex, my mate rips my head off and I go into spasm, which brings our genitalia together and delivers my sperm into the female.

I have a flexible penis that I use to scour out plugs put into the female reproductive tract by other males.

We are hermaphrodites and we take it in turns to be the male and the female.

I'm hermaphrodite but I prefer to mate with others; if I can't find a mate into whom I can fire my 'love darts' to make them more receptive to me, I give up and self-fertilise.



Giant octopus



Garden snail



Black Hamlet fish



Praying mantis



Argiope aemula



Rat

You'll find the answers and more strange sexual practices in Big Picture Online.

## Generation game

Germ cells (eggs and sperm) are special. Uniquely, each has the potential to contribute to an entire new organism.

In 1893, August Weismann (see left) proposed that the cells producing eggs and sperm were different from the cells in the rest of the body. In his view, the body was just a housing for the germ cells. In other words, a hen is only an egg's way of making another egg.

The germ cells are indeed different. Early in development, they are set apart from the cells that will form the rest of the body, move through the embryo to the gonads, and mature into **germline stem cells** that can produce eggs or sperm; during a lifetime, a woman may ovulate several hundred eggs while a man may produce more than a trillion sperm.

Sex cells have only half as many chromosomes as other cells. But that is not their only difference. When eggs and sperm are being made, their DNA is chemically modified at specific locations, a process known as **imprinting** (see page 10).

Researchers are investigating ways to make **artificial germ cells**. Nobody has yet managed to grow spermatozoa outside the body, partly because these cells seem to need the complex environment found in the tissues where they grow.

### SPERM FROM STEM CELLS?

An alternative approach is to use **stem cell technologies**. Stem cells have the potential to develop into many different types of cell. In mice, early versions of egg and sperm cells have been made from embryonic stem cells, but no one has yet made fully functioning egg or sperm cells.

Although this approach is still experimental, and has not been tried in humans, it raises some fascinating medical and ethical issues. For example, it could allow an infertile man or woman to generate 'artificial' sperm or eggs carrying their own genes.

It could also, in theory, allow a man to give rise to an egg (a woman would not be able to make sperm, however, as this requires the **SRY** gene; see page 3). This would, again in theory, allow a homosexual male couple to create a baby in which they had each contributed equally to its genetic make-up. How would we react to that?

**GAY TIMES:** On the face it, preferring same-sex partners is an evolutionary dead end: unless you mate with the opposite sex you will not pass on your genes. Find out what biology, evolutionary theory and studies of sheep have revealed about homosexuality in Big Picture Online.



[www.wellcome.ac.uk/bigpicture/sex](http://www.wellcome.ac.uk/bigpicture/sex)

ON THE WEB

# VIVE LA DIFFERENCE?

## FAST FACT

Life expectancy is higher for women than men, although this difference is expected to narrow slightly over the next 25 years.

Physical differences between the sexes are fairly obvious. But how different are their brains and behaviour? And if there are differences in behaviour, how much are they 'hard-wired' – innate or biologically based – and how much do they reflect the impact of society or environment – upbringing, media influences and so on?

## Sex on the brain

Perhaps the most fascinating differences – certainly the most controversial – are those seen in brain and behaviour. Are men and women hard-wired for masculinity and femininity?

Historically, women have been seen as the 'fairer sex' or the 'weaker sex'. Men have been the head of the family. And courage is often said to depend on the possession of testes.

Now, perhaps, the tables have turned. Modern society depends more on collaboration and cooperation: communication is in. Girls are outperforming boys at school and, to some extent, in the job market.

We seem to be obsessed with gender differences, and particularly their impact on personal relationships. *Men are from Mars, Women are from Venus* by John Gray has sold 30 million copies and has been translated into 40 languages. Deborah Tannen's book *You Just Don't Understand: Women and Men in Conversation* has been on US bestseller lists for four years; it argues that men and women communicate so differently they are, in effect, talking different languages.

### MYTH OR REALITY

What is the reality? To assess sex differences, otherwise matched groups of boys and girls are given experimental tests or questionnaires that explore brain function and attitudes, beliefs or behaviours.

So do such studies reveal huge differences between boys and girls, men and women? In short, no.

Many studies have been carried out, and a mass of data has been gathered, often conflicting. One way to make sense of it is to group together similar studies to see if differences are reliably seen. This approach reveals good evidence for

sex differences in only a few areas (below right)

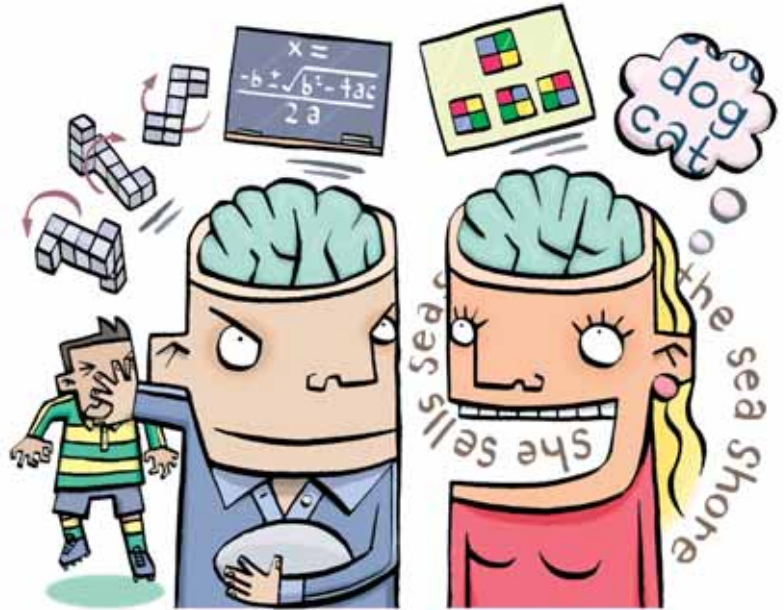
This is a statistical analysis, and small differences are not considered **statistically significant** – they may just have arisen by chance. But not everyone agrees at what point a difference is significant. So there may be other differences between the sexes – but even if there are, they are not having a big impact.

### CONTEXT

Even this small list of areas hides important details. For example, boys are supposed to have superior mathematical ability, but this effect is not seen at all ages or in all situations.

