

Chapter

11

Central themes from
the reviews of the
evidence



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Introduction

- 11.1 The four preceding chapters have set out some recent findings from research in behavioural genetics into intelligence, personality, antisocial behaviour and sexual orientation. These areas of research were selected to illustrate the breadth of topics which researchers in behavioural genetics are investigating and to include those areas in which practical applications of the research might be likely.
- 11.2 As the reviews of the evidence demonstrate, research is at different stages in different areas. For some traits, areas of the genome have been identified that might contain genes which have an effect on behaviour. For most traits, the route from such genetic factors to a particular behaviour is unclear. To date, most research in behavioural genetics has relied on quantitative methods (see Chapter 4) to assess the relative contributions of different types of factor. However, the use of molecular genetics (see Chapter 5) is increasing, a trend which is expected to continue. In this chapter, we draw some general conclusions about the research in the four selected areas and highlight some central themes that emerge. These will inform our consideration, in the next section of this Report, of the ethical, legal, social and policy issues to which the research gives rise.

The difficulty of defining and measuring traits

- 11.3 The traits on which research in behavioural genetics focuses are complex and multi-faceted. The difficulty of defining such traits in a rigorous and reproducible manner is a problem that equally affects psychologists and other researchers of human behaviour. Scores on scales of aggression, neuroticism or capacity for memory are useful tools for researchers and have applications in the realm of clinical psychology. However, broader claims from research in behavioural genetics about influences on human behaviour must be accompanied by a caveat about the necessarily artificial and limited context in which traits are considered.

Estimates of heritability

- 11.4 As noted in Chapter 4, the estimates of heritability derived from quantitative research methods apply only to particular groups of people, and represent the percentage of the variation in a trait that can be accounted for by genetic influences, among the members of that group, at the time of study. Thus, an estimate of the heritability of a trait does not provide any information about the number or identity of the genes that may be involved. Most calculations of heritability assume that the genetic influences in question work together in an additive fashion, so that if two hypothetical genetic factors contributed 5% of the variance each, together they would contribute 10% of the variance. However, it is likely that in many cases, the action of genes will depend on the presence of other genes and on particular environmental factors. Such effects can be overlooked by quantitative techniques. Furthermore, because heritability is a ratio of variation that has a genetic origin to the total variation, changes in the degree of variation that has an environmental origin will affect the estimate of heritability, even if the genetic contribution to the trait in question does not change.

11.5 Estimates of heritability refer only to the population sample on which they were calculated. If similar estimates are obtained across many studies that have different features, such as nationality, historical period and so on, this will show that the estimate can be generalised to some extent. It is commonly acknowledged by researchers in behavioural genetics that estimates of heritability for most human traits that have been measured are in the region of 0.40 to 0.60. Within this general range, some traits, for example intelligence (Chapter 7), appear to be more heritable than others, for example antisocial behaviour (Chapter 9). For the reasons given above, this information alone is of comparatively little value, except in so far as it only shows that there is some genetic influence, of whatever sort, on a particular trait, and thus makes the trait a potentially worthwhile candidate for molecular research. Such estimates are certainly not an appropriate basis for making claims about particular individuals, or for social policy.

The lack of replicated findings in molecular genetics

11.6 As we have seen, the task of finding genes that influence complex human behaviours is a difficult one. The reviews of the evidence have shown that there are very few confirmed and replicated findings in molecular genetics. No individual gene has been identified in humans that influences sexual orientation, antisocial behaviour or intelligence within the normal range. One gene variant, called monoamine oxidase A (MAOA), has been associated with low intelligence and aggression but so far, only in one family (paragraph 9.24). One study has indicated an effect of this genotype when combined with deleterious environmental conditions in male children, but this study awaits replication (paragraph 9.25). Another gene variant, called the dopamine receptor D4 gene (DRD4), has been associated with a handful of personality traits, psychiatric conditions and other behaviours, but the evidence remains inconclusive for its association with traits in the normal range (paragraphs 5.10 and 8.12). A gene that affects a chemical in the brain called serotonin has been associated with anxiety (paragraph 8.12). An alcohol-metabolising enzyme that protects against alcoholism has also been identified (Chapter 5, footnote 1), although this latter finding can be viewed as relating to a trait outside the normal range. Of course, when we consider that genetic influences on complex diseases such as diabetes and asthma are proving difficult to dissect, it is perhaps unsurprising that research on probably more complex behavioural traits should be even less advanced.

