CHAPTER 2

Biological Explanations for Criminal Behaviour

INTRODUCTION

In this chapter we examine the controversy over attempting to explain criminal behaviour in biological terms. We consider the main types of biological explanation for human behaviour that are used within the subject of criminology and the evidence that underpins them. Typical biological theories are that some people are more likely to commit violent crimes because of the genes that they have inherited; or that there is more chance of acting in an impulsive way that breaks the law if you have attention deficit hyperactivity disorder (ADHD), because it involves a reduction in activity in a part of the brain that helps us both to control our own actions and to see their consequences.

It will be clearer if, before we engage with the criticisms of a biological perspective on criminal behaviour, we set out a very brief outline of why biology must be relevant.

Human beings are surely just one species out of the millions of living creatures on the earth.

Criminal behaviour is still behaviour even if what is regarded as 'criminal' changes over time and place.

All our behaviour, thoughts, feelings, etc. are rooted in our biology.

Given these points, it must be possible to learn about criminal behaviour by taking a biological perspective.

THE DEBATE OVER THE VALUE OF BIOLOGY

When the contents of this textbook were first proposed, several criminologists considered the outline. Some thought that a chapter on biology was valuable, but some said that a chapter about biological explanations of criminal behaviour did not belong in a criminology book. This reflects a lively controversy within criminology (Wright and Miller 1998).

We have sympathy for those who oppose the use of biology within criminology because of two interrelated strands of the history of the social sciences.

Firstly, for the majority of the twentieth century social scientists rejected biological explanations for human behaviours (Tooby and Cosmides 1992), especially social behaviours, of which criminal behaviour is an example (Walsh 2002).

Secondly, biological explanations of human behaviour were used by politicians to legitimize inhumane and invalid policies. This was seen in major countries with diametrically opposed political systems from the first to the last decade of the twentieth century. For example, 'Social Darwinism' refers to a group of theories that claim that Darwinism could be applied to social institutions as well as to organisms. It is best known in the version proposed by the philosopher Herbert Spencer (1820–1903), who wrote on psychology, sociology, evolution and philosophy and influenced Charles Darwin (1809–1882). Darwin published *The Origin of the Species* in 1859, in which he first set out his theory of evolution by natural selection.

Spencer and Darwin were both heavily influenced by Thomas Malthus (1766–1834). In 1798 Malthus published his 'demographic theory' proposing that famine and conflict were inevitable because population grows exponentially (i.e. 2, 4, 8, 16, 32) while resources increase only arithmetically (i.e. 1, 2, 3, 4). He argued that the poor, but not the wealthier members of society, should show moral restraint by having fewer children. His arguments were used to justify laws that made life harder for the most vulnerable.

This type of Social Darwinism was popular from late Victorian times until the Second World War. The results were used to justify the inequalities of wealth found in capitalist society as the natural consequence of the survival of the fittest – a term coined by Spencer – as well as the exclusion of would-be immigrants from Eastern Europe to the USA. They were rejected on the grounds that they were poor because they lacked the biological potential to succeed. Therefore, if they were allowed to enter the USA they would interbreed with, or outbreed, the established American population from largely Western European backgrounds and bring down the country by degrading its biological, genetic, quality.

This position, which now seems clearly to reflect the prejudice of those who supported such policies rather than being an objective consequence of biological theory, was taken by other governments, including the UK, and was a factor in trapping so many Jews in Nazi Europe where they were the target of genocide (Rose 1997).

Another consequence of this crude application of biological principles to political and social issues was the widespread acceptance of eugenics by both left-wing and right-wing political thinkers. Eugenics is selective breeding, whereby people with

'good biological stock' were encouraged to reproduce and those with 'poor biological stock' were discouraged, in the extreme by sterilization and abortion. The Nazis appealed to 'science' to justify their campaign to exterminate the Jews, Slavs, Gypsies, gays and the mentally handicapped – all of whom were said to have inferior biological make-ups. This was used to demand their destruction for the good of humanity. Because the Nazis so enthusiastically embraced eugenics it was publicly rejected by most societies after the Second World War, though even then it was used covertly in several Western countries.

Two American controversies since the 1950s show how biological explanations are still being used to justify discriminatory policy.

Firstly, the claim that black children do badly at school (and, indeed, in life – including their higher rates of criminal conviction) because they are inherently less intelligent than other racial groups for biological reasons (see the discussion of Murray and Herrenstein's book *The Bell Curve* in Chapter 5, p. 170).

Secondly, and directly concerning criminal behaviour, were two American projects to apply biology to criminal behaviour in the inner cities. In 1966 three Harvard professors, Frank Ervin, Vernon Mark and William Sweet, were involved in a federally sponsored, low-profile research programme set up in response to serious inner city riots. They proposed using brain surgery for the ringleaders and other treatments for those who took part. The argument was that the causes could not be poverty, racial discrimination and social breakdown, because then all the people in the area subject to the same factors would have rioted. Fortunately the public became aware of what was going on and the government abruptly changed its policy and removed all funding for research into brain surgery; unfortunately some individuals had already been experimented on and left permanently damaged (Breggin 1995).

Things then went quiet until President George Bush announced the Federal Violence Initiative in 1992 with the goal of identifying biological factors in, and interventions for, criminal behaviour. Once again, as soon as people began to talk about what was going to be done in detail it looked as if it was based on the idea that Black American young males were obviously biologically different. This difference explained their higher levels of violent crime, rather than social, economic and political factors. The respected researcher, Frederick Goodwin, chosen to head the programme, compared unusually aggressive and sexually active monkeys seen in natural populations to inner-city youths (Breggin 1995). After a period of media and political debate Goodwin resigned; later the funding for the overall programme was withdrawn but several of the individual projects are still going on.

The problem here is the implicit assumption that the reason that some groups are poorer, more anti-social and have shorter life-spans etc. is a result of their different biological make-up. The solution is to 'fix' their biology with surgery, electrodes or drugs rather than considering the environmental disadvantages that are much more likely to be relevant.

QUESTION BREAK

- Can you think of any other examples of how biological explanations could be used to justify social policies?
- As some policies based on biology have had terrible consequences, do you think biological explanations should be ignored? Give reasons for your answers.

The historical factors (as shown in these examples) of the political misuse of biological explanations to justify extreme discrimination and of the dominance of non-biological theories within the social sciences make the distrust of biological explanations by criminologists very understandable. However, there is growing support for the recognition of the key role of biology in understanding human behaviour. This chapter argues for the Biosocial Interaction (BSI) model (e.g. Raine 2002b) which recognizes the critical contribution of other factors such as family environment, the peer group and the opportunities to behave in particular ways. BSI is consistent with the vertical integration approach to understanding.

Vertical integration recognizes that we can validly examine something like anti-social or criminal behaviour at many distinct levels of explanation, and that these are arranged in a ladder going from the lowest levels, like physics, through increasingly higher levels such as chemistry to biology to psychology to sociology (Rose 2003a).

Mayr (1982) sets out how explanations of the way that something is caused (for example, rape) need to match both the level of the perspective being used and the question being asked. Explaining rape in terms of physics seems pointless; using a biological perspective may treat rape as being just heterosexual sex against the female's wishes (see the section below on evolution, p. 26); while a sociological approach can include factors such as political change, shifting gender roles and sexual politics. However, a sociological approach is blind to biological factors such as brain systems. One crucial element of this model of understanding is that the rules, relationships and laws at a particular level cannot be predicted simply by knowing all about the lower rungs of the ladder. Even if one could understand all the biology of human development through adolescence it would be difficult to see patterns crucial to the psychology of adolescent development (Steinberg and Morris 2001) such as the experience of first love, or relationships like that between skin colour and chance of being imprisoned. The world as seen from a higher rung is said to 'emerge' from the world as seen from those rungs below it. Consciousness, a key psychological phenomenon, is often held to be an emergent property that is based on biology and yet cannot be explained from a biological perspective.

This example may help: everything that a computer does is based on physics, because a computer is a physical, material thing. If you sit down at your keyboard and compose a love poem it would be possible to give an explanation of this at the level of physics (e.g. how the 'L' of 'Love' was created on the screen by directing electrons using structures and processes within the computer, and even in terms of

quantum mechanical interactions within some of the essential components). This could be accurate and correct; however it can never be complete because the world of physics does not have concepts like 'love' – something essential for a full understanding and totally unpredictable from a knowledge of physics alone.

No level is absolutely best: the levels that you use need to reflect the question you want to answer and provide information suitable for the task at hand.

Today's biological researchers largely accept three propositions.

- The brain is the cause of the mind (whatever goes on in your mind is the result of physical processes in your brain).
- The mind is modular (made of many specialized parts, each largely independent of the rest but taking their input from other modules and sending their output to yet others).
- The brain is also made of largely separate, interacting systems.

This suggests certain research questions: for example, which systems are involved in aggression? Are they different in those convicted of violent crimes? How are they different, and can we change this or compensate for it? Are particular brain systems important in impulsive aggression?

Most current biological researchers also accept that the way to understand subjects as complex as human beings is to reduce the complexity by breaking them down into simpler parts: this is termed reductionism. Reductionism suggests that the way to understand, say, road rage attacks is to look for the parts of the brain involved; the organization and activity of neurons that make up those critical parts; the functioning of the chemical messengers that mediate communication between those neurons; the involvement of genes in that functioning and communication; and the effect of all of these on road rage behaviour.

The reductionist approach has been incredibly successful across science and seems rational, but it has limits. For example, suicide bombings are an extreme behaviour so one might expect to find evidence that suicide bombers are different in some biological way. Or if not, that there are clear differences between their experiences and those of other people.

It is important to realize that biologists have no problem with the idea that our biology may predispose us to behave in particular ways in response to outside forces. In this case things like having seen your family maltreated, or how extreme your religious or political education has been, appear plausible suggestions.

However, researchers have looked hard for signs of differences between suicide bombers and others without much success. This is true at the level of personality (an aspect of ourselves clearly connected to our biology (Davidson 2001)) and of experience. Some researchers think they have found slight differences in both areas but they are not enough to suggest that suicide bombers are basically different from the rest of the world. Instead it seems to be largely social pressures that lead to their actions (Bond 2004).

Stanley Milgram's studies, inspired by the savage behaviours of concentration camp guards and other staff during the Second World War, had a very similar outcome. To the amazement of experts and lay people it turned out that almost all normal

people can be made to give an innocent stranger apparently lethal electric shocks simply by being told to (Milgram 1983; Blass 2000).

From these two examples of the most extreme anti-social behaviour we can see that biological differences are not necessarily present just because the perpetrators do what most people agree is wrong. In this chapter the emphasis on the interaction of biology with other factors at higher levels is an admission that reductionism cannot explain criminal behaviour.

Biological researchers are also predominantly materialists. This means that they see the real world as being made of physical 'stuff' – matter and energy. If you believe this then you are likely to ask questions about material things such as genes, chemicals and brain structures.

Finally, the majority of modern biologists are determinists. This means that they believe that everything that happens is caused by something else. For example, if someone sexually abuses a child we can assume that the behaviour followed some facilitating thoughts and was motivated by some strong feelings. These in turn will have been caused by other factors such as genetic predispositions or low activity in brain systems involved in self-control.

Our approach is to argue for a 'weak' determinism which suggests that criminal behaviour is determined not solely by the person's biology but rather by the interaction of various factors including biological ones. The complexity of the interplay between different elements cannot be resolved. This is why we cannot say that one cause is more important than others for criminal behaviour; instead we must look at what seems to increase a person's chance of displaying criminal behaviour and in which environments this is the case.