In addition, **context** can markedly affect the results of studies. Females, for example, are supposed to be the **caring sex**. Averaged over all studies, however, men come out as helping more. But men are much more likely to help only when they know someone is watching. And if the situation involves danger, they are even more eager to get involved.

On the other hand, in a test of students playing a computer game, where the number of bombs dropped was a measure of aggression, males were typically more aggressive than females, dropping more bombs. This effect disappeared, however,



Areas where males tend to excel:

- some aspects of **visuospatial ability** (e.g. mentally rotating objects in space)
- **mathematical problem solving** (but not mathematical ability in general)
- **physical aggression**.

Areas where females tend to excel:

- **verbal fluency** (but not verbal or language ability in general)
- **perceptual speed** (the ability to compare letters or patterns quickly and accurately)
- **verbal memory** (recalling spoken terms accurately).

when the researchers removed as many gender cues as possible (e.g. they didn't use forenames). So, despite the widespread popular perceptions, men and women really don't appear to be that fundamentally different.

False assumptions may create or exaggerate differences, which could have a big impact.

For example, it is widely accepted that adolescent girls typically have problems with self-esteem. That seems to be true – but it's also true of boys. The danger is that parents, teachers or other professionals may overlook the boys' problems. Or the belief that girls are always poor at maths could lead to parents or teachers failing girls by not expecting enough of them in the maths classroom.



ON THE

# Evolutionary explanations

Natural selection and Darwinian evolution are believed to be the main forces shaping life. An evolutionary approach can be used to try to understand sex differences, but it has its drawbacks.

Evolution by natural selection is a key principle of biology. It is based on the idea that selective pressures act on naturally occurring variations, so that those most suited to their environment do well at the expense of the less well adapted.

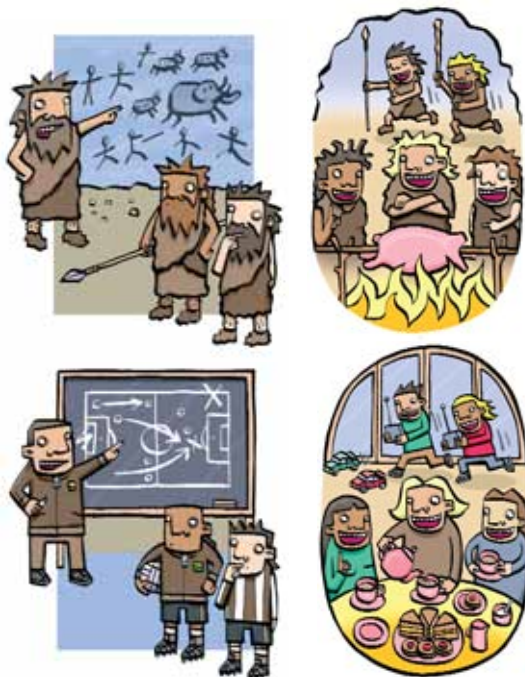
So if there are biological sex differences, they should therefore have their origins in natural selection.

One assumption is that humans are adapted to a **stone-age life**. We have developed culturally and socially so rapidly that natural selection simply has not had time to adapt our bodies (and we have also been able to remove many selective pressures through use of medicine, better hygiene and so on).

Sex differences can be explained by selection for **sex-specific roles** useful in early human history (see illustration). But although the theory can explain the observations, it is very difficult to test experimentally.

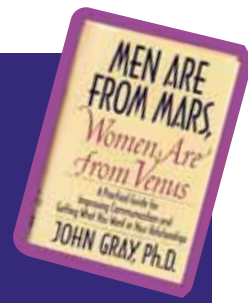
Like sex differences, **gender roles** can be passed on from generation to generation, adapt to changing circumstances, and provide a survival advantage. They may not be genetic, however, but **culturally inherited** – handed down through family or social traditions, storytelling, religion or formal education.

It is tempting to see ourselves as stone-age humans trying to cope with the modern world, mentally specialised to a hunting-and-gathering lifestyle. On the other hand, our brains may be flexible problem-solving devices able to adapt to a wide range of circumstances.



**ABOVE: Did early males and female humans have well-defined roles? Has evolution selected for males with good visuospatial skills – all the better for hunting woolly mammoths? Are women naturally good carers and communicators? Or are gender roles simply a convenient division of labour that is passed on from generation to generation?**

## REPORTING OF SEX DIFFERENCES



Nearly everyone has an opinion on sex differences. And there's money to be made by writing about them.

Take a look at any magazine shelf and it's clear that there are sex differences in magazine publishing. Beautiful women smile out from countless women's magazines, while men's magazines boast... well, beautiful smiling women mainly, with perhaps the odd car, gadget or footballer.

So magazine publishing tends to see men and women as separate audiences, with different desires and needs. This can be seen either as reacting to differing gender roles or reinforcing them. Interestingly, these **magazines** also provide tips on how to understand individuals of the opposite sex.

Some **popular books** have taken this to the extreme, such as John Gray's *Men are from Mars, Women are from Venus*. Other publications exploit perceived differences to promote traditional gender roles. Some **newspapers**, for example, will pounce on any suggestion that women are adapted to be home-makers and loyal supporters of their male partners.

There are at least two obvious problems here. The first is that small sex differences get exaggerated, because of a writer's personal beliefs or in order to sell more newspapers or books. The other danger is that such publications reinforce perceptions of differences. If men and women are really so different in communication styles, say, what chance is there of talking through issues?

## In the genes or in the papers?

Are differences between males and females biologically based or do they reflect cultural influences?

A person's sex is clearly biologically defined. If you have a working **SRY** gene and other male-specific genes, you will be male. You will be born with testes and after puberty you will become a man.

But your gender will not be so straightforward. **Gender qualities** vary across individuals of both sexes, rather than neatly falling into one of two categories. Many factors other than genes will affect these qualities, such as the behaviour of parents and friends, school environment, social attitudes and so on.

This is the long-standing **nature–nurture debate**. Like most other human characteristics, **sex and gender differences** are likely to reflect a complex interplay between genes, hormones and environment.

Ignoring this complexity has obvious dangers. If differences are viewed as innate, they may be seen as unchangeable or forcing people to behave in a particular way – or can promote unhelpful stereotyping. But ignoring biological reality when dealing with social issues could also be unproductive.