Applications of current research findings

11.7 In light of the lack of findings that have been replicated in research in behavioural genetics using molecular genetics techniques in this field, there are currently no practical applications of the research. There are no genetic tests for behavioural traits, nor are there pharmacological interventions that have been developed based on information about genetic influences on behavioural traits in the normal range.

11.8 With regard to intelligence, the only case where it seems plausible to see interventions based on genetic knowledge in the near future is that of serious mental retardation (see paragraph 7.14). However, future applications with regard to intelligence in the normal range cannot be ruled out, subject to the qualifications set out in this Report about the predictive accuracy of genetic tests for behavioural traits.

11.9 Scores on measures of personality can be moderately useful in predicting the likelihood of behavioural traits and disorders being exhibited in the future. For example, those who have a high score on the psychological scale of Neuroticism have an elevated chance of developing a neurotic disorder. Similarly, those with a high score who are affected by a

disaster have a higher probability of developing post-traumatic stress disorder. These predictions are already made with the measures of personality used by psychologists. It is not clear whether, in the adult population, additional information about genetic factors will add to these abilities to make predictions. However, the ability to make predictions based on genetic information might, in principle, be used to devise interventions such as environmental manipulations that modify the genetic contribution. So, for example one might choose to provide an environment that would develop courage in a child with a genetic susceptibility to timidity.

- 11.10 In the context of antisocial behaviour, there are currently no practical applications of the research. One study suggests that a particular gene, MAOA, might have an effect on antisocial behaviour in males, depending on whether individuals are maltreated as children. If replicated, this finding could have implications for preventing antisocial behaviour (see paragraph 9.25).¹ The finding from other research in the field, that genetic variance influences behaviour, but is not necessarily associated with official efforts to control behaviour, may help add clarity to the controversy about whether or not offending is heritable. The status of juvenile delinquent and the conviction of adults in law courts are socio-political-legal constructions, and on the basis of this truism, scholars have questioned how such constructions could possibly be inherited. Research suggests that a distinction between antisocial traits which are heritable and delinquent/conviction status, particularly among juveniles, which is less heritable, is a crucial one. Information from research in behavioural genetics is unlikely to be relevant to individual cases in juvenile court proceedings. (See Chapters 14 and 15 for consideration of the use of information about genetic influences on behaviour with regard to legal practice and social policy.)
- 11.11 To date, no gene that affects sexual orientation in humans has been identified (see paragraphs 10.14–10.17). Thus, there are currently no practical applications of the research, in terms of the use of genetic tests for predictive purposes.

Reporting research in behavioural genetics

- 11.12 Research which claims to show an association between particular genetic variants and particular traits tends to receive considerable attention in the scientific and lay media. Research in genetics and research that aims to show why human beings behave as they do (for example psychological and sociological research) are both subjects of enormous interest to society, so it is perhaps unsurprising that, when combined in the form of research in behavioural genetics, any findings are widely reported and discussed.
- 11.13 However, we noted in Chapters 4–6 that the various methods of research in this field are not infallible, and the reviews of the evidence in Chapters 7–10 have shown that few findings have been replicated successfully to date. Thus, reports of such things as ‘gay genes’ or ‘smart mice’ convey a highly inaccurate impression of the state of the research. The lack of reporting of negative or contradictory findings exacerbates this problem. These difficulties are not unique to research in behavioural genetics. However, it does seem that such research is, at present, particularly susceptible to reporting which, whether strictly accurate or not, is misleading in the impression it gives to the reader. The potential for the abuse of findings in this area means that the reporting of this research ought to be conducted with particular care.