As they tend to be reductionists, materialists and determinists, biological researchers give more importance to the simpler, biological processes. This easily slips into treating biological factors as causing the psychological, behavioural and sociological phenomena that are relevant to criminal behaviour. BSI explicitly takes biological and non-biological factors as equally important, this reduces the risk of invalidly assuming that our 'biological essence' is the real cause of criminal behaviour.

Critics attack the very assumptions upon which most biological criminology rests (Poole 1994), but the biological perspective on humans is becoming more dominant. Politically and economically the biological paradigm fits with the spirit of the age (American Psychiatric Association 1997; Herbert 1997), and the simple stories it tells are convincing even when the evidence and argument are not really sound (Rose 1997). Indeed the history of biological approaches to human nature demonstrates how easily popular prejudices can be transformed into apparently 'scientific' truths (Sennett 1977).

However, non-biological researchers are just as likely to make these errors: the last century saw the blaming of mothers for every sort of social problem from 'refrigerator mothers' producing schizophrenia in their children to poor mothering creating criminals (Ladd-Taylor and Umansky 1998). It is important to remember that whichever approach we use carries the risk of ignoring factors from other levels of explanation. The BSI model supported here is an example of a non-additive interaction model because the effect of two different factors cannot be predicted reliably by simply adding the effect that the first would have by itself to the effect

the second factor would have by itself. Think of a recipe: a cake does not taste like raw flour plus raw eggs and the other ingredients.

QUESTION BREAK

When researching rape, what questions do you think that biological criminologists might ask?

- What might they hypothesize leads to rape?
- What questions and hypotheses do you think psychological or sociological criminologists might use instead?
- Do you think that a biological approach to understanding rape is likely to be a good thing? Why?

Before we briefly consider the history of biological theories of criminal behaviour, there is one simple biological factor that is associated with a big increase in risk of criminal behaviour. Stop here and try to think what this might be before reading the next paragraph.

The factor can be seen from several biological perspectives:

- Possession of a Y chromosome
- Having a penis and testes rather than a vagina and ovaries
- Having higher levels of testosterone
- Behaving more aggressively
- Being a male.

Why should this be so unless the biological differences between males and females are also connected to the very different levels of crime they commit?

Unfortunately it is plausible that such differences could arise from social and cultural factors, together with incidental consequences of the differences in strength and in time spent looking after children, for example. In summary, then, we believe that the differences in criminal activity are due both to biological and to other factors.

THE HISTORY OF BIOLOGICAL THEORIES OF CRIMINAL BEHAVIOUR

Now you have thought about some of the wider issues concerning the value of biological explanations of criminal behaviour we will consider the history of this type of theory.

Since the time of the earliest surviving records, ugliness, disability and deformity have been taken as reflections of evil and criminality. Egyptian papyri, the Bible and Homer's *Iliad* all take the link as valid and this belief has survived to the present day. Physiognomy (assessing personality from facial features) traces its roots to ancient

Greece where the concept that mind, morality and body were intimately interrelated was widely accepted, even by Aristotle (perhaps the most scientific of the ancient Greeks). Socrates was condemned to death partly on the evidence of a physiognomist that his face showed him to be a cruel drunk.

In medieval Europe physical imperfections, such as warts, moles and third nipples, were taken as proof of demonic possession (Einstadter and Henry 1995) and in ordinary, secular, law if two people were under equal suspicion then the uglier was to be found guilty (Wilson and Herrnstein 1985).

The pre-existing belief that appearance reflected inner worth was first woven into a more scientific version of physiognomy by Della Porte (1535–1615). Della Porte studied dead bodies and claimed he had found a connection between facial features such as small ears and large lips with criminal behaviour. Later physiognomists such as Beccaria ('On Crimes and Punishments', 1764) and Lavater ('Physiognomical Fragments', 1775) extended Della Porte's theory.

Many of their claims are still heard in everyday conversation, for example 'weak chins' and 'shifty eyes' are still remarked upon as if they were true indicators of moral weaknesses.

The increasing status of scientific methods encouraged the search for physical signs of moral degeneracy. Phrenology was a theory adopted and publicized by Gall (1758–1828). It proposed that the surface of the skull was raised where it lay over parts of the brain that were more active than average. In many ways it prefigured our present view of the brain as made of many largely independent modules each with a specific task. Indeed, Gall correctly predicted the location of a part of the brain concerned with producing spoken language.

Some of the 'bumps' that phrenologists linked with criminal behaviour actually have some empirical support. The 'destructiveness centre' behind and above the left ear really is prominent in about 17 per cent of criminals, and there are others at the back of the skull that seem to reflect abnormalities of two parts of the brain, the hippocampus and amygdala. You will see that these are thought to be important in violent anti-social or criminal behaviour (see the section below on brain structures, p. 44). It may be that things that distort the development of our brains can also disturb the growth of the neighbouring bone, or vice versa. Injuries later in life certainly can damage the skull and the underlying brain tissue.

The methods, and philosophical understanding, to test Gall's theory did not exist in his lifetime and his attempts to get around these problems ended by invalidating the project. Indeed, the popular success of phrenology (it became quite fashionable to 'have one's bumps felt') led to a counter-movement that focused not only on the problems of testing its claims but also on the idea that our brain was built of largely independent systems.

QUESTION BREAK

Phrenology is a well-known enough fashion for it to have appeared in *The Simpsons*. When Homer's mother comes back and Mr Burns spots her likeness

to an ancient 'Wanted' poster the Springfield officers interview him. Officer Friday asks 'Are you sure this is the woman you saw in the post office?' Burns replies 'Absolutely! Who could forget such a monstrous visage? She has the sloping brow and cranial bumpage of the career criminal.' When Smithers objects to Mr Burns's use of phrenology by saying 'Uh, Sir, phrenology was dismissed as quackery 160 years ago', he is met with the unanswerable riposte 'Of course you'd say that: you have the brainpan of a stagecoach tilter' (Appel 1995).

- Have these old ways of thinking about humans disappeared?
- If not, where can you see their influence?

The next major step on the road to current biological theories comes with Lombroso, one of the people who founded modern criminology. As Garland (1997) points out, the founders of criminology as we now understand it were very open to the idea of biological factors leading to criminal behaviour. Lombroso (1876) used Darwin's theory of evolution by natural selection to argue that criminals were biological throwbacks (i.e. their looks, morality and behaviour were atavistic – or like their primitive ancestors). Criminals were physically and morally degenerate.

Biological positivism is the term for theories that claim that criminal behaviour is caused by biological factors: most current criminologists regard it as either false or simplistic. When the claims of physiognomy, phrenology and other similar 'sciences' were disproved by empirical data, biological theorizing in general was brought into disrepute.

However, even if the specific claims were wrong there could still be other biological bases for criminal behaviour. If you are not convinced by Lombroso's claim that prostitutes' feet showed the same prehensile (or gripping) form as our primate relatives (e.g. apes and monkeys), the link between looks and criminal behaviour could still be true. After all, why would an idea have such a long history if it had no basis in reality or was completely invalid? Indeed these ideas are so attractive that they appear in the wider popular culture. For example, in his novel *Crime and Punishment* Dostoyevsky makes a point of the central character's good looks. He does not want readers to assume that his evil acts are a consequence of an innate weakness that would show itself as both a physical and a moral deficiency. Dostoyevsky knew that at that time, 1866, people believed that the two went together in most criminals. Charles Dickens often makes the connection between physical appearance and morality in his novels. Think of *Oliver Twist*, where Oliver, even though he does not know it, is from a 'good family' and thus carries 'good genes' (although that term did not exist then). Oliver turns out to be good because of his biological inheritance while the Artful Dodger, from a classic deprived background, is destined to go to the bad because of his (Dickens 1897).

Lombroso himself studied 383 criminals looking for a set of signs (stigmata) that he argued showed atavism. These included such things as excess digits and an asymmetrical face. He found that about one in five had one sign and over two in five

had at least five. On this evidence he argued that five or more stigmata indicated that someone was born biologically destined to be a criminal.

In a later study he found that about one in three anarchists (people who believed that violence was justified to gain their political aims) showed the stigmata compared to about one in eight members of other extreme political factions. He did compare his criminals to a control group of soldiers and used simple statistics but he did not control for variables such as mental illness and ethnic origin. The criminal groups showed more mental illness and had more Sicilian people: both of these would accentuate any differences between criminals and controls. As the methods were not adequate for the task his data cannot be relied upon and should be treated as of historical interest.

The problems with Lombroso's work illustrate the importance of methodology and statistics. Lombroso and Gall both struggled to get around the relatively primitive methodology of their times.

An English scientist responded to Lombroso's claims with one of the earliest convincing tests of the atavism hypothesis. Goring (1913) compared over three thousand habitual criminals with large, varied control groups over a decade: he used objective measures for 37 possible signs of atavism and found no differences other than that the criminals were, on average, two inches shorter and about five pounds lighter. Goring took this as support for his own theory that criminals had inherited a poorer set of genes but it is also consistent with the hypothesis that if people grow up in impoverished environments then they are likely to be physically less developed and more likely to turn to crime.

Interestingly, 26 years after Goring's book, Hooten (1939) published the results of a study of nearly fourteen thousand prisoners compared to 3,200 controls using 33 measures, many of which could have come from Lombroso, including malformed ears and sloping foreheads. Hooten found the criminals to be 'inferior' on all the body-part measures. Unfortunately Hooten's study had serious flaws, such as unsuitable controls and the same plausibility of environmental explanations for the physical differences as for Goring's results. He also claimed differences between types of criminal although many had been previously convicted for different offences. However as mentioned earlier, one would expect people to engage in behaviours for which they are physically suited, so big people are more likely to be able to use force effectively. In addition Hooten's theory and style of writing embody racist assumptions of the time. Indeed, Hooten's work was dismissed with contempt (e.g. Merton 1938) particularly for the circular reasoning that criminals were biologically inferior and therefore whatever physical differences they showed must indicate biological inferiority that must explain their criminality . . . and so on.

QUESTION BREAK

- Do you think it is reasonable to think that there may be a link between looks and criminality?

- What biological explanation(s) might explain any connection?
- What non-biological explanations can you think of?
- How could you test whether looks themselves caused criminal behaviour?

The idea that looks and crime are somehow connected via biology continued to develop, and after the Second World War Sheldon (1949) published a book that proposed a theory that body type was linked to personality. There have been ideas like this for hundreds of years – think of Shakespeare having Caesar say that he did not want lean men like Cassius around him as they were dangerous: 'Yond Cassius has a lean and hungry look, He thinks too much; such men are dangerous' (*Julius Caesar*, I.ii.194), but Sheldon used scientific methods to support his hypotheses. There were three extremes: the round, chubby endomorph who is tolerant, extrovert and likes food and people; the ectomorph who is slender and artistic, sensitive and introverted; and the mesomorph who is muscular, shaped like a triangle pointing down, and aggressive, competitive, fearless and risk-taking. If you imagine a triangle with each extreme at one point we all fall somewhere within it – few people are 'pure' mesomorphs, endomorphs or ectomorphs – but the more a person approached the mesomorphic point then the more likely Sheldon thought they were to be criminal. He produced data to show that convicted offenders are more mesomorphic on average than the rest of the population.