**THE BRAIN GAME:** Are men's brains bigger than women's? Are women's better connected? How important are the left and right hemispheres? Find out in Big Picture Online.

**WEB** [www.wellcome.ac.uk/bigpicture/sex](http://www.wellcome.ac.uk/bigpicture/sex)

# MEDICAL DIFFERENCES

**FAST FACT**

Recent research suggests that aspirin protects men against heart attack but not stroke, yet protects women against stroke but not heart attack.

Many diseases affect men and women equally. Some show a bias for obvious biological reasons – women don't get testicular cancer (though men can get breast cancer) – but there are some differences with less obvious causes.

It also seems to be true that men and women sometimes respond differently to certain drugs or suffer different side-effects. This could have important consequences for the development of new drugs, and for their use.

## Sex and death

Is illness sex-blind? Sometimes, but there are clear cases of a sex bias.

On average, women in the UK can expect to live more than four years longer than men (though they will spend more time in later life in ill-health).

Biological differences in the incidence of disease may reflect X-linked conditions (e.g. haemophilia), which will affect men more than women. Differing actions of sex hormones may also have a sex-biased effect – for example women tend to suffer more from weaker bones (osteoporosis) due to low levels of oestrogen after the menopause. Women are also more likely to suffer from autoimmune disorders (e.g. lupus, rheumatoid arthritis). Sex differences can also be seen in brain and behavioural disorders.

## MALES AND AUTISM



Is autism linked to an 'extreme male brain', as proposed by Cambridge scientist Simon Baron-Cohen?

People with autism (and associated disorders such as Asperger's syndrome) usually relate poorly to others and show characteristic abnormal behaviours. For example, they may avoid eye contact, become anxious in social situations, be self-absorbed and perform repetitive tasks. The disorder is markedly more common in males but its causes are unknown.

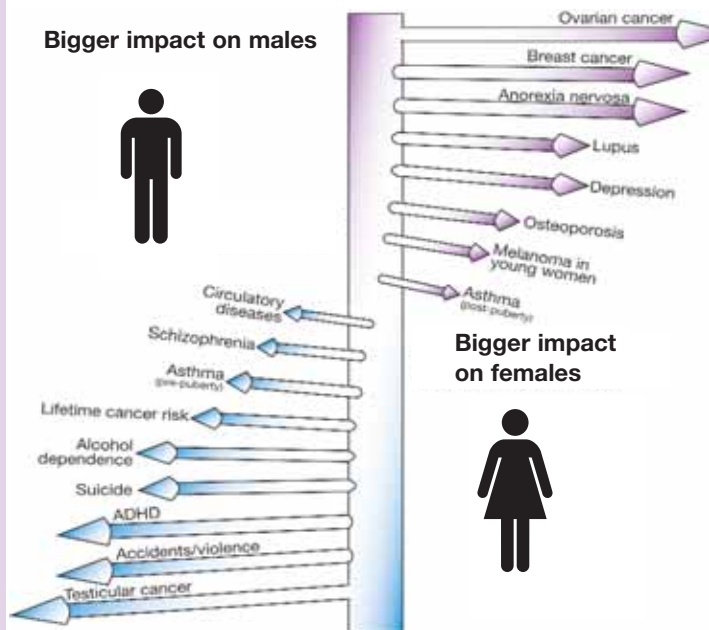
Professor Baron-Cohen's theory is based primarily on the differences seen between boys and girls in two areas: the ability to empathise (identify someone else's thoughts or feelings and respond appropriately) and to systemise

(construct systems, allowing prediction and control of how the system behaves). A 'female brain', he suggests, is better at empathising, while the 'male brain' is superior at systemising.

Individuals with autism score poorly in tests of empathy (e.g. reading emotions from eye expressions; see above), yet show superior systemising (e.g. mathematical calculation skills) – an 'extreme male brain'.

Although this idea has received a lot of media attention, it is controversial. For example, a recent study of children's skills on various tests of empathy shows only small sex differences and only on certain tests. So young boys are slightly less able to identify particular emotions on faces, but the difference is not huge.

## Bigger impact on males



ABOVE: A schematic view of sex differences in disease. The longer the bar, the more common the disease is in one sex compared with the other.

## ONLINE ACTIVITY

### Debating Sex Selection – online resources and classroom debate

This issue's classroom activity is based on the debate format used by the Debating Matters Competition – a national debating competition for sixth form students developed by the Institute of Ideas.

Debating Matters seeks to reward content and ideas over debating style and aims to engage both the debaters and audience within a freeflowing but rigorous format.

In this activity, students have the opportunity to research and debate the issues associated with sex selection and whether parents should be allowed to use reproductive technologies to choose the sex of their children.

The activity is supported by background material, including video footage and written opinion pieces, plus support notes and video clips for teachers.

Full details can be found at [www.wellcome.ac.uk/bigpicture/sex](http://www.wellcome.ac.uk/bigpicture/sex)

For more information on the Debating Matters Competition, see [www.debatingmatters.com](http://www.debatingmatters.com).

Institute of Ideas:  
[www.instituteofideas.com](http://www.instituteofideas.com)

The Debating Matters Competition has been supported by a Wellcome Trust Society Award grant.



# Implications of sex differences

If we want to improve health, should we treat males and females differently?



Drugs or vaccines do not usually come in 'male' and 'female' forms. Some disease processes in common conditions affect men and women differently, though, and tailoring of medicines according to sex may become more common as the mechanisms of disease (and of patients' responses to drugs) are better understood.

One area in which sex differences do influence treatment is **anaesthetics**. The dose of **opioid drugs** used is tailored to a patient's weight and sex.

Incorrect assumptions about sex differences can also have medical consequences. Cardiovascular disease,

for example, is often seen as a male problem, but it is common in women too. Studies have shown that GPs underdiagnose cardiovascular problems in women, who tend to have a different range of symptoms to men.

Some other differences in medical practice arise from women's **reproductive roles**. Certain drugs may affect a developing fetus, so are not given to pregnant women. Women of child-bearing age are not included in clinical trials, so most drugs are not actually tested on women before they are introduced.

This is because of the **Thalidomide** episode in the 1960s. Women were given this new wonder drug

to treat morning sickness. Sadly, Thalidomide turned out to affect limb growth in unborn babies. Since that time, the testing of medicines in the UK has been much more rigorous, but has not involved women.