¹ Brunner, H. G., Nelen, M., Breakefield, X. O., Ropers, H. H & van Oost, B. A. (1993). Abnormal behaviour associated with a point mutation in the structural gene for monoamine oxidase A. *Science* **262**, 578–80.

- 11.14 **We consider that researchers and those who report research have a duty to communicate findings in a responsible manner. We welcome the Guidelines on Science and Health Communication published by the Social Issues Research Centre, the Royal Society and the Royal Institution of Great Britain and recommend that further initiatives in this area should be encouraged.**²

Funding research in behavioural genetics

- 11.15 It has proved difficult to gauge the precise extent of UK funding in this area. In response to our public consultation, the Medical Research Council (MRC) stated that 'funding for UK research in behavioural genetics is modest'. One problem with obtaining a more precise account is that, as we have repeatedly observed in this Report, there is no clear line between behaviour in the normal range and that which constitutes a disorder. Moreover, since it may be that the same genes that affect behaviour at the extremes of variation, which may be seen as disorders, also affect behaviour within the normal range, it will be difficult to distinguish research that focuses on the normal range from that which focuses on the extremes. It is possible that research which attempts to identify genes that affect extremes of behaviour may have implications for behaviour in the normal range, and conversely, that research that focuses on behaviour in the normal range may have implications for that at the extremes. For example, research suggests that the genetic factors which contribute to depression, which is a disorder, also contribute to the trait of negative emotionality, which is a trait that is continuously distributed throughout the population. This phenomenon also arises in research into diseases; for example, research into normal blood pressure may be useful in understanding hypertension.
- 11.16 Notwithstanding the difficulty in delineating research in behavioural genetics that focuses on behaviour in the normal range, the MRC stated in its response that it 'does not give grants for research into the genetics of what are seen as "normal" variations in behaviour or personality, but [does] fund work relevant to aspects of behaviour seen by society as significant medical, psychological or educational problems'. The MRC notes that research into genetic influences on traits in the normal range such as 'general intelligence' could have value, but that the MRC 'does not give grants for such work because we have a medical remit, and to us, the benefits do not clearly outweigh the risks'. In 1997, the MRC developed a policy on research in behavioural genetics and devised a list of criteria against which potential research projects should be assessed. This includes the possible misuse of the research findings. In its response to the consultation, the Wellcome Trust stated that 'some of the research we fund looks at "normal" (or milder) traits and other projects focus on "abnormal" variations'.
- 11.17 Our public consultation showed that many people consider that, compared to research on disease, research into genetic influences on behavioural traits in the normal range ought to receive low priority for funding. This was partly due to doubts about the likely success of the research, and partly due to concerns about the potential applications. **We take the view that research in behavioural genetics has the potential to advance our understanding of human behaviour and that the research can therefore be justified. However, we note that it is important that those who fund research in this area should continue to fund research of a high calibre,**

² Social Issues Research Centre, the Royal Society and the Royal Institution. Guidelines on Science and Health Communication. November 2001. http://www.sirc.org/publik/revised_guidelines.pdf (9 Aug 2002).

should be transparent about their funding practices and should be aware of the potential for the abuse and misinterpretation of results. In addition, we recommend that research sponsors who intend to focus strategic funding in this area should pay careful attention to public concerns about the research and its applications.

Conclusion

11.18 This section of the Report has summarised the current evidence for genetic influences on a selection of behavioural traits. It is clear that very little is yet known about particular genetic factors and their roles in influencing behaviour. However, a considerable amount of research is under way that aims to improve our understanding in this field. We note the need for careful and accurate reporting of research findings. In the following section of the Report, we move on to consider the possible implications for society if such programmes of research are successful.