Other researchers have confirmed this: in one study by Eleanor and Sheldon Glueck 60 per cent of delinquents compared to only 30 per cent of non-delinquents had mesomorphic body characteristics (Glueck and Glueck 1950). But the Gluecks' theory is vulnerable to the criticism that of course muscular people are more likely to commit crimes involving aggression and violence. However, you will see later in this chapter that there is some biological support linking testosterone levels with both mesomorphic bodies and aggressive criminal acts.

Whatever the reason there does seem to be a connection between looks and the risk of conviction: Cavior and Howard (1973) took 159 photographs of male juvenile delinquents and 134 of male high-school seniors. University psychology students rated them for attractiveness: the high-school seniors were significantly more likely to be judged attractive.

Even more convincingly Kurtzberg et al. (1978) took one hundred 'ugly' convicts from one of the USA's toughest prisons, Rikers Island, New York, at their release and gave them plastic surgery. They were compared against a control group of equally ugly convicts who did not receive surgery. After 12 months those who had had plastic surgery were significantly less likely to have been rearrested. Finally, Saladin, Saper and Breen (1988) showed that there is a bias to believe that uglier people are more likely to be criminal by showing two psychology classes a set of photographs. The first class rated them for attractiveness and the other rated them on the chance they would commit murder or robbery: those rated less attractive tended to be judged more likely to commit serious crime. All of these studies of attractiveness should remind you of the claims of the physiognomists and the historical beliefs that physical beauty reflects goodness.

This takes us into the 'modern' period of biological thought on which the rest of this chapter concentrates. As you will see, studies of the possible genetic basis of factors related to criminality had already been going on for decades. An important study by Cloninger et al. in 1982 can now be seen as a milestone in the development of methods which highlighted the interaction between biological and social factors: the biosocial interaction model that is the most promising in this area. Also Wilson's revolutionary book (1975) argued that human social behaviour had biological roots and was evolved.

The rest of the discussion is divided into five sections:

- Evolutionary perspectives, to give you a framework within which to interpret the other viewpoints.
- Genes, as the bridge between evolution and our working bodies and brains – this subsection also covers the transmitters that carry signals within the brain.
- Physical characteristics, as some are related to your risk of criminal behaviour.
- Brain structures, as the organ with which we sense, process and respond to the world.
- Development of the brain, as this process ties together the other biological perspectives.

EVOLUTION

The most useful way to begin looking at particular approaches within biology is to consider criminal behaviour from an evolutionary perspective. As the geneticist Dobzhansky (1973) wrote: 'Nothing in biology makes sense except in the light of evolution.' To give you an idea of how this may help understand criminal behaviour, after introducing the concept of evolution below, we will look at three applications: firstly, one of the most convincing, which explains the age–crime curve for males (Kanazawa 2003); secondly, one of the most interesting but contested claims – that step-parents are much more of a danger to children than biological parents (Daly and Wilson 1988, 2002); thirdly, one highly controversial and not very convincing hypothesis – that rape is a behaviour that has evolved to increase men's chance of leaving the greatest number of offspring (Thornhill and Palmer 2000).

Introducing evolution

Evolution applies to populations of animals (including humans) not to individual animals. You *are* the product of many generations of evolution, but the pattern of change that evolution produces can be seen only by looking at the whole population that you are a member of.

Individuals differ in their genes and so in their characteristics. Different characteristics give you differing chances of surviving and leaving successful offspring. Those offspring will carry their parents' genes into the next generation. The more successful descendants a person leaves, the more successful they are in evolutionary

terms. (See Dawkins (1976) for an explanation of how it is really genes that are 'successful' or not.)

Thus, if you look at the population as a whole over time you will see evolution: an increase in the proportion of the population carrying versions of genes that fit them well to the environment.

The production of different combinations of genes is ruled by chance. The success of the combinations is tested by the particular environment: evolution is shooting at a moving target: the best combinations of genes now, in Latvia, is not likely to be the same as the best in a thousand years' time in Surinam. The environment 'selects' those genes that lead to more offspring. However, evolution does not produce 'progress'; we are no 'better' than our ancestors; what is good now was not, and will not be, good in other environments.

Humans are as highly evolved as every other living organism, no more, no less. Owing to our shared evolution we share genes with other living things: the more closely related we are (i.e. the more recently that we shared a common ancestor with another species) the more of our genes are shared with them. We share about half of our genes with the banana (Begley 2002), even though that is obviously only distantly related to humans, but chimpanzees and humans have over 96 per cent of their genes in common (Holmes 2005).

Recently researchers have found clear evidence that we are still evolving quickly. Two genes that control development of the brain have versions, or alleles, that are being selected by the environment – this means that people who have the preferred versions are leaving more successful offspring. This seems to be an extension of the differences between humans and chimps and has lead to the selected alleles becoming much more common over the last six thousand to thirty thousand years, broadly speaking up to the period that city life first appeared (Inman 2005). Evidence showing substantial human evolution over the last fifteen thousand years across at least seven hundred of our 25,000 genes has been published with the expectation that many more will be recognized (Douglas 2006).

Evolution will tend to make a really useful adaptation spread throughout the population for example the impulsivity, competitiveness and high sex-drive of 15–30-year-old males are typical of males in general (just as antlers are typical of sexually mature male red deer). This is thought to be due in part to sexual selection where members of one sex prefer mates with certain traits, as when female deer prefer bucks with larger antlers. Then, even if those traits have other disadvantages, the genes that underlie them will become more common. This will go on until the disadvantages (of say huge antlers or extreme competitiveness) outweigh the advantages, always in terms of how many successful offspring you leave. As a general rule in humans females prefer high-status males while males prefer young, sexually mature females (Miller 2001).

There is more than one successful strategy possible. For example one view of psychopaths is that they are a relatively small group within the population who carry genes selected by evolution that suit them for a life of preying on the rest of us (Mealey 1995). Humans are highly adapted for co-operation (Ridley 1996) and are a social animal that relies on working with the group. This often means that we assist someone now and trust them to help us if we need it in the future (reciprocal altruism);

however, this creates a niche for cheats who take the help now but never repay it (Katz 2000). Thus psychopaths are seen not to feel guilt or remorse, to be impulsive and egocentric, and not to be deterred by negative consequences. They understand how others' emotions work but do not care if they hurt someone else, this combination helps them to manipulate others (Hare 1996).

While psychopaths make up about 1 per cent of the general population, because of their persistent and varied offending from an early age, about 20 per cent of prisoners are psychopaths. They commit an even larger fraction of the most extreme offences: in 1992 the FBI found that about half the law enforcement officers killed at work were victims of psychopaths (Hare 1996).

Ellis (2005) uses this style of explanation to cover criminal behaviour in general. Testosterone and related male hormones lead to more competitive or victimizing behaviour while higher intelligence results in this behaviour being less violent and less criminal.

Animals have evolved flexibility and will change their behaviour as the social and physical environment changes. Humans do the same. The Hadza society (a hunter-gatherer people from Tanzania) was regarded as the hardest-hearted he had ever come across by an anthropologist who just happened to have studied them during a severe famine. Evolution produces a range of possible strategies: we are evolved to use unconsciously the one that is most appropriate for the circumstances.

The idea that we do not think out what is best to do, but our behaviour is unconscious, wired into our brains, is crucial. For example, women appear to present themselves in a more sexual way when they are at their most fertile point in the menstrual cycle, but women are not consciously aware of when this is (Miller 2001).

Modern humans and evolution

Presumably something that we would recognize as criminal behaviour must have existed as long as humans have lived in cities. At the moment the oldest city that we have good evidence for is Tell Brak, from about six thousand years ago, although it is thought that in Iraq cities may have been established from eight thousand years ago (Lawton 2004). Some of our earliest written records, for example Hindu texts, the Old Testament, ancient Greek philosophy, discuss issues concerning anti-social behaviour and practical moral issues. Over this time the social and physical environment must have changed drastically, many times, yet – as far as we can make out – crime has always been there and at roughly comparable levels.

Evolution can produce rapid change in biologically determined characters: for example the specialized beaks of the finches that Darwin collected in the Galapagos Islands change in response to the sharp changes in the type of food available (Weiner 1995). However, most biologists believe that humans now are biologically very similar to those from ten thousand years ago.

Biology does not only affect physical things such as hair colour, height, risk of heart disease etc.; it also underlies how we behave. There is good evidence that biology underpins our emotions (Damasio 2003) and thoughts (McGinn 2000) – two factors

that motivate and guide our behaviour. Later you will see evidence that the behaviour patterns of attention deficit with hyperactivity disorder (ADHD), a condition that gives an increased risk of criminal convictions and delinquent acts, are due to biological factors. These seem to be often inherited from the person's parents and these behaviours may have been an advantage to their carriers in the past.

When E.O. Wilson published *Sociobiology: A New Synthesis*, in 1975, he argued that, just as in other animals, human social behaviours such as altruism and courtship were based on biology. Although most biologists agreed that there were some human behaviours largely under genetic control there was a powerful negative response to extending this to what were felt to be behaviours shaped by our education, society and moral beliefs, and for which we held people responsible. Wilson's view was attacked from one side for being a right-wing attack on the liberal-left consensus, and from the other as excusing bad behaviour and undermining responsibility (Segerstråle 2000).

Since 1975 Wilson's ideas have been implemented and extended by many researchers. Most evolutionary biologists believe that the genes we carry now evolved to suit our modern human ancestors' way of life. This is typically argued to be on the African grasslands about sixty thousand years ago (Barrett et al. 2006).

For our purposes evolutionary researchers who work in the areas of evolutionary psychology, sociobiology and human behavioural ecology are the most important. They argue that criminal and delinquent behaviour has been shaped by evolution because it has an impact on reproductive success. These approaches will be referred to collectively as human evolutionary psychology (HEP), as Daly and Wilson (1999) suggest.

Three examples of evolutionary explanations of criminal behaviour

The male age–crime curve

The male age–crime curve (MACC) shows how the number of male offenders per thousand males changes as their age increases. There are very few offenders up until about 11 years of age. The curve increases steeply until the proportion who are convicted offenders reaches a peak at about 18 years. From there it drops – steeply at first, but reducing more gently after about 25 years of age. The MACC has been called 'the best accepted fact in criminology' (Gottfredson and Hirschi 1990), although there is disagreement over how universal it actually is, and there have been many attempts to explain it in sociological terms. However the evolutionary explanation is both interesting and useful.

Kanazawa (2003a; 2003b) presents a readable account of his hypothesis that the bulk of offenders are just young men displaying behaviour that evolved to increase their chances of finding a mate and having children. Remember that producing successful children is what drives evolution: we might suspect that the MACC relates to this. We might also guess that the ways in which young males differ from young females are more likely to be linked to reproduction (think of the different mature sexual organs such as the vagina versus the penis, ovaries versus testes, breasts versus

chests). We know that young men are more aggressive, impulsive, novelty-seeking and sexually driven than young women and also less empathic. We also know that there are biological changes through puberty and beyond that underlie these differences. One example is the male surge in testosterone levels that begins at about 11 years of age and does not decline until about 30 years of age. Women find men who show the physical changes associated with higher levels of testosterone more sexually attractive (Miller 2001).

QUESTION BREAK

- What is happening to males from about 11 years until about 18 years old?
- What might tend to be happening in men's lives between about 18 and 27 years of age?
- Why do you think young men show off so much to their peers?