This issue is now being reconsidered. In the USA, women can be included in clinical trials. The different response of women and men to **anti-HIV medication** – women suffer worse side-effects – highlights the importance of considering sex differences.

## Sex selection

Nature sees to it that the number of boys born is more or less the same as the numbers of girls. Selecting the sex of a baby is allowed for medical reasons, but should everyone be free to choose?

Until recently, parents had to accept what nature provided – though many went to extreme lengths to bias the odds. In 17th-century France, for example, men were advised to remove their right testicle if they wanted a boy.

The 'natural' ratio of boys to girls is just over 1 – slightly more boys are born than girls. In some countries, though, the ratio of males to females is highly distorted, when daughters are seen as less 'desirable'.

This has led to fears that sex selection would be used for **social reasons** where boys are more highly prized. In some parts of the UK, doctors will not tell parents the sex of a fetus after an ultrasound scan in case this leads to termination of the pregnancy for social reasons.

Some commentators have also argued that sex selection goes against the principle that children are a gift to be loved unconditionally, not treated as a belonging. Others have said that parents should not have their freedom to choose taken away without evidence that sex selection is harmful.

Sex selection can now be carried out pre- or post-fertilisation. In **post-fertilisation selection**, doctors work out the sex of embryos created by *in vitro* fertilisation (IVF). At the moment selection is only allowed for **medical reasons** (e.g. a wish to avoid sex-related disorders such as haemophilia). In a recent report, the House of Commons Science and Technology Committee argued that **sex selection for 'family balancing'** should also be allowed (though not all Committee members agreed). So someone with one or more girls could choose to have a boy (or vice versa). This is not yet legal – a consultation is taking place to assess public opinion.

**Pre-implantation techniques** include **sorting sperm** into those carrying an X chromosome and those with a Y chromosome (sperm cells can be labelled with differently coloured probes specific for either the X or Y chromosome; labelled sperm can be separated).

**DOING WITHOUT SEX:** How realistic are artificial wombs? Can life be sustained outside the body? Will we ever take the human out of human reproduction? Find out in Big Picture Online.

[www.wellcome.ac.uk/bigpicture/sex](http://www.wellcome.ac.uk/bigpicture/sex)

## SEXUAL DIMORPHISM

In most species, males and females differ. Although in humans males are, on average, bigger than females, elsewhere in nature the opposite is often true. Male and female forms are shaped by evolution and sexual selection, and depend on animals' reproductive strategies, where they live etc.



Try our special 'sexual dimorphism' quiz:

- The males of what animal have a voice box that occupies more than half its body cavity?
- Fearsome angler fish (above) are all of which sex?
- In which species do males spend their entire lives inside the female's digestive tract?
- Why are female fish in Lake Tanganyika 14 times lighter than males?

Find the answers on Big Picture Online.

## HEALTH BEHAVIOURS

Men and women have different approaches when it comes to health.

It is a cliché that men treat a cold as a life-endangering infection, while women bravely struggle on. Whether or not there is any truth in that stereotype, men's healthcare-seeking behaviour does tend to be different – and usually in harmful ways.

A good example is mental health. **Depression** is more common in young females than males, but the incidence of **suicide** is much higher in men. Men feel less able to talk about their problems and obtain help – a study in Scotland, for example, found that just a third of GP visits for depression were by men.

It is likely that many male health problems are **gender-based** rather than sex-based. Masculinity is associated with independence and self-reliance, rather than asking for help when needed; and taking care of yourself has been seen as a feminine behaviour.



# SEX AND SOCIETY

## Pink and blue

Particular values have traditionally been associated with masculinity and femininity.

Sociologist Janet Saltzman Chafetz describes seven areas of traditional masculinity:

1. **Physical:** virile, athletic, strong, brave.  
Sloppy, worries less about appearance and ageing.
2. **Functional:** breadwinner, provider.
3. **Sexual:** sexually aggressive, experienced.  
Single status acceptable; prefers freedom and feels 'tied down' by spouse.
4. **Emotional:** unemotional, stiff upper lip, doesn't cry.
5. **Intellectual:** logical, intellectual, rational, objective.
6. **Interpersonal:** leader, dominating; disciplinarian.
7. **Other:** aggressive, success-oriented, ambitious; proud; moral, trustworthy; decisive, competitive, adventurous.

Traditional feminine roles include:

1. **Physical:** dainty, graceful.
2. **Functional:** nurturing, care giver.
3. **Sexual:** sexually submissive, inexperienced.
4. **Emotional:** emotionally open, engaging.
5. **Intellectual:** unintellectual, illogical, haphazard.
6. **Interpersonal:** feeling-oriented, empathic.
7. **Other:** mild-mannered, modest.

These characteristics are not the 'ideal' or 'perfect' representations of males and females. Nor are they restricted to one sex or the other. Also, they allow for variability – we may be 'quite emotional' or 'very emotional'. In the UK, gender differences are probably narrowing as it becomes more socially acceptable for women to show masculine qualities and men to be more feminine. But people who adopt 'gender-inappropriate' behaviour patterns may still be ridiculed (or have their sexual orientation questioned).



ABOVE: In the past, gender roles have been very restrictive.

**HIGH FIDELITY:** We expect sexual partners to be loyal. But does this conflict with basic urges to spread our genes? Are male and female animals naturally loyal or born to be promiscuous? The answers are surprising.

Find out on Big Picture Online.

[www.wellcome.ac.uk/bigpicture/sex](http://www.wellcome.ac.uk/bigpicture/sex)

## Male and female genomes

We inherit a complete genome from our mother and another from our father. Surprisingly, a male genome is not the same as a female genome – and it even appears that genomes may be engaged in a genetic 'tug of war' within a developing embryo.



ABOVE: In an embryo, genes in the male genome may act to speed the growth of the embryo, while genes in the female genome may act to block these effects.

It has recently been discovered that chemical modifications to DNA can be stably passed on when a cell divides. This **imprinting** process controls whether a gene is active or not.

An example is the **insulin-like growth factor system**, which has a strong influence on the size of a baby. The logic is that the paternal genome works to maximise the growth of the offspring, to give it the best chance of survival when it is born. The maternal genome, though, protects the mother, so she can go through further pregnancies.

Male and female genomes may be constantly battling with one another, driven by evolutionary pressures to ensure that their genes survive and spread.

