GENETIC FACTORS IN AGGRESSIVE BEHAVIOUR

The relationship between genes and behaviour is a complex one. Much of the human genome is devoted to behaviour, and more genes are expressed in the brain than in any other organ. Researchers have approached the investigation of genetic factors in aggression in several different ways to try and establish whether aggression is more a product of inherited characteristics (***nature***) or environmental influences (***nurture***). Two of the main methods are **twin studies** and **adoption studies**.

Twin studies

Monozygotic (**MZ** or **identical**) **twins** share the same genes because they are the result of one sperm fertilising one egg, which then splits apart and produces two genetically identical individuals. So, if a behaviour is the result of a single gene, and one twin shows that behaviour, the other twin should as well. The extent to which this occurs in different twin pairs is called the **concordance rate** (**CR**). The higher the concordance rate, the greater the role played by genetic factors.

There have been many studies of the CR for aggression and anti-social behaviour. For example, **McGuffin & Gottesman (1985)** reported a CR in MZ twins of 87%. Whilst other studies have reported a figure lower than this, it is generally accepted that genetic factors are involved in aggression, especially more violent behaviours and crime.

Identical twins showing concordance for aggression

The problem with these studies is that the twins that have been studied typically share the same environment. The ideal study would be to look at

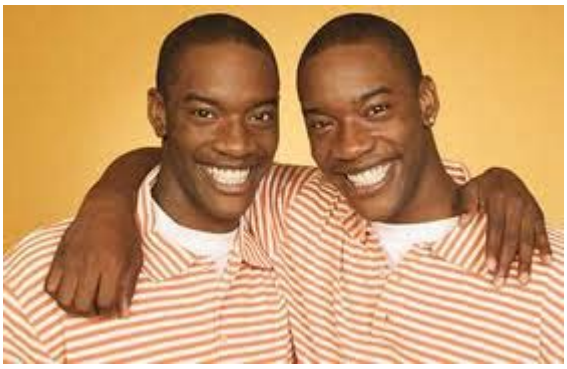
the CR in MZ twins who have been separated at birth and raised in very different environments. Here, research shows a concordance rate of around 60%. However, this kind of study uses only very small sample sizes, meaning that any conclusions drawn from them must be treated very cautiously.

One way that researchers get around this problem is to compare the CR of MZs raised in the same environment with the CR of **dizygotic** (**DZ** or **non-identical**) **twins** raised in the same environment. DZ twins are formed from two sperm fertilising two eggs, and they share 50% of their genes. If MZ twins show a higher CR than DZ twins, this *must* be due to genetic factors, given that the environment is the same for both kinds of twin.

All studies show that the CR for MZ twins *is* higher than that for DZ twins. For example, **McGuffin & Gottesman (1985)** report a figure of 72% for DZ twins. Research has also shown that genetic influences are greater for more violent behaviours than less violent behaviours (**Mason & Frick, 1994**). Interestingly, one study has shown an interesting gender difference, with the CR of aggressive anti-social behaviour being higher in *girls* aged 11-18 than in boys. This suggests a stronger genetic effect on aggression in females than males.

One problem with twin studies is that they are based on a number of assumptions. However, these assumptions are not always met, which means that any findings must be treated cautiously. For example, researchers assume that people are as likely to choose partners who are different from themselves (*random mating*) as they are to choose partners who are similar for a particular trait. However, people tend to choose partners who are similar to themselves (the *matching hypothesis*). So, DZ twins might actually share more than 50% of their genes, and hence be more similar on genetically influenced traits because they receive similar genes from their mothers and fathers.

Researchers also assume that MZ and DZ twins raised in the same homes experience exactly the same environments. However, research suggests that parents, teachers, peers and others may treat MZ twins more similarly than they treat DZ twins. Even MZ twins themselves might form closer relationships than DZ twins. Thus, twin studies are not the perfect genes versus environment study that researchers see them as being, and the environment may play a greater role in aggressive behaviour than genetic psychologists believe.



Identical twins are seen as being more 'special than non-identical twins, and might be treated more similarly because of this

It has been claimed that genes account for 30-50% of individual differences in aggression whilst environmental factors account for 50-70%. However, many researchers now believe that it is the *interaction* between genes and environment that influences many traits, including aggression. We will return to this point later on.

Adoption studies

Another way of investigating genetic factors is by studying children who have been brought up by adults who are *not* their biological parents. If there is a greater similarity in aggression levels between adopted children and their *biological* parents than between adopted children and their *adoptive* parents, this would suggest that genetic influences are at work. However, if the children are more similar to their adoptive parents (with whom they share no genes), this would suggest that environmental influences are more important.

Mednick, et al (1984) studied over 14,000 Danish adoptees and found that boys with no criminal parents, either biological or adoptive, had a criminal conviction rate of 14%. If the adoptive but not the biological parents were criminals, the conviction rate was 15%. However, if the biological but *not* the adoptive parents were criminal, the rate increased to 20%. If both sets of parents were criminal, the rate was 25%. These data suggest that biological characteristics increase the likelihood of anti-social behaviour and aggression more than the environment does.

One problem with adoption studies is that in some countries (e.g. New Zealand and the USA), children given up for adoption display a higher rate of anti-social behaviour (including aggression) than the general

population *at the time of their adoption*. Additionally, **Tremblay (2003)** proposes that *parents* who give up their children for adoption also display higher levels of anti-social behaviour compared with the general population and with potential adoptive parents. Consequently, the correlation between adopted children and their biological parents *might* be genetic or it *might* be environmental. It might even be the case that the *stress* of being adopted leads children to behave aggressively.

Adoption studies offer better control
of environmental influences than twin studies

Is there a 'candidate' gene for aggression?

Most research interest has been focused on the gene **monoamine oxidase A** (**MAOA**). This gene produces an enzyme which deactivates the neurotransmitter noradrenaline, serotonin and dopamine. In 1995, researchers discovered that male mice which lack this gene behave more aggressively than mice which do not lack it. **Brunner et al (1993)** have found a rare MAOA gene mutation in *humans*. Their study looked at a Dutch family whose male members had a history of extreme violence which could be traced back through nine family members all the way back to 1870.

The living violent family members all had a genetic defect on the X chromosome, whereas non-violent family members did not. When the urine of the violent family members was tested, it was found to contain abnormally high levels of noradrenaline, serotonin, and dopamine. According to Brunner, et al, an *excess* of these neurotransmitters somehow predisposes the men to behave aggressively. Note how this *contradicts* the claim about low levels of serotonin being involved in aggression (see 'Neural mechanisms in aggression').

The candidate gene for aggression?

Even if it turns out that MAO-A *is* the gene that predisposes animals to aggression, it would be wrong to say that aggression is caused entirely by genetic factors. All genes are influenced by the environment, and so aggression must be an *interaction* between a gene (**nature**) and the environment (**nurture**). Therefore, even if MAOA *is* the gene 'for' aggression it does not mean that a person will behave automatically behave aggressively. It is for that reason that possessing such a gene will only *poorly* predict whether a person will be aggressive or not unless environmental risk factors (e.g. abuse and maltreatment) are known about.

Finally, it is also worth mentioning that other genes have been suggested to play a role in aggression (e.g. DRD3 and DRD4, both of which are dopamine receptor genes). It is possible that these other genes might operate in as yet unknown ways, such as by influencing **testosterone** levels.


Inherited aggression?