Puberty in males begins at about 11 to 13 years of age and usually continues into the late teens. The biological purpose of puberty is to create a sexually mature person who can find a good mate and have children; males are interested in sex and capable of fertilizing a woman from early puberty.

Kanazawa argues that the initial rise in the MACC is set off by puberty; he thinks that the increase in criminal behaviour reflects young males' increased drive to behave aggressively and/or impulsively. Therefore he proposes that these changes are concerned with finding a good mate. Recently it has been claimed that although young women do not prefer risk-taking men, men get higher status among their male peers by taking risks and women prefer men with higher status. Similarly you could argue that aggression and competition between young males are to do with establishing their status in their peer group.

If this is so then one might expect criminal behaviour to be only one type of behaviour that young men will adopt to compete with their fellow males. Kanazawa says that this is exactly what you find with sport, art, music and scientific achievement, and he shows that the curves for each of these for different ages have very similar shapes and characteristics to the MACC.

QUESTION BREAK

- Why do you think that evolutionary psychologists expect young women to have evolved different behaviour patterns than young men?
- What differences do you think there are in what a woman compared to a man looks for in a sexual partner?

The differences between male and female behaviour we see are expected by human evolutionary psychologists. We will use Miller's (2001) account as the basis for our discussion.

Sex has different cost and benefits for males and females. When men have sex they produce millions of sperm each time: sperm are tiny and cheap to produce. Women, once a month, release one (sometimes two) of the eggs that they have stored in their ovaries from birth. Eggs are much more substantial than sperm and women have only a limited number.

If one of the man's sperm fertilizes a woman's egg then he can leave her to bring up his child while he fertilizes more women, leading to lots of potential offspring for him – think of the harem system where powerful men had sexual access to many women who bore them many children. If a woman is pregnant then she is stuck with nine months of pregnancy, using large quantities of energy and exposing her to health risks and making her less able to look after and defend herself. Human birth is a dangerous event: in rich countries we forget that women used to face, and still do in poorer states, a serious chance of dying around the time of giving birth.

Because of this difference women are less keen on promiscuity than men (although contraception has changed behaviour, remember that these tendencies evolved over long periods and act below the level of consciousness) and more selective in whom they choose to have sex with. In particular women want someone who is healthy and carries successful genes *and* who has significant resources and is reliable. Most males do not combine both types of qualities.

HEP can explain the differences in criminal behaviour between males and females naturally. In many species males compete amongst themselves, with the winners having the best chance of being chosen as a mate by the females. Attributes increasing a male's chance of impressing potential mates are then selected by evolution.

The HEP hypothesis that criminal behaviour is often just a way of impressing possible mates by out-competing your peers suggests that schemes that offer alternative ways for young males to compete in public should reduce both crime and anti-social acts. For example, there are projects for young men convicted of joyriding that teach them to repair old cars and then to race them. It also implies that there needs to be an element of genuine danger and that competition itself is necessary for adolescents. Another lesson is that we should expect youths from more disadvantaged homes to be more likely to show anti-social or criminal behaviour because they tend to have poorer educations and fewer opportunities to engage in other competition that satisfies their evolved drives. We should not think that males from less supportive environments are more 'naturally criminal' even if they are more likely to display behaviour for which they could be convicted.

QUESTION BREAK

- Has this view helped you to understand young male anti-social or criminal behaviour?
- Can you see any practical lessons or implications for policy from it?

'The Cinderella hypothesis'

The hypothesis being proposed here is that step-parents are much more dangerous to children than biological parents, and that this is because the step-parents do not share genes with the children. Therefore they have less interest in the children's survival and may even benefit from their death. (This section is based on Daly and Wilson 1998 and 2002.)

This is what we see in numerous animal species, the best known example being the African lion. Lions live in groups of closely related females called prides. Each pride has one or two sexually mature males who are closely related, often brothers, and who fight off others to keep their right to have sole access to mate with the females. Eventually another pair of males will come along and defeat them. When the new lions take over one of their first acts is to search out any young cubs and kill them. There are two reproductive benefits: they do not want to waste any of the resources they could use to bring up cubs of their own on unrelated cubs that will compete with their children; and the lionesses will not come back to peak fertility until they stop breast-feeding.

QUESTION BREAK

- Suggest some reasons why step-parents might look after their stepchildren less carefully than their biological offspring.
- What evidence can you think of that suggests that step-parents might be unhappy to support their stepchildren?
- What sorts of conflict might exist?

In human culture we have worldwide stereotypes of stepmothers (e.g. in 'Cinderella', 'Snow White' or 'Hansel and Gretel') and stepfathers (e.g. King Claudius in *Hamlet*) as being cruel to the children from previous relationships. Although there are many more wicked stepmothers in fiction, in real life it is often stepfathers who are more dangerous. Sociologists looking at how stepfathers actually behave find high levels of conflict in Western stepfamilies. Anthropologists have described the accepted practice in the Pacific island of Tikopia by which new stepfathers publicly state that they are not willing to bring up unrelated children and insist that they are either fostered or killed.

Daly and Wilson analysed evidence on crimes against children within the family. For abuse the USA data showed that in 1976 under-three-year-olds were almost seven times as likely to be recorded as abused if they lived with a stepfather rather than two biological parents. To check that this was not due to cultural bias against stepfathers they looked at more serious cases, ending up with 279 fatalities from nearly 88,000 cases. These records are likely to be accurate because of the seriousness of the crime. When they did this they found that stepchildren were at one hundred times more risk than children living with both biological parents.

There have been criticisms of this work, but most of them do not convincingly undermine the hypothesis.

A sociological perspective would suggest that stepfamilies are under greater stress than first families: there are the effects of whatever led to the break-up of the previous relationship, tensions between step-parent and children due to loyalty to the missing parent, psychological issues such as anger and jealousy, the strain of managing on less income (thinking of the average stepfamily) with the consequential impact on education, housing, diet or recreational opportunity. And all these factors can increase the risk of criminal behaviour via mediating variables like substance misuse, bad peer group, while reducing the protective elements of a happy family life.

The factors in the previous paragraph are clearly relevant and there is great variety of quality within both different stepfamilies and different biological families. After all humans adopt unrelated children (although there is a preference for relatives in adoptions) and invest heavily in them. This may reflect the fact that many adopting parents cannot have children of their own.

A natural history of rape?

The final hypothesis examined is based on a book by Thornhill and Palmer (2000) with the same title as this section. The point they are trying to establish is that human rape is sexually, or reproductively, driven rather than being an act of violence reflecting unbalanced power relations between men and women as Brownmiller (1975) proposed. Brownmiller's position has been dominant for the last 30 years and she does not accept a sexual, reproductive explanation for rape.

Thornhill and Palmer use evidence from animals, including the scorpion fly – an insect whose mating behaviour Thornhill has studied. The normal way for a male scorpion fly to get sexual access to a female is for him to bring her a piece of food. Similarly human females prefer mates with resources. Some males cannot manage this but they have an alternate strategy – the males have a notch in their wing with which they can hold an unwilling female in the correct position for sex. They propose that this is a model of human rape.

To make this argument work, Thornhill and Palmer have to define rape very tightly: it must involve vaginal sex as this is the only way that rape could produce a child. This seems to miss out a sizeable proportion of human rape, for example rape with objects, anal rape, rape followed by murder – especially in conflicts where rape is widely practised, sometimes as a deliberate weapon of terror – or rape of women past reproductive age or of pre-pubertal girls. This is necessary because they want to argue that men show adaptations that help them rape women which are encoded in the genes and so can be selected by the environment, but this can happen only if they leave more children because they rape women. They do not suggest that men have physical adaptations like the scorpion fly but Thornhill thinks that men show psychological adaptations inclining them to rape.

It is certainly true that rape is common, especially when you include date rape and coercion that falls short of legal rape. Rape is found in all cultures and has been so throughout recorded history. It also seems that males try to push for sex more often

than women do. Together this is consistent with some biological factor being important. Palmer's position is more plausible: he argues that rape is a side-effect of male traits that do tend to result in more offspring, such as aggression and high sex-drive.

Virtually every aspect of their project has been attacked, from their definition of rape to their interpretation of the statistics, to their suggested advice based on their work, for example that young women should not wear provocative clothing. While their hypothesis may be flawed, the idea that there is a biological side to rape is reasonable, even though it does not yet seem to have produced any useful interpretations. We would not argue that human rape is the same as forced sex in other species because rape has other dimensions and meanings that do not exist in other animals. Human culture and intelligence are likely to be relevant to this, but evolutionary factors such as men's vulnerability to bringing up another man's child and the importance to a woman of choosing her own mate may help us understand the horror that rape arouses.

Summarizing evolution

We have considered the evolutionary perspective at some length to encourage you to see this as the view that unifies and makes sense of the other biological approaches. It has the advantage that it reunites us with the rest of the living world and evolution is being applied to many new areas with impressive results. You will see that the later biological approaches to understanding crime make more sense if you have an evolutionary framework in which to interpret them. The sociological and psychological theories looked at in the next two chapters can also be integrated with this perspective. The evolutionary perspective sees the way that we behave as depending partly on our genes but also on the environment: this is an example of biosocial interaction.

GENES

We have seen how evolution can provide a framework for understanding human behaviour: now we will take a brief look at how genes provide the link between evolution and the biological factors that more directly underlie criminal behaviour. The evidence supports the biosocial interaction model.

The debate over the importance of genes in behaviour has always been intense, from the eugenics movement at the start of the twentieth century right through to the present (e.g. Lewontin, Rose and Kamin 1984). Critics, some from within biology, have attacked the implication that genes largely determine our behaviour as well as the interpretation of the data from some of the methods that form the cornerstone of the genetic approach. For most of the twentieth century the 'nature versus nurture' debate, in which one side argued that biology, especially genes, determined our behaviour and the other that the environment determined how we behaved, was how disagreements were presented. More recently it has become clear

that the evidence makes sense only if the biosocial interaction model is used (e.g. Raine 2002b).

No serious biologists think that there is 'a criminal gene': they are looking for genes that make criminal behaviour more probable. If genes can influence our impulsivity, and we know impulsivity makes you more likely to become an offender, then those genes increase the probability that you will perform criminal acts.

We now have compelling evidence that genes are important in establishing the likelihood that we will display particular anti-social and criminal behaviour. For example Brunner et al. (1991) showed that one defective version of a gene that makes an enzyme crucial in how some of our neurons work leads to a massively increased risk of very violent behaviour.

The combination of sustained criticism and improved understanding has resulted in the recognition that the impact of genes depends on the social and physical environment that the person lives in. Investigating the contribution genes make to a behaviour also reveals the importance of the environment. Parens (2004) gives a clear account of our present understanding of the role of each and of the difficulties in interpreting the results from such studies.

As with evolution there are several distinct approaches within genetic research. We will consider two: behavioural genetics and molecular biology.

Behavioural genetics

Behavioural genetics tries to identify how important genes are in particular behaviours using methods that rely on comparing how similar different relatives are on that behaviour. Different relatives share different, predictable proportions of their genes. Humans share about 99 per cent of their genes because most are for crucial biological systems such as your heart, liver etc. Humans all need genes to do the same tasks, so we may all seem to have the same set of genes. However, remember that there will be a variety of versions of the same gene so we will end up with different genotypes. Almost all the genes we have do not appear to be relevant to how likely we are to be anti-social or criminal; that leaves a much smaller number where variations in the versions, or alleles that we inherit may alter our predisposition to criminality. If you share half of your alleles in general with a relative then you will also be likely to share half of those alleles relevant to criminal behaviour.