### FAST FACT

For people aged 15 to 29, mortality rates for injury and poisoning are four times higher in men than women.

## Gender defenders

Biologically, men and women are (usually) different in obvious ways. In many cultures, including our own, men and women have typically also had distinct social roles – women as mothers and carers, men as breadwinners.

But how far do these roles reflect biological differences and how much are they simply reinforced by the weight of history, the fact that society has traditionally been set up to men's advantage, the influence of media representations and so on?

The power relationship between men and women is changing in the West, with women achieving equality or near-equality in a number of areas. Some argue these have not gone far enough; others have suggested that they are causing social problems and ignore biological realities.



ON THE WEB

## THE X FACTOR

Why are there so few female composers? Or Nobel Prize-winning scientists? Are males simply superior, or is it down to a lack of opportunity?

In almost every sphere of public life, historically it has been men who have excelled. Even now, there are few world-famous female conductors or brain surgeons or architects – certainly fewer than the 50 per cent of the total one might expect, all other things being equal.

Several theories have been put forward to explain this. The simplest is that women are generally inferior to men, so will never match men's achievements. This may be true in many sports, but there is little evidence for male superiority in areas where physical strength is not needed.

An alternative theory is that there is greater **variability** of characteristics in men. So although the average may be the same, there are more men at the extremes. Most high performers (and worst underachievers) will therefore be male. Again, there is not much evidence for this view.

A third theory is that life at the extremes is highly **competitive**, so those exploiting masculine behaviours will succeed. This is likely to favour men over women.

Or perhaps women have simply had **less opportunity**. Some occupations were closed to women (e.g. medicine until the late 19th century), or women had to leave when they married or became pregnant. Sometimes women's contributions were belittled or ignored, or credit was given to a male 'superior' (as happened in Rodin's sculpture studio). It is not that women lacked the ability; they just never had the chance.

TOP FROM LEFT: Albert Einstein, Sir Isaac Newton, Stephen Hawking.  
RIGHT: Marie Curie.



## The good old bad old days

Throughout history, science has explored sex differences – usually attempting to reinforce the assumption of male superiority.

The **ancient Greeks**, from whom we have inherited many of our social systems, developed the idea that man is the perfect human, representing the mind. Woman was imperfect, not fully developed, and represented matter. This was clearly to be seen by the fact that men produce sperm, thought to be the superior liquid, able to convert the female menstrual blood into an embryo.

Once the first microscopes were available in the 17th century, male scientists thought they saw 'little men' in the sperm (the '**homunculi**'). These were simply to be nourished by women during pregnancy.

The 19th century saw yet more scientific 'proof' of men's superiority. Because women had **smaller brains**, it was argued, it did not make sense for girls to get higher education. This idea remained until the 20th century, even though once body size is taken into account, women actually have more grey matter than men.

The **medical profession** also tended to see women as defined by their ovaries and childbearing capacities, prone to hysteria, unreliable, and in need of a man to guide them.

Recent brain-imaging techniques have shown that brain activity is different in men and women performing the same task – but what does this really mean? Is it evidence of fundamentally different male and female brains, or have all the years of social expectations led women and men to think differently?

Science may reveal nature's truths, but history suggests that the interpretation of scientific findings can be influenced by deep-seated social beliefs and attitudes.



## Girls on top

Most human societies are **male-dominated** – patriarchal. However, in some parts of the world it's the women who call the shots. And in the animal world, males or females can be dominant.

Is it part of the 'natural order' for society to favour men? Although most societies are patriarchal, there are some cultures in which women hold power:

The **Nairs** are a large, powerful warrior caste in Kerala, who traditionally had a female-dominated (matriarchal) society and lived in households headed by a woman. Men belonged solely to their mother's family. Property passed from mothers to daughters, with women allowed to have multiple sex partners.

In Malaysia, the women of **Negri Sembilan** had exclusive inheritance rights to ancestral rice fields (a 'matrilineal' culture).

Women's influence was thus as great as the men's.

The **Minangkabau** of Indonesia are still a matrilineal culture. Women inherit property, and both sexes have an equal share of power.

In the animal world, both male-dominated and female-dominated societies are common. In some species, such as **gorillas**, males have harems of females under their control; in others, females keep harems of males. **Spotted hyena** society is vicious – but female-dominated. The animals live in large groups headed by a dominant female.

Even in primate societies, male dominance is not inevitable. **Bonobos** are, with chimpanzees, our closest relatives, but they have a female-oriented society. Males stay attached to their mothers throughout life, and the status of a male in a group will depend on the status of his mother.

What all this suggests is that society is not inevitably run by and for the benefit of men. The fact that many human societies are male-dominated may reflect the advantage that physical strength and aggression provided in the past.

In modern societies, feminine qualities, those traditionally associated with women, now offer many advantages. Cooperation, teamwork, caring and empathy can all contribute to the smooth running of a peaceful society.



ABOVE: Bonobos appear to be as intelligent as chimpanzees but have a far more sensitive temperament. During World War II bombing of Hellabrunn in Germany, for example, the bonobos in a nearby zoo all died of fright from the noise; the chimpanzees were unaffected.

SPL

# REAL VOICES

Where are we now with sex, and where are we going?  
We asked three people with different stories to tell us their views.



**Alan Jenkins is a community midwife working in London.**

**Why did you decide to become a midwife?**

I wanted to do physiotherapy originally, then my wife suggested nursing because I'm a people person and as a gym instructor, I was used to working with the human body.

I decided to become a midwife when I did my maternity placement, during my nursing training. I was fascinated with labour and childbirth, the technical and emotional aspects of delivering a healthy baby to a healthy mother.

**Do you know any other male midwives?**

No. In the UK there are 35 000 female midwives and under 100 male ones.

**Do you think you get more attention from your colleagues because you are a man?**

When I started there were a lot of mixed emotions about male midwives, but if people had any concerns they were never verbalised. I've been doing it for 15 years and I'm accepted by my colleagues as a member of staff.

To be a midwife, as either a man or woman, you need to be a people person and to be able to empathise.

**Are there colleagues who have preconceptions about your ability to do your job well, because you are a man?**

Yes, at the start. People were worried about me caring for women in compromised conditions – whether I should be overseen for vaginal or breast examinations, or helping women to breastfeed.

**Are there members of the public who have preconceptions about your ability to do your job well, because you are a man?**

Yes. Some women say they don't want a male midwife, or their partners aren't happy. They won't question a male doctor, but midwifery is more intimate, you form a close relationship with the patient. I'm godfather to some of the children and friends with a lot of the women.

**Do you get treated differently by your colleagues because you're a man?**

Yes. I'm still a member of the team, largely, but because I'm the only male I'm always recognised. People say "Alan, the male one". So you get pushed to the front and there's more pressure to keep standards up.

**Are there any parts of the job you can't do because you're a man?**

No. If there were I'd give up. It would be pointless.

**Would you recommend it as a career to other men?**

Yes, if they had the same ideals. There are plenty of nurses, doctors, midwives who shouldn't be in those jobs because of their attitude.

**Melissa Cull is the founder of the Adrenal Hyperplasia Network, which aims to provide support, improve research, raise awareness, and educate society and the medical profession about the issues of living with congenital adrenal hyperplasia (CAH).**

**When did you realise you were intersexed?**

I always knew something was wrong because I knew I had to take tablets all the time or I felt very ill.

I first had surgery when I was four years old. After the operation – which was the complete removal of my clitoris to make me look more female – an extremely barbaric form of surgery – I felt terrible pain. Further vaginal repair surgery followed at the ages of 11, 12 and 13.

I spent years searching for answers. My parents didn't know much and the doctors brushed it aside. When I was 18 I contacted a support group and eventually a large brown envelope arrived with lots of information on CAH. I finally understood my condition. I felt a lot of anger, relief, and sadness.

**How have your doctors reacted to your condition?**

I've had to have a lot of medical help because with CAH you need constant monitoring to ensure your hormones are balanced with the right doses of steroids. Otherwise you go into adrenal crisis, which is a bit like diabetic collapse. You have 20 to 60 minutes to get treatment otherwise you can die.

When I was 31, I got referred to a super-specialist clinic – the best in the UK for this condition. When the gynaecologist examined me she almost burst into tears and said "I can't believe anyone has done this to someone".

## INTERSEX CONDITIONS

The most common form is **congenital adrenal hyperplasia (CAH)**, an inherited condition that disrupts sex hormone metabolism. Although girls with CAH are chromosomally female, their genitalia are a mix of male and female. Usually, they are brought up as girls and are comfortable with a female gender identity.

**Other conditions:** Mutations affecting the **SRY** programme (see pages 2 and 3) disrupt male development. In **Swyer syndrome**, for example, an XY fetus is born with female genitalia and a uterus, but malformed internal testes instead of ovaries. People may only realise they have the condition when their periods fail to start.

Sometimes male sex determination begins but an XY person with testes does not produce testosterone or the body does not respond to it (**androgen insensitivity syndrome**).

Doctors almost always carry out surgery, with or without hormone treatment, to make a baby look like a girl (surgery to create male structures was much harder). Is surgery actually necessary? Society is based on a categorisation of people as either male or female, and intersexed people can face stereotyping and prejudice. If space could be found for a 'third way', intersex people could retain their 'midway' status, if they wished to.



Rex Features

## Angela Curnick is a long-serving firefighter for London Fire Brigade.

### Why did you join the Fire Brigade?

I wanted a profession where I could work with members of the public in a caring capacity. And something that was challenging, where every day would be different.

Most women have the skills needed. The main quality of a firefighter is not physical fitness, but to work well in a team, have good interpersonal skills, and stay calm in stressful situations.

### Are there any other women on your team?

Not at Dowgate Fire Station in the City of London, where I work. I'm watch manager, in charge of the station, with five or six firefighters under me – all men. But there are three other women at surrounding stations. The Fire Brigade has a cluster system, so that women get a chance to see other women at incidents.

### Do you think you get more attention (positive or negative) from your colleagues because you are a woman?

I personally don't, I'm a strong character and don't get any negative attention. I get lots of positive attention – encouragement with progress – in equal measure to the men.

### Are there colleagues who have preconceptions about your ability to do your job well because you are a woman?

In all athletic sports, women don't compete directly against men. But to be a female firefighter, women have to take the same entrance tests – physically and academically, including spatial awareness tests – and carry out the same intense training and continuing development as the men. If you pass all that, you get respect.

### Are there members of the public who have preconceptions about your ability to do your job well because you are a woman?

Some members of the public are shocked: they say, "I've never seen a female firefighter before". But at an incident it's not an issue.

### Do you think you are treated differently by your colleagues because you are a woman, and in what ways?

No. We're all individuals with our own qualities and abilities, whether we're male or female. We're part of a team.

### Are there some parts of the job you can't do because you are a woman?

No. There's absolutely nothing a female firefighter can't do that a male firefighter can. We use heavy machinery and carry people out like the men. Of course, everyone uses their individual attributes in a situation: I'm small, so I can get into tiny spaces.

### Would you recommend the career to other women?

Most definitely. It's the best job I ever had, I go to work every day with a smile on my face. That's why I'm doing this interview, because we're trying to recruit women to the Fire Brigade. It's not for everyone, but I hope girls will read this and consider it as a career.

She said there was so much tissue damage there was nothing she could do surgically. For me it was very helpful she showed her emotions, as most doctors come across cold and uncaring and never do this.

### How do you think about yourself?

Although some people mistake intersex for being transsexual, gay or bisexual, most people with CAH don't have gender or sexuality problems. I always felt I was a heterosexual woman. I just felt failed by medicine.

I'm more into masculine hobbies and jobs. I worked in engineering and electronics for 14 years (but then so did half my family, so I don't know how much that is down to CAH) and now work in medical research. I enjoy computers, model-making, DIY and car maintenance, but I'm also into so-called 'female' pursuits like tapestry, photography and cooking. With this condition, you are supposed to have enhanced spatial ability, and be good at maths and sport. I didn't get the maths and sport, but I have the spatial ability.

My friendships have been predominantly male. Men seem to be more on my wavelength, but they see me as a mate, rather than a girlfriend. Women don't understand why I'm interested in so-called male pursuits, and I can't understand 'normal' women much either.

### How do other people react to you?

Mostly people are OK, however I had one boss (a research nurse of all people!) who called me a freak when she found out. She said, "I'm not working with you, you should be exterminated." I had to leave and the stress brought on an adrenal crisis.