Identical twins share all their genes; non-identical twins and other brothers and sisters share half their genes; parents share half their genes with each child; an aunt or uncle shares 25 per cent of their nieces' or nephews' genes, and so on. This means that by studying families we can compare how similar they are on, say, having a criminal record and see whether those who share more genes are also more alike on criminality.

QUESTION BREAK

- If a study finds that children with criminal parents are more likely to be criminals than those parents' nephews, does this show that being a criminal has genetic roots?
- Why do you think researchers often use twins to study the role of genes in criminal behaviour?
- Studies of twins separated at birth are regarded as especially powerful. Why do you think this is?
- Studies comparing adopted children's behaviour with their biological versus adoptive parents' behaviour are also useful. Why?

Twin studies have shown that genes are relevant to anti-social and criminal behaviour. If we ignore those with small sample sizes (as a rule the larger the sample the more valid the results) there are two early projects that stand out: Dalgaard and Kringlen (1976) and Christiansen (1977). They both compared identical twins with non-identical twins on how alike each type of twin was on adult criminal behaviour (not adolescence-limited anti-social and criminal behaviour). This similarity is called concordance, and can range from 0 per cent (meaning no similarity) up to 100 per cent (meaning if one twin was a criminal the other always was too).

If we combine their results, the concordance for identical twins was 31 per cent and for non-identical 12.9 per cent. As both types of twins share much of their environment this is interpreted as showing that genes are important because sharing all your genes makes you much more alike in adult criminal behaviour than if you share half your genes.

Cloninger and Gottesman (1987) added more subjects to Christiansen's set and reanalysed the data. Now the concordance for identical twins was 74 per cent against 47 per cent for non-identical. This was then used to calculate the importance of genes in adult crime, also called its heritability. They found that 54 per cent of the differences between adults in criminal behaviour were due to genetic differences.

Genes were more important in males than females. Perhaps this is because some of the genes are on the Y sex chromosome that only the male inherits. Or maybe there is less reproductive advantage to females in carrying these genes and therefore female adult criminals are more likely to behave like that either because of biological damage or because of their past or present environment.

More recently Taylor, Iacono and McGue (2000) tested about 140 male twins and found evidence that genes are involved in early-onset delinquency. This is known to be a good predictor of a persistent criminal lifestyle lasting through adulthood.

At this point you need to be aware of some of the criticisms of twin studies. For example, identical twins may be treated more similarly than non-identical twins because of their appearance (identical twins are often dressed identically by their parents): this would make them more alike for non-genetic reasons (see Allen 1976). Also, there is evidence that we seek out environments that suit our genes (Rowe 1990) so identical twins tend to choose similar friends and activities – including anti-social

and criminal ones. This is an example of the complexity of environment–gene interactions: similar genes lead people to choose similar environments that amplify the effect of those genes.

Adoption studies are another way of looking for genetic effects. These look at people adopted at an early age and see whether, in later life, they are more like their biological parents (which would suggest that genes are important) or their adoptive parents (which would suggest that the environment dominates).

Mednick, Gabrielli and Hutchings (1984) looked at all adoptions in Denmark from 1924 to 1947, an unbiased set of over fourteen thousand cases. They found strong evidence of genetic influence, with about half of the sons convicted of crimes having criminal biological parents compared to about a third of the sons without criminal convictions. Genes were more important in persistent offending, as in the twin studies.

These results are consistent with other studies, including Bohman et al. (1982) who looked at over 1,750 Swedish cases. This study also found that genes were more important in the daughters. Presumably this difference from the Cloninger and Gottesman (1987) results is because the majority of female offending is also adolescence-limited and Bohman et al. looked at all crime, not just adult crime. Also females differ much more in their tendency toward criminal behaviour in their adolescence than males, and therefore we expect there to be genetic differences underlying the behavioural ones.

As with twin studies there are criticisms of adoption studies. Some studies have included children adopted by relatives, or adopted by an aunt living in the same street as the biological parents with whom they spent a lot of time (Lewontin et al. 1984). Also adoption agencies tend to place children with families similar to their biological one, which will make it more difficult to separate out environmental from biological effects (Jones 2006).

The different methods do seem to find compatible results even though there are differences in the precise figures they produce. Rhee and Waldman (2002) combined the data from 51 twin and adoption studies in a meta-analysis: their conclusion was that genes and environment are both important factors in explaining anti-social behaviour for both males and females. Similarly, Raine (1993) combined results from twin studies and, separately, from adoption studies and made a convincing case for the importance of genes in criminal behaviour across cultures. There is also evidence that this genetic influence is relevant to non-violent property crime but not to violent crime. In the sections on the brain and development we will see how biologists explain violent criminal behaviour.

There are many studies showing evidence that factors we know to be strong predictors of persistent criminal behaviour, such as early bullying, certain personality traits and conduct disorder have genetic components. For example Slutske et al. (1997) used over 2,500 twins to show that genes are a strong risk factor for conduct disorder, while Eley et al. (1999) tested over 1,500 twins and found a genetic factor underlying early onset aggressive bullying. Krueger et al. (1994) directly measured the link between the personality traits of rejection of conventional values, sensation seeking and recklessness and anti-social behaviour in over eight hundred participants and found evidence of a significant genetic influence.

In summary, the genes you inherit do put you at more or less risk of anti-social and criminal behaviour but their impact depends on the environment you grow up in. One final study illustrates the dominance of this non-additive interaction. Cloninger et al. (1982) carried out an adoption study and found that the risk of becoming a criminal if the adoptee had criminal biological parents was 12 per cent, if they had criminal adoptive parents their risk was 7 per cent, but if they had both then the risk shot up to 40 per cent. This shows that we must consider both biology and other factors together if we want to understand crime.

Molecular genetics

Molecular genetics involves the use of sophisticated laboratory-based methods to identify precisely which genes, and which alleles, are linked to particular traits and behaviours. This connects the findings of behavioural genetics to the functioning of brain systems and structures. We will give a flavour of this work because it will suggest how the transmitters and related structures and processes that carry signals within the brain relate to anti-social and criminal behaviour.

Most of this work has focused on the molecules involved in communications between the brain cells (or neurons). To be even more precise, the clearest evidence implicates elements of the communication systems concerned with the neurotransmitters serotonin and dopamine.

Genes connecting criminal behaviour to serotonin systems

Low serotonin activity has repeatedly been associated with criminality, for example conduct disorder (Coccaro et al. 1997), anti-social personality disorder (Dolan et al. 2002) and young adult offending (Moffitt et al. 1998). Therefore it is not surprising to find that genes involved in different aspects of serotonin function have been linked with various types of anti-social and criminal behaviour.

Brunner et al. (1991) reported a Dutch family with at least six generations of males showing extreme violence and learning disability. One was convicted of raping his sister at 23 years old. In the institution he was sent to he repeatedly got into fights with the other criminally insane inmates; at 35 he drove a pitchfork into the chest of a prison officer. Another relative made his sisters strip at knifepoint, another drove at his sheltered workshop manager when he was criticized. No females showed these behaviours, which made Brunner's team suspect the genetic flaw was on the female sex chromosome (the X). This is because the X is larger than the male Y chromosome and holds more genes. If one of the 'extra' genes is faulty males do not have a matching gene to cover the flaw: this is why genetic developmental disorders are so much more common in males.

The 'Brunner version' cannot be common in violent criminals because it produces learning disabilities and extreme behaviour that are rarely seen in offenders. Offenders like the Dutch family members above are held in special hospitals as they are both very dangerous and felt to be not legally responsible for their violence.

Considering the process by which signals are received by serotonin-using neurons, Quist et al. (2000) found that one version of a gene (the HTR2A gene) that builds one of the serotonin receptors makes a child significantly more likely to have ADHD. ADHD is a substantial risk factor for later criminal behaviour.

QUESTION BREAK

- From what you have read, if serotonin activity and the genes that influence it are likely to be relevant to a person's chance of committing criminal offences, what offences are they more likely to carry out?
- What sort of biological interventions to deal with such behaviour do you guess people might suggest?

There are always problems in carrying out and interpreting these types of studies – for example serotonin activity is almost always measured indirectly because of problems in accessing the brain safely and comfortably. The overall picture suggests that genes that influence serotonin function will affect their holder's tendency to be involved in impulsive and aggressive behaviour.

Because of these links, researchers have tried using drugs that increase serotonin activity in offenders. The SSRIs (Selective Serotonin Reuptake Inhibitors) increase the activity of serotonin-using neurons by preventing neurons re-absorbing serotonin so that it is able to continue stimulating receptors. Prozac and Seroxat are two common brand names in Britain. A small number of male sex offenders who, despite hating their behaviour so much that some had considered suicide, were almost totally unable to resist their urges have been treated with SSRIs with some apparent success (see Rowe 2002 chapter 7). Similarly other researchers have suggested using the same drugs to reduce crime levels in the inner cities (Breggin 1995). Although some are sceptical of the benefits of using such measures widely there is a case for testing them on offenders who seem to be desperate to stop impulsive violent or sexual behaviour and who show signs of low serotonin activity. MDMA (better known by the street name Ecstasy) is known for its enhancement of empathy and positive feelings towards others and it acts primarily by boosting serotonin activity for several hours.

Lawyers have already tried to use molecular genetics research into serotonin systems to excuse or mitigate their clients' criminal acts. For example, Stephen Mobley ('the Domino's Pizza Killer') robbed a pizzeria at gunpoint in Georgia, USA, in 1991 and then for no apparent reason chose to shoot the manager in the back of the neck. At his murder trial his defence tried to have his death sentence commuted to life imprisonment on the basis of a family tree (like that Brunner constructed) showing several relatives with violent and criminal records. The court ruled that this was not relevant, and did not allow him to undergo biological tests of levels of the enzyme (MAO) that was malfunctioning in the Dutch family Brunner studied, or of the relevant transmitter, serotonin (Deno 1996). Mobley was executed on 1 March 2005. You may be interested to know that one of Mobley's brothers, sharing half his genes,

became a self-made millionaire. This should make you distrust simplistic genetic determinism as an explanation of anti-social or criminal behaviour.

Genes affecting dopamine function

The other transmitter system that has been researched with encouraging results is the dopamine system. One part of the brain's dopamine system is known to be involved in experiencing reward, or perhaps in the motivation to get a reward. Cocaine and amphetamine act directly on these neurons and other drugs like heroin act on it indirectly (Julien 2004).

One type of transmitter will be used in several systems in the brain, each carrying out a distinct function. There are also several different receptor types for each transmitter, and we assume that these create different results in the neurons that carry them. The Dopamine 4 receptor (D4) has been implicated in characteristics relevant to criminal behaviour, with different versions creating different tendencies to act in particular ways. This type of research is relatively recent. Ebstein et al. (1996) found that Israeli students showed greater novelty-seeking if they carried the '7 repeat' version of the D4 gene. Although this has been retested by several groups with mixed results, it did trigger a burst of research into the gene itself.

The '7 repeat' version of the D4 gene has often been associated with ADHD, a risk factor for anti-social or criminal behaviour. Faraone et al. (2001) reviewed all the studies that could be found (including unpublished data) and concluded that there is clear evidence for a significant link between the '7 repeat' version and ADHD. Interestingly Rowe et al. (2001) found that adults who said that they had been more involved in teenage delinquency were also more likely to have the '7 repeat' allele, but only in males.

There is an evolutionary perspective that regards the characteristics of ADHD as having been useful, and leading to more offspring. Now we make children sit in busy classrooms and judge their progress by how well they can ignore distractions, sit still, be quiet and concentrate on often dull material (Jensen et al. 1997). Indeed many famous people showed traits that we now interpret as elements of ADHD, for example Edison, Mozart, Churchill, Einstein, John Lennon and many sportspeople.

Practical implications

How then might we use the information from genetics? There is already a genuine debate about using genetic information to show that an offender has a predisposition towards anti-social or criminal behaviour, and on that basis altering the sentence they receive (Evansburg 2001). In at least one case in the USA a death sentence has been reduced to life in prison on grounds including genetic vulnerability (see the case study of John Eastlack at the end of the chapter, p. 52).

We could intervene biologically by altering the diets of children with low levels of a transmitter and increasing the amount of the 'building blocks' of that transmitter, or the chemicals involved in making it. For example tryptophan is part of a normal

diet and is essential for constructing dopamine; it is easy to eat more foods that contain it. Vitamins, minerals, omega-3 and related essential fatty acids (found in oily fish, cod-liver oil and some plants, such as flax seeds) are essential for effective functioning of our brains. Well-designed studies have clearly and repeatedly shown that simple, cheap supplements in tablets decrease the amount of criminal behaviour. In a series of studies over more than 14 years involving all the relevant children in Mauritius, there was much less anti-social and criminal behaviour in the teenage years if supplements were given in childhood. Poor diets at three years old were linked to criminal behaviour.

There has even been a study in England (Gesch et al. 2002) where males detained in a young offenders' institution were randomly assigned to two groups. One was given a simple supplement, the other was given identical-looking tablets without the supplements. At the end of the trial the records of the supplemented group showed 25 per cent fewer disciplinary offences than those of the unsupplemented group, with the greatest difference for the most serious offences such as hostage-taking and assault (Lawson 2003). These findings raise the question as to why such cheap, effective measures are not applied in prisons, in schools and in schemes for the under-fives – perhaps because there are no great profits to be made?

Genetics is not destiny: to use a metaphor, it is more like playing a long session of poker where each card is a version of one of the genes we inherited from our parents. We need to play until we have been dealt about 25,000 cards (one per gene) so luck is unlikely to be a major factor. Also your hand can be judged only in the context of the other players' cards, and your success depends partly on with whom you are playing. So a child with genes associated with a higher risk of anti-social or criminal behaviour who is brought up in a supportive environment is much more likely to have a happy and successful life than one who has high-risk genes and a poor social and physical environment.

Biosocial interaction is once more the best model. Evolution works because some combinations and versions of genes, in a particular environment, result on average in the person that inherited them leaving more offspring. Those offspring then carry those genes into the next generation.

We have seen how the next step of the process – when the genes produce different characteristics in their holders – works with respect to communication between the neurons that we think are the key brain cells underlying emotions, thoughts, our physical responses and motivations etc. Note that most of the findings we discussed apply to the sort of traits – for example impulsivity, novelty-seeking, aggression – that we saw evolution has selected in young men in general. However we also saw that 'faults' can also help to explain some criminal behaviour, as in Brunner's team's work with the Dutch family.

Systems using serotonin and dopamine are important in the prefrontal cortex and temporal lobe. In the brain structures section (pp. 44–8) you will find that these parts of the brain are implicated in criminal behaviour, and this helps to tie together the different biological perspectives. Firstly, we will look at how those who seem predisposed to criminal behaviour differ from the majority of the population in various physical factors.

PHYSICAL CHARACTERISTICS OF OFFENDERS

In this section we will consider ways in which offenders differ physically from non-offenders. Bear in mind the proposed differences in attractiveness and physical characteristics that you read about in the introduction to this chapter.

QUESTION BREAK

- In what ways do you think offenders differ physically from non-offenders?
- Which ideas mentioned in the introduction to this chapter does this remind you of?
- If we could find differences between offenders and non-offenders what actions or policies do you think would be suggested?

Mesomorphy and testosterone

We looked earlier at Sheldon's theory that males fell into three general body types. Of these the mesomorph, having a muscular body, little body fat and adventurous, fearless, competitive, low empathy, risk-taking personality, is the most likely to become a criminal. It makes sense that physically strong and aggressive people are better equipped for crimes involving force and intimidation. Mike Tyson and Bernard Hopkins are both world champion professional boxers who have committed serious crimes of violence.

Sheldon's work is now seen as simplistic and also as perhaps confusing cause and effect (for example skinny, anxious people are unlikely to be successful armed robbers even if they really want to be); however that is not to say that he was totally mistaken. Even if you cannot tell that someone is a criminal just because they are mesomorphic there is evidence that the physique and personality do often go together, and that they are more common in offenders. Eight studies have tested this relationship and all have found that mesomorphs are more often offenders than the other body types; one study has also found this for males with anti-social personality disorder (Ellis 2005).

In considering why this might be, Ellis convincingly argues that the underlying biological factor that leads to the personality and physical characteristics of the mesomorph that in turn make them more likely to become criminals is the hormone testosterone. Testosterone shapes the brain before we are even born and sets it up to respond in a particular way when puberty sets off the massive increase in testosterone levels many years later. This time delay explains why we do not see large correlations between adult testosterone levels and criminal behaviour, although there are consistent associations between them. There is also evidence that testosterone is especially important in violent offences including domestic violence and other aggressive crimes.

This theory might help to explain why females are so much less likely to be

involved in such crimes. Baby girls are not set up in the womb to respond to testosterone in the same way as baby boys, and later levels of testosterone are much lower in females.

Fight or flight

Our response to danger depends on a web of systems that predispose us either to flee from the threat or to fight. There are significant and well-established links between criminal behaviour and different aspects of these systems.

Fearlessness is a trait with biological underpinnings that is linked to offending and anti-social acts. This is associated with the heart rate – which Raine (2002a) has called 'the best-replicated biological correlate of antisocial and aggressive behavior in children' (417). Low resting heart rate has been linked to conduct disorder but not to other psychiatric conditions (i.e. it is specific to a condition diagnosed by extreme anti-social and criminal acts). Five studies that measured resting heart rate at a young age – one at three years old, all before any criminal behaviour – have found that low rates predict aggressive and delinquent behaviour later in life. Moreover, low resting heart rate, by itself, is a predictor of later violence, more so than having a criminal parent!

Males as a group have lower heart rates than females, but among females those with low rates are at greater risk of criminal behaviour. This indicator is particularly good at predicting the small group of anti-social young people who go on to become lifelong offenders. In addition to these reasons to take it seriously, heart rate is also known to be heritable (it is genetically determined to a substantial extent). A high rate protects against other risk factors and it interacts with other, non-biological risk factors (see Raine 2002a).

It could be argued that this factor is so important because of a link with fearlessness; indeed decorated bomb disposal operatives have very low resting heart rates and low reactivity to threat (Cox et al. 1983), as do decorated British paratroopers (McMillan and Rachman 1987). A more general explanation is that it is part of a general low level of arousal in the several systems underlying fight or flight responses. This is supported by recent research by several groups showing that other measures of arousal are associated with anti-social and delinquent behaviour in children. It also fits with the higher levels of sensation-seeking seen in anti-social, delinquent and criminal populations. The connection is thought to exist because we all have a level of arousal that we find preferable. If we are biologically highly aroused then we do not want to be more stimulated because that takes us past the optimal level; if we are biologically under-aroused then we will seek out stimulation to bring us up to that preferred arousal level (Eysenck 1987).

Joy riding, burglary, street fighting and many other criminal acts are clearly very exciting and arousing and so would be expected to be seen more often in those with low biological arousal than in other people. As there are many other ways to be excited we can also see how this fits with sociological theories linking criminal behaviour with lack of opportunity and with exclusion as this in turn limits access to legal ways of experiencing risk and excitement.

There are other factors that are thought to reflect low arousal and reactivity such as low pulse rate, low levels of sweating when emotionally challenged (galvanic skin response or GSR) and low levels of hormones released in response to stress, especially cortisol (see Raine 2002a and Ellis 2005).

Overall the evidence for lower than normal activity in the body's arousal systems of anti-social, delinquent and criminal persons seems convincing and plausible; it also relates to psychological and sociological theories. It makes sense in the evolutionary framework within which we are considering biological factors. However, it should be obvious that having a low arousal level cannot, by itself, cause crime any more than any other biological factor can. After all besides bomb disposal officers, it is likely that risk-taking sportsmen and women, such as racing drivers or mountaineers, and entrepreneurs would also have low resting arousal levels and responsivity to stress; indeed it is another example of the critical role of interaction between biology and other types of factors.

The final biological factor we will consider concerns those brain structures and functions that seem to be particularly relevant to understanding criminal behaviour.

BRAIN STRUCTURES

This section focuses on research into the frontal lobes of the brain (especially the prefrontal cortex) and the temporal lobes (especially the amygdala and hippocampus). It also considers differences between the two halves of the brain. The reason for looking in some detail at the brain is that a significant proportion of the most extreme, life-course persistent, offenders show clear signs of significant brain damage in exactly the parts of the brain where we would predict their leading to immoral, impulsive, violent, anti-social and unpredictable behaviour.

The prefrontal cortex

In 1848 Phineas Gage, a respected, diligent railway worker, survived a one-metre-long, six-kilogram, iron rod being blasted through the frontal lobe of his brain, landing about ten metres behind him. The destruction was mostly on the left, mainly impacting the prefrontal area, and showed us that traumatic damage to the prefrontal cortex can change a person's character and behaviour dramatically for the worse (Macmillan 1999/2005). Phineas was not allowed to return to his job because his employers said that he had changed from their most capable, reliable, efficient and businesslike foreman into an unreliable, disrespectful, offensive man who could not deal with his fellow workers and showed impulsivity, obstinacy and an inability to decide on and follow any plan. He was said to 'no longer be Phineas Gage', abandoned his family, showed no respect to his fellows, swore, gambled, drank and ended up as a freak exhibit for the Barnum museum in New York and working in stables in Chile (Macmillan 2000). Notice that the way Phineas was after damaging his prefrontal cortex is similar to the collection of characteristics that are seen in many of those who have been convicted of crimes.

Less sudden damage to the frontal and/or temporal cortex can also produce anti-social behaviour in people with frontal-temporal dementia (FTD). Miller et al. (1997) compared 22 patients with FTD against 22 with Alzheimer's dementia (which damages structures further back in the brain). Their families said that the FTD group had been responsible, competent, reliable citizens before their dementia began; therefore it is unlikely that the FTD 'unmasked' pre-existing anti-social characteristics. The diagnoses were made before the dementia was severe enough to explain their anti-social actions as due to cognitive difficulties.

There was a large difference between the groups: ten out of the 22 with FTD had records of socially disruptive behaviours including theft, assault, inappropriate sexual behaviour, unethical behaviour at work and even one hit-and-run. Three had been arrested and two others had avoided arrest only because their families persuaded the police that they were ill. The Alzheimer's group had only one patient with a socially disruptive record. Once again we can see the same types of behaviours that are seen in criminals, especially those with anti-social personality disorder and those who belong in the life-course-persistent subgroup of offenders.

Many children thought to have conditions predisposing them to criminal behaviour (especially the disruptive behaviour disorders that include conduct disorder, oppositional-defiant disorder (ODD) and the attention deficit disorders (ADHD)) show differences in brain function (and even structure) when compared to children who do not have these conditions.