I'm doing this interview because I want the condition to be talked about in schools, to help clear up some of the misconceptions and prevent people with the condition from being bullied.

### Do we place too much emphasis on the differences between the sexes?

Sometimes. We need to understand there are differences, but medical conditions like this show society there are other differences and similarities.

People can't accept a continuum from A to B. [But] the macho male can have a feminine side and some women like doing the same hobbies and jobs as men.

### Do you have any insight not shared by men and women?

Men and women with CAH become more sensitive, empathetic and caring. I also think females with this condition have a better insight into how men think about women. But this is a very complex question.

# ARE MEN REDUNDANT?

## FAST FACT

At least 31 drugs are metabolised more rapidly by liver enzymes in women than men.

Things don't look good for British men. The Y chromosome seems to be fading away. There's no heavy industry left for hefty young males to work in.

Meanwhile, women have equal rights, access to education and are prospering in the expanding service industries. With new reproductive technologies, men may one day not even be needed as a source of sperm.

But men don't need to panic just yet. Many aspects of society still favour men, and women have yet to achieve full equality in a number of areas.

## IS IT A WOMAN'S WORLD?

For centuries men have dominated society. The pendulum has swung towards women – but has it gone too far?

In September 2005, BBC newsreader Michael Buerk lamented the growing power of women at the BBC. Meanwhile, former GP Anthony Daniels frothed in the *Daily Telegraph* that the influx of women into the medical profession was damaging its status.

Michael Buerk argued that power had become concentrated in a social group whose behaviour excluded men (the feminine equivalent of business deals being done on the golf course). With women having greater opportunities, are the values and behaviours traditionally associated with women becoming more common in the workplace?

Perhaps. Many people would argue this is a good thing. And women are still rare in senior management positions in the UK. In 2003, there were celebrations that the number of women holding board positions in the country's 100 leading companies had passed 100. Progress, but that's still just 8.6 per cent of the total.

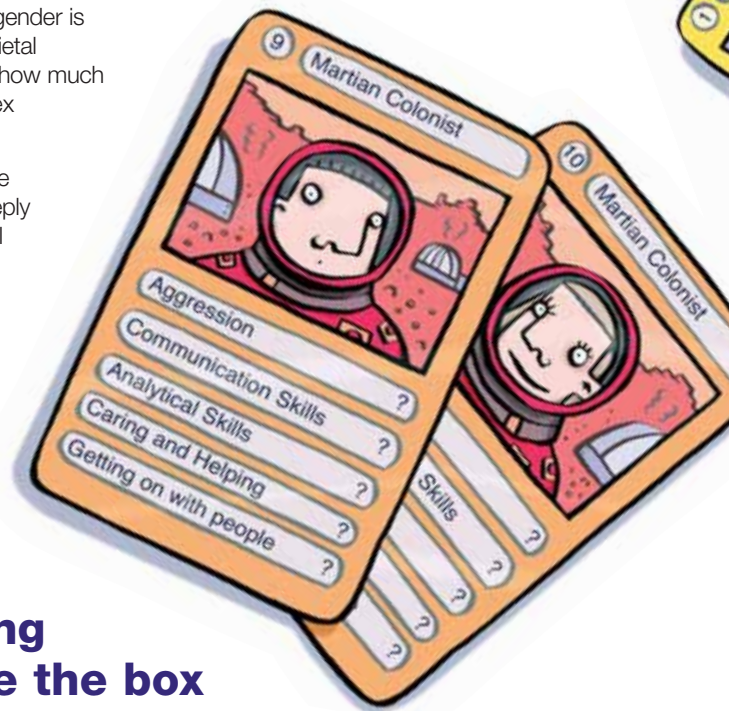
There are other powerful trends affecting men and women in the workplace. The decline in **heavy industry** and growth of the **service sector** provide greater opportunities for women to find work – the qualities favoured are those traditionally associated with women. In the UK there are now almost as many women in work as men.

Even so, women are much more likely to work in (poorly paid) part-time jobs. And a **glass ceiling** seems to prevent women ascending to senior positions in industry. The reasons are likely to be complex, ranging from deliberate or accidental **sex discrimination** through to the influence of domestic **gender roles** – it is much more likely that women will take time out to raise a family, and they still do the bulk of household chores and look after elderly sick relatives.

More subtly, how different are men and women really? How useful is it to see people in terms of their sex rather than in terms of the full range of qualities they possess?

How much of gender is shaped by societal pressures and how much by biological sex differences?

And how do we respond to deeply ingrained social roles and biologically based sex differences of men and women?



## Thinking outside the box

Is sex a useful way to distinguish people?

There are many ways we could group people. We tend to use obvious physical features, such as ethnic origins revealed by facial features – and sex. This causes problems for people who do not fall neatly into the boxes labelled 'male' or 'female' (see interview, pages 12–13).

But is this the best way to group people? The value of **ethnic groupings** is controversial, as so much merging is going on. Medically, there is value in grouping people according to genetic characteristics (for example, those with a similar response to a drug). These may be similar to human population groups but do not match exactly the **social categories** we have created, such as race.

Similarly, arguing for two genders may drive us toward an artificial distinction into two types: male/masculine and female/feminine. But a typical man may show very 'masculine' responses in some areas and 'feminine' traits in others (and vice versa for women).

Overall, there may be some traits stronger in men than women (and vice versa), but that does not mean that all men possess this trait (or that women don't). It can be more useful to think of people as a **gender mosaic**, possessing a mix of characteristics – and that these characteristics are not necessarily set in stone.



**FEMINISED FISH AND SAGGY SPERM:** Are sperm counts in terminal decline? Are all of our male fish being turned into females? There are fears that a cocktail of industrial chemicals, and natural and artificial hormones in the environment, are interfering with human and animal biology. Are these 'endocrine disruptors' feminising the world?

[www.wellcome.ac.uk/bigpicture/sex](http://www.wellcome.ac.uk/bigpicture/sex)

ON THE WEB



Our 'Top Trumps'-style cards illustrate people from familiar periods in history. We've given them some scores for a number of gender qualities. Do you agree with them? What would be the ideal scores for men and women setting up a new society on Mars?

## UPPERS AND DOWNERS

Stereotyping can create self-fulfilling predictions.

In the mental arena, the evidence suggests that there are some small intrinsic brain and behavioural differences. But they become exaggerated in a number of ways.