There are also cases of brain injury in children. It is generally agreed that conduct disorder and other behaviour problems commonly appear after such damage (Raine 2002a). The frontal lobes and the tip of the temporal lobe (where the amygdala and hippocampus lie) are particularly vulnerable to head injury. More specifically, children can have damage limited to the prefrontal cortex. For example, Anderson et al. (1999) studied two young adults whose prefrontal cortex had been damaged before 16 months. One was a 20-year-old woman who was intelligent but stole, abused others verbally and physically, lied, was sexually promiscuous, never expressed guilt and had no empathy for her illegitimate child. The other was a 23-year-old man who was apathetic, slovenly, financially reckless, lied, physically assaulted others, stole in ways that were easily detected, never showed guilt and also had no empathy for his illegitimate child. Both had good environments but had shown such behaviours consistently since the damage with no apparent effect of punishment; also neither had been able even to learn social and moral conventions, let alone act upon them.

Vargha-Khadem et al. (2000) report on two British teenagers with childhood frontal damage who then developed delinquent behaviour that got worse until they were found guilty of criminal offences. Pennington and Bennetto (1993) discuss nine other children with frontal damage under the age of ten years. All showed behavioural disorders after their injuries, seven of them having conduct disorder, while one showed impulsive, unpredictable behaviour and another uncontrollable behaviour.

This evidence shows that childhood damage to the prefrontal cortex can cause later criminal behaviour, and is consistent with childhood abnormalities of structure or function being strong predictors of adult anti-social or criminal behaviour.

It is important to understand that, although you may be born with this type of brain, it is also easy to produce this pattern of damage by direct physical abuse.

Shaking a baby or infant, falls and other blows can produce damage to the prefrontal cortex. Even more worryingly it is now established that simply growing up in a family where it witnesses domestic abuse is associated with brain changes that make the child more likely to respond violently in future (Margolin and Gordis 2000).

In adults there is much more direct evidence of abnormal function and structure in the prefrontal cortex being linked with criminal behaviour. There have been several reviews of functional brain-imaging studies. These look at studies using diverse methods and testing different types of anti-social or criminal individuals; also the number of subjects tested is often low. Bearing these issues in mind it is impressive to what extent there is agreement that violent offenders show abnormal patterns of activity in their prefrontal cortex (Raine 2002a). Probably the best studies are a series by Raine's team which ended up by comparing 41 murderers to 41 non-offenders matched for age, sex and schizophrenia. They found an underactive prefrontal cortex in the murderers, with the reduction being greater in impulsive, emotion-driven murderers than in predatory murderers who killed to achieve a goal.

Paedophilia has also been associated with prefrontal damage. Langevin reported that paedophiles' brains were structurally different in a series of papers from 1985, but the methods did not allow very fine resolution (Freund 1994). In 2003 Burns and Swerdlow described a 40-year-old married male teacher with conventional sexual behaviour who had begun visiting child pornography websites, using prostitutes and propositioning young children. His wife left him and he was soon convicted of child molestation, then he was expelled from his treatment programme for soliciting sex from the women on the course. Fortunately he went to hospital complaining of headaches and a fear that he would rape his landlady. The doctors spotted other signs of brain dysfunction and scanned his brain, finding a large tumour in his right prefrontal cortex. An operation removed the growth and he returned to his old self. Some time later his sexual deviance returned and they found that the tumour had regrown. On its removal he once again became his original, sexually conventional self. This is strong evidence that his behaviour was caused by the tumour impairing prefrontal functions.

More recently, Tost et al. (2004) used tasks based in the prefrontal cortex to show that four paedophiles were very impaired, while their performance on tasks associated with other brain structures was normal. Together these studies suggest a role for the prefrontal cortex in paedophilia: it may be that moral judgement, or self-control, or some other function, is both important in keeping levels of child abuse down and also based in the prefrontal cortex.

There are also many cases where previously law-abiding adults who have had their prefrontal cortex damaged have then developed anti-social, psychopathic characteristics, including low arousal, thus supporting the research we have discussed.

The temporal lobe

The temporal lobes have a covering of cortex like a tablecloth on a table. Under this is a sizeable space where the amygdala sits: this is known to be critical in strong negative emotions like anger and fear. Along its lower side the sheet of cortex is rolled

up like a Swiss roll: the edge that ends up in the centre of the roll is hemmed with the hippocampus, a structure critical in anxiety, memory and controlling anger. Damage to the hippocampus, amygdala and the front half of the temporal cortex on the left side of the brain has been shown to often produce violent behaviour, and the amygdala is part of a system including the prefrontal cortex that controls aggressive behaviour. Damage to the amygdala can result also in an inability to empathize with others, the loss of emotional memory and emotional under-arousal, all factors which we have seen to be linked to criminal behaviour (Martens 2002).

Mendez and colleagues (2000) found that two patients with homosexual paedophilia starting after brain damage showed substantial underactivity in the front half of their right temporal lobe. One was a case of frontotemporal dementia, the other had damage to the hippocampus on both sides of the brain. This is consistent with other evidence that damage to the right temporal lobe can produce an increase in sexual behaviour, especially inappropriate sexual acts.

So how can we make sense of all this? Bufkin and Luttrell (2005) have recently reviewed 17 brain-imaging studies on aggressive, violent offenders. They argue that the prefrontal cortex and the temporal lobe in the amygdala and hippocampus region work together in a system to regulate negative emotions. Kiehl et al. (2001) found that criminal psychopaths showed significantly less emotionally related activity in the temporal cortex and in part of the prefrontal cortex as well as in a connected part of the brain important in producing behaviour (the striatum). At the same time the rest of their prefrontal and temporal cortex was over-active.

This seems to tie together the studies that implicate the frontal cortex with those highlighting the temporal lobe: both are part of a system critically important in emotional processing and controlling impulsive, aggressive and sexual behaviour.

The two sides of the brain

There is evidence that lower than normal right-hemisphere functioning might be important in the lower heart rate clearly linked to higher risk of criminal behaviour. Damage to the right side of the brain in adulthood has been shown to reduce the patient's response to negative emotional stimuli. This supports the idea that the fearlessness and impaired ability to learn from negative consequences known to be risk factors for criminal behaviour might be due to right-hemisphere underactivity (Raine 2002a).

Dysfunction of the left hemisphere has been convincingly associated with violence and criminal behaviour in psychopaths, sex offenders, people with conduct disorder, children showing anti-social behaviour, male violent offenders and others, using several methods (Raine 1993). More recently, Raine et al. (2003b) have measured the size of the corpus callosum (the great band of fibres connecting the two halves of the cortex) in 15 men with anti-social personality disorder and high psychopathy scores and in 25 controls. They found several differences that imply greater connectivity between the two halves in the anti-social group. The greater the volume of the corpus callosum the lower the men's response to stress was and the more they showed the signs of psychopathy.

The type of evidence outlined here, although quite detailed and technical, suggests that the balance of activity between the hemispheres might be abnormal in those predisposed to criminal behaviour, although it is not yet clear how best to interpret it.

QUESTION BREAK

- Do you think that frontal damage, or frontal malfunction from birth, should be taken into account when deciding guilt?
- What about when deciding sentence?
- What should we do with such people after they have served their sentence?

In summary, there is evidence that the brains of some offenders are different in function and structure from those of non-offenders. This is particularly striking for life-course-persistent, impulsive, violent offenders.

DEVELOPMENT OF THE BRAIN

This section brings together many of the ideas from this chapter and will help you to understand how the different biological perspectives interlock. It also emphasizes the biosocial interaction at the heart of human life.

Anti-social behaviour is not unusual, so it is unlikely that much of it is caused by dramatic problems such as tumours, maladaptive genes or injuries. Over the last fifty years researchers have begun to understand the normal processes by which our brain develops in response to our environment (Schore 1997). This development certainly continues into our early twenties (Andersen 2003) and in all likelihood will be found to go on past the age of 30. In this section on early development we look at what happens up to puberty.

Even in the womb the baby is sensitive to the mother's environment. At the end of the Second World War there was a famine in the Netherlands where the population was reduced to eating such things as tulip bulbs, grass and rats (Hart 1993). Women who were in the third trimester of pregnancy at the time gave birth to underweight babies. However, those in the first trimester had overweight babies on average and when the females grew up and went on to have their own children they too were heavier than average (Motluk 2004). This was unexpected and shows the power of the environment to change biology: it is argued that this is a response to adapt the baby to the environment it is going to be living in (Vines 1998) and it may be working by a mechanism called imprinting where genes can be turned off for long periods before being passed on to the next generation or even beyond.

Even more dramatic effects can be seen in many mammals if a pregnant female is stressed during pregnancy: for example rabbits will reabsorb growing embryos and, after birth, stressed guinea pigs will eat their own babies. Both of these behaviours save resources for when they can be better used to bring up offspring successfully. In

humans it is suspected that maternal stress can predispose a child to be anxious and in one study to double the chance of hyperactivity in boys (Glover and O'Connor 2002).

In humans, babies exposed to alcohol in the womb can have their development impaired. If the mother drinks heavily the babies may show foetal alcohol syndrome (FAS) which is seen in about one in five hundred births worldwide. FAS is due to brain damage, especially to the prefrontal cortex, which leads to impulsivity, hyperactivity, attention difficulties, learning disabilities and problems with thinking things out – all of which, as we have seen, are risk factors for criminal behaviour. Unsurprisingly when they grow into their teens and beyond such children are at significantly greater risk of being imprisoned (Boland et al. 1998). Recently there has been evidence that even low levels of drinking during pregnancy can lead to less severe forms of these problems (Hall 2005).

Using drugs such as cocaine (powder or crack), heroin or methamphetamine can have severe consequences for the baby's brain, behaviour and likelihood of later criminal behaviour (MedlinePlus 2005). People are often surprised that smoking tobacco during pregnancy has been shown to increase the child's chance of criminal behaviour: in six studies since 1992, four showed clear evidence and two limited support. These are not small effects: one study found twice the risk of a criminal record at 22 years.

Besides drugs, exposure to toxins such as lead, mercury, pesticides, industrial chemicals that mimic hormones (such as pthalates which are used to keep some plastics soft) and many other environmentally widespread poisons can distort brain development and lead to increased chances of criminal behaviour (Galen 2000). If there are medical problems during pregnancy, for example bleeding or infections, there is an increased chance of the baby having minor physical anomalies (MPAs) such as lower ears than average or a furrowed tongue. These are an indicator of disturbed development and mean that is likely that the brain has also been slightly affected. MPAs are associated with aggression, impulsivity and behavioural problems at school in children from the age of three years. They have also been shown to indicate a higher risk of teenage conduct disorder and adult violent offending (Raine 2002a). Note the link to earlier beliefs that to be physically ugly indicated moral weakness.

The next danger is at birth itself where complications such as lack of oxygen, forceps delivery and pre-eclampsia have been linked to conduct disorder, delinquency, impulsive crimes and violence as an adult in a range of studies (Raine 2002a).

In case you are now terrified of having a child, or feeling guilty for having given birth to the next serial killer, here is the good news: there is very strong and convincing evidence that all of these factors can be counteracted by a stable, supportive upbringing (Raine 2002b). As we have repeatedly seen, it is when there are both a biological predisposition and then a bad environment that the most serious problems arise. This is an example of biological research showing the importance of the non-biological environment and gives a very encouraging message to parents as well as suggesting how governments might reduce biologically influenced anti-social or criminal behaviour without doping our children up on the latest pharmaceutical product.

QUESTION BREAK

- What type of environment do you think will lead to successful biological development?
- How might a child's upbringing change the impact of early biological disruption?
- How might growing up as a witness to domestic violence or as a subject of abuse disturb normal biological development?

As regards the complex interactions between mother and baby, and identifying some of the key factors leading to successful early maturation, it is now believed that the first two to three years of life are crucial in the development of emotion (or affect). In the aftermath of the Second World War there were a great many orphans and the World Health Organization funded research into their needs. In a famous report Bowlby (1951) showed the dire effects of being brought up with enough food, clothes and other physical staples but without real emotional contact with a carer. Such children grew up to be emotionally damaged. These findings have been replicated many times in group settings (e.g. Groza et al. 2003) and in individual cases of extreme neglect (e.g. Rymer 1993).

The more recent studies do show the possibility of counteracting the damage by providing a supportive, patient family environment through later childhood but also emphasize the long-term consequences in behaviour, emotional sensitivity and expression and mental health if early neglect is not dealt with effectively. These studies emphasize the interplay between biology and the social and physical environment. A person's earliest experiences shape the development of their brain and so change the way they will respond in future. We know that children with the types of behavioural patterns that make them more likely to become criminals are also more likely to have had neglectful or abusive childhoods.

The evidence that genes are important in conduct disorder (AACAP 1997) and that systems using the transmitter serotonin are disturbed (Lahey et al. 1993) highlights the biological-environmental interaction at the heart of human development. This seems to be a common way in which biological systems have evolved: our genes describe a generally useful set-up but the set-up then adapts to the environment we happen to have been born into. This is a powerful way of dealing with the fact that evolution is 'blind' and cannot tell what the world will be like in the future.

One of the psychological constructs most clearly linked to development is that of attachment. Bowlby (1951) and Harlow (1962) set the stage for later work, especially by Ainsworth and her colleagues (Ainsworth et al. 1978). Cicchetti and Barnett (1991) found that a massive 80 per cent of abused or maltreated infants showed signs of attachment disorders.

In addition to attachment researchers have shown that the style of discipline in a family has important long-term consequences (Wade and Kendler 2001). Discipline styles may be summarized as warm-consistent (clear rules, talking not hitting), warm-inconsistent (rules not clear, but talking not hitting), cold-consistent (clear rules,

physically enforced) and cold-inconsistent (rules not clear with hitting not talking): these styles interact with attachment styles and together lead to long-term consequences (Kerr et al. 2004; Johnson and Smailes 2004).

It is clear that these psychological differences reflect biological differences and will also make it more or less likely that a person will engage in anti-social and criminal activity – for example an impulsive, uncontrolled person who has grown up without clear rules in an atmosphere of arbitrary violence is more likely to behave anti-socially as an adult (Hirschi 1995; George and West 1999).

Extreme or chronic stressful experiences, such as abuse or witnessing domestic violence, lead to high levels of stress-related hormones that damage the brain, including the hippocampus which is critical in memory, dealing with stress and controlling aggression (McEwen 1999).

Case studies of serial killers often find that their childhood attachments and family discipline seem to be one of the building blocks that lead to their extreme criminal acts. Harvey Carignan, convicted of multiple rape and homicide, was the illegitimate son of a 20-year-old who could not cope. She passed him round numerous temporary carers, thus undermining any proper attachment and exposing him to inconsistent but physical discipline. He grew up to be a very hostile man who hated all women (Berry-Dee 2003).

We are now in a position to see how all the biological threads can be drawn together to suggest a consistent model of the biology underlying criminal behaviour. The evidence also shows how preposterous it is to suggest that biology alone, or even more ridiculously just one biological factor, can explain criminal behaviour – only a biosocial interaction model is consistent with the evidence.

QUESTION BREAK

- Which aspects of early family life might be important in how an infant develops as a person?
- Thinking about yourself, your children or people you know, can you identify behaviours that we have seen are linked to offending?
- Did they always show them or was it more obvious at one period of their lives?
- Do you think people can be anti-social and delinquent in their teens and early twenties but good citizens later in life?

CONCLUSION

In concluding this chapter we will use two case studies to try and draw the various threads and issues together. Read through them and then consider the questions at the end.

John Eastlack

John Eastlack was sentenced to death for brutally beating an elderly Tucson couple, Kathryn and Leicester Sherrill, to death in their home in 1989. At appeal his sentence was reduced to life imprisonment. In her decision the judge said that the biological vulnerabilities caused by his previously undiagnosed foetal alcohol syndrome, together with his genetic vulnerability – deduced from his biological family's history of generations of substantial mental illness and criminality – made him less able to understand what was right and wrong, not able to feel guilt and less able to control his behaviour.

Eastlack was taken from his mother at birth, then went through various foster homes (one of which had handed him back so the foster parents could more easily go on holiday). His father was shot to death soon after John's birth when caught stealing cash from a pinball machine.

By the time he was adopted by a loving, supportive family he was already a habitual liar and thief with learning difficulties. Bringing up a child who was so demanding, and who soon began to get into trouble at school and ended up in an institution for juvenile criminals for theft, was a reason behind the divorce of his adoptive parents.

Eventually he was sentenced to nine years' imprisonment for credit card fraud but he escaped from the Arizona State prison, and was on the run when he broke into the Sherrills' home. At the trial he said that the wife had attacked him with a poker and he had then beaten them both to death and fled in their car. He said that he had felt as if he was watching events unfold rather than as if he was actually committing them himself (Revere 1999).

This is a typical case of biological damage and illustrates the interaction between the biological and environmental factors that make it almost impossible to decide what was the ultimate cause of his actions that night.

Charles Whitman

This case also illustrates the danger that taking the 'obvious' biological view may lead you to miss the environmental factors that are at least as important in understanding an offence.

Whitman was one of the first 'spree' killers to be widely covered in the media. In 1966 he climbed the University of Texas Tower and spent 96 minutes shooting randomly chosen victims before killing himself. At autopsy he was found to have a tumour on the amygdala, an area known to be critical in intense negative emotions. Stimulation of the amygdala in animals, or damage to it in humans, is known to be capable of causing extreme violence. Therefore that may well have been a critical factor behind the murders he committed that day.

However a more detailed examination of his story (MacLeod n.d.) reveals evidence of other possible biological factors. Whitman's father had an extreme temper, leading to his beating his wife and son. This is consistent with a genetic vulnerability in his son, but of course also illustrates a family environment that taught the use of violence. As with John Eastman, the domestic violence he witnessed and experienced

are likely to have led to biological changes that increased the likelihood of him offending as well.

If his, relatively small, tumour was important we might expect his violence to be something that began near the time of the murders. Several years previously he had said to a number of people that the tower would be a perfect place from which to shoot passers-by, suggesting that the thought patterns shown in his crime were already present, in part.

He was sponsored by the Marines to attend university, but without clear rules he began to display criminal and violent behaviours. He was arrested for poaching deer, did not pay gambling debts and got poor grades, ending his sponsorship. Back at a Marine camp at the end of 1963 he was court-martialled for gambling, unauthorized possession of firearms and threatening a fellow soldier over a debt of $30. In addition, he had beaten his wife on several occasions: although he made efforts to stop this behaviour with some success, he also had fits of temper; she filed for divorce in 1966.

In early 1966 his wife did report that he had been getting depressed and anxious, which is consistent both with a tumour and with the growing pressures in his life. He went to a doctor, and told him that he had fantasized about shooting people from the tower.

Whitman then began using amphetamines to help him work. Amphetamine use increases the chance of violent behaviour. Drug or alcohol abuse is perhaps the most important risk factor for violent crime in general: it increases a person's risk to others by about fourteen times (in comparison severe schizophrenia increases a person's danger to others by only about four times) (Eisenberg 2005).

In his suicide note he did state that his violent fantasies had been increasing and that his treatment had not helped. He also wrote that he was going to kill his wife and mother because the world was such an awful place that he did not want to leave them to suffer. This is not an unusual theme in cases where depression drives a parent to commit suicide and also kill their own children: depression is influenced by both biological and environmental factors.

He then killed his mother followed by his wife and completed his thorough preparations to enact his fantasy. During his killing spree he murdered 14 passers-by and wounded dozens more.

QUESTION BREAK

The case studies above illustrate some of the difficulties in determining causes of criminal behaviour – and the difficulty of settling on either biology or the environment as *the* cause.

- Do you agree with the appeal court judge's comments concerning John Eastlack? Suggest reasons for and against her decision that Eastlack was not as culpable as someone who had not had the biological vulnerabilities he had thrust upon him.

- On consideration of the second case, do you think the genes Whitman inherited made him more likely to act violently, or that his environment was a more convincing cause? Why might people feel that he was less culpable if his biology had been an obvious cause than if the dominant cause was his family and later environment?

SUMMARY

As we have stressed, modern biologists do not look for 'the crime gene', they look for genes that increase a person's probability of committing particular types of offence in certain environments. The large majority of them do not think that black young men in the USA and Britain are more likely to be imprisoned because of their biology. Even if there were to be biological differences there are clear factors such as poverty that are much more plausible causal factors (Jones 2005).

Evolutionary psychologists do not think that biological explanations will destroy the utility of concepts such as responsibility and morality. If a child shoots a friend dead while playing a game of soldiers with the father's loaded handgun we accept that they are not morally, or legally, responsible owing to their age and consequent immaturity. Surely we can find a way to deal with cases of people who, for other biological reasons, may have reduced culpability?

Violent and other crimes seem to be universally found in human societies: indeed the evidence suggests that levels of violence and murder are considerably higher in pre-state, hunter-gatherer groups than in the type of state we find in Europe and many other parts of the world (Pinker 2005): when the state structure breaks down, as in the former Yugoslavia, crime rates soar. Surely we do have evolved tendencies to behave in certain anti-social and criminal ways in certain circumstances, and part of normal male development is to compete in ways that include criminal behaviour. Although this does not mean that we have to accept behaviours that harm other members of society, 'natural' does not mean 'moral' or 'right'.

As to the role of biological perspectives on anti-social and criminal behaviour in helping to understand and deal with such behaviour, maybe the effective response is not to try to ignore biology but to learn enough so that you can understand it and make an informed contribution to the debate (Stangroom 2005). The greatest dangers have arisen when people without scientific knowledge (including politicians like Stalin or Hitler) have taken up scientific hypotheses with no real understanding and based policies upon their own ignorance.

FURTHER READING

Daly, M. and Wilson, M. (1998) *The Truth About Cinderella*. London: Weidenfeld & Nicolson. A very short and easy read. Clearly sets out their argument that stepfathers are much more dangerous to children than biological fathers. Puts it in an evolutionary psychology framework.

Raine, A. (1994) *The Psychopathology of Crime: Criminal Behavior as a Clinical Disorder*. New York: Academic Press. The most important text in this area. Sets out to address the most common criticisms made of the biological approach to explaining crime. Clearly written but does assume some knowledge.

Rowe, D. (2002) *Biology and Crime*. Los Angeles: Roxbury. A short textbook that is especially good on the genetic and evolutionary explanations. If you are new to this area read it with a 'Dummy's Guide' to genetics and evolution by your side and you should be able to understand it all.

WEBSITE

http://www.crime-times.org/. A website devoted to spreading the word about biological explanations of crime. Very clear and covers the latest research and has archives going back at least ten years.