One factor is **stereotype threat** (and its opposite, **stereotype lift**). This is the finding that reminding people of a supposed association causes them to fulfil expectations.

So, boys are supposedly superior to girls at maths. In one US study, the performance of girls of Asian origin declined when they were reminded of this, but increased when they were reminded of Asian groups' academic success (an example of stereotype lift).

# CARD PLAY

## IS EQUALITY POSSIBLE?

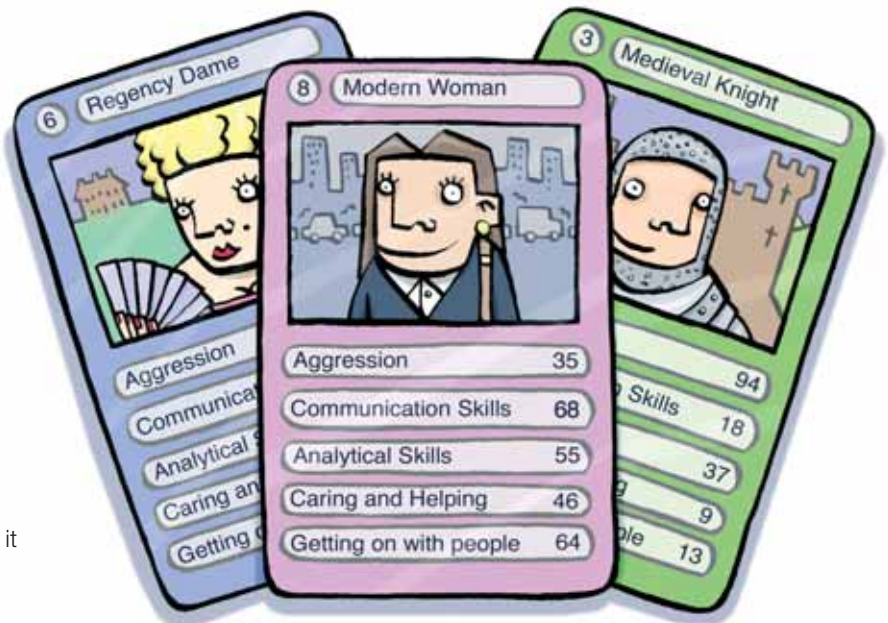
If men and women are different, is equality really possible?

Men tend to be bigger and heavier than women, so it could be argued they are better suited to physically demanding jobs.

Yet most human characteristics – unlike sexual features – are not 'either/or' but vary across a population. Hence there are plenty of women bigger or stronger than plenty of men.

So it is understandable on a biological basis that some jobs have disproportionate numbers of one sex (though complete exclusion of one sex rarely seems justified); for other jobs it is not. This implies cultural and social factors are of much greater significance. And if we want to, we can take steps to tackle these to ensure more equal representations of the sexes – whether that means more women in male-dominated professions or more men in women-dominated vocations.

A major snag is that male-dominated professions tend to be high status (law, business) and women-dominated activities viewed as lower status (nursing, secretarial work). And it seems to be true that when females begin to enter a field, its status drops (as some believe is happening now with medicine), even if its quality does not. Again, the reasons for this are likely to be complex. It may, however, encourage some to resist moves towards greater sex equality.



## Vive la différence?

If there are sex differences, how do we respond to them?

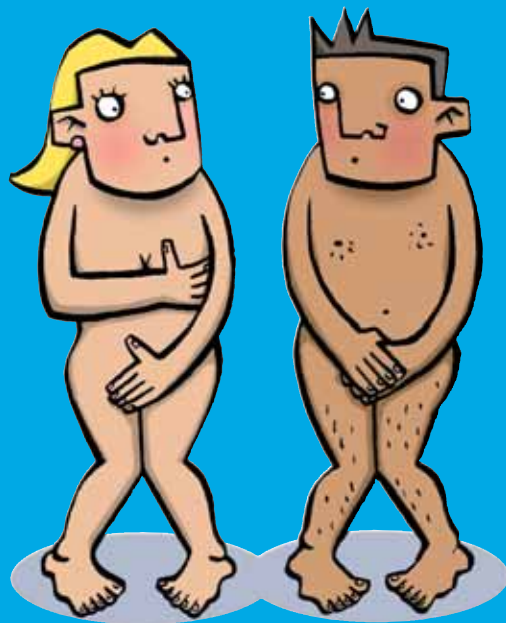
One issue is how strongly determined a difference is. It is highly unlikely that the best female weight-lifter will ever outperform the best male – body physiology simply won't allow it. The origins of behavioural differences, though, are less clear and we cannot be certain how easy they would be to change.

In terms of the choices we have to make, should we acknowledge such differences that exist and make the most of them, or do more to overcome the differences nature has created? Should we be concerned that most road-builders are men? Or most nurses women? Or most top business executives male?

Perhaps the distributions simply reflect genuine sex differences in the abilities and traits most needed in such positions. The biological contributions, though, need to be compared with social influences and attitudes that, for many generations, have been based on the idea of male superiority.

# SEX AND GENDER: THE BIG PICTURE

- Our sex is governed by our X and Y sex chromosomes.
- Their biological effects depend primarily on sex hormones.
- The most important periods of sex hormone action are **in the womb** and at **puberty**; in women, hormonal changes at the **menopause** have a significant impact on health.
- **Gender qualities** – masculine or feminine – are more variable than sex and do not exclusively apply to one or other sex.
- **Biological differences** between males and females exist, for example in gene activity, metabolism, and brain structure and activity, but are not fully understood.
- There are very few clear-cut differences in mental abilities between the sexes.
- It is usually unclear whether sex-specific behaviours or biases reflect innate biological factors or social pressures (or a combination of the two).
- **Mechanisms of disease and responses to drugs** often differ significantly; the full impact of these differences is unclear.
- **Patterns of diseases** can differ significantly between the sexes. These may arise from hormonal or other biological differences or for behavioural reasons.
- UK society has traditionally given **privileges to males**. Many (but not all) of these privileges have been removed.
- Women have yet to achieve **equality** with men in many aspects of life.
- Sex differences may be **narrowing** as society becomes more tolerant of diversity.



This issue in the *Big Picture* series comes in 'male' and 'female' forms. The content, rest assured, is the same in both versions.



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