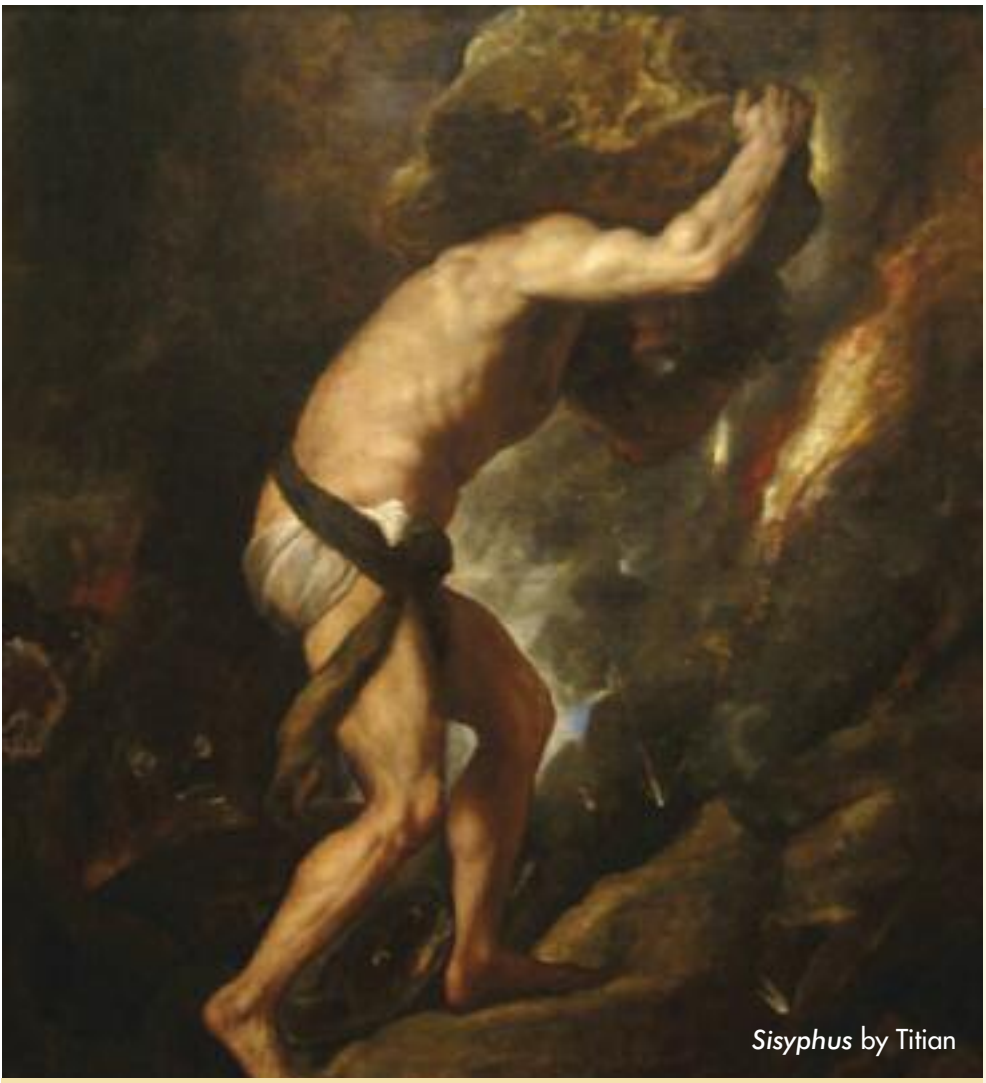

Sisyphus by Titian

Why we can't be whoever we want to be: the biological limits to change

by **Barbara Dowds**

..if there is a sin against life, it lies perhaps less in despairing of it than in hoping for another life, and evading the implacable grandeur of the one we have.

Albert Camus.

ABSTRACT

Genetics shows that most psychological traits are significantly, and in some cases primarily, inherited: people differ from each other because of nature more than nurture. However, further research, still in its infancy, is revealing interactions between nature and nurture, which shows that the effect of 'damaging' gene variants is dependent on the social environment. The effect of environment on long-term changes in gene expression, including potential silencing of damaging genes, is still poorly understood. Despite the limitations in our knowledge of psychological genetics, we can conclude that our current environmentalist model of psychotherapy should be supplemented by a vulnerability model, which recognises genetic predispositions and accepts that there are limits to change.

Introduction

Clients go into therapy in order to change what they perceive as unworkable in their lives and ways of being. Sometimes therapy results in a change in externally observable behaviour, perhaps in the manner in which we live in the world, how we make decisions or relate to others. Perhaps we emerge less anxious or depressed, cease self-destructive behaviour, or our relationships are less conflicted in any of a variety of ways. Alternatively, our behaviour or way of being or relating to others does not change, but our *feeling* about it does, so that we become more accepting of who we are. We may begin to accept and even value, for example, being gay or introverted, non-intellectual, non-sporty, or less successful or artistic than other family members. We begin - in the words of Carl Rogers - to live from an internal rather than an external locus of evaluation. We thus become less divided against ourselves and more authentic.

The Serenity Prayer used in Alcoholics Anonymous asks that we accept the things we cannot change, change the things we can and have the wisdom to know the difference. The difference between what we can and cannot change is something all clients and psychotherapists must grapple with. I will propose here that the things we cannot change may derive from our nature – our genes – whereas what we can change may correspond to parts of ourselves derived from nurture – our upbringing and other environmental effects. Of course, it's a bit more complicated than this simple equation: some neural circuits (which are laid down in response to the environment) are established so early that it may be extremely difficult to change them in adulthood. I am thinking, for example, of an infant subjected to extreme trauma, who thereafter has an over-active amygdala and HPA axis and a highly sensitive stress response. The stress threshold is set very early – in the womb and within the first six months of life (Gerhardt 2004: 77) – so that while it may be primarily environmental in origin, it is nevertheless very difficult to change through therapy. The probable reason for this is explained by Meaney's work on stress in rats, which is described later. Thus some aspects of our nurture are subject to later change, while others are difficult or impossible to alter. The reverse side of the argument is more certain. We cannot change our genes, though it is true that gene expression can be altered; in the future, when we know a great deal more about the subject, it is conceivable that we will be able to target damaging genes to silence them. In arguing this point, we are limited by the extent of our knowledge of behavioural genetics, which is still in its infancy. To summarise what we do and don't yet know about this subject:

1. We all vary in our expression of or susceptibility to various psychological (e.g. personality types) or psychiatric (e.g. depression, schizophrenia) traits. The proportion of variation within a population that is due to genes vs the environment has been calculated for a wide variety of traits and conditions. This is what we <u>do</u> know with varying degrees of accuracy about a growing number of traits.

2. The number of genes involved in any one behavioural trait is very large and may run into hundreds or thousands. This makes it very difficult to identify significant genes because any particular one has an individually small effect. Only a few relevant genes have been identified. This is one important thing we know very little about.

3. The difficulty of identifying behaviour-determining genes has made the study of gene expression impossible in most cases. [Epigenetics is the name given to DNA *modifications* – without changing DNA *sequence* - that bring about long-term changes in gene expression that continue over generations of cells]. This is the second important thing that we know even less about, though I will mention one exception to this. However, this exception has been studied in rats, not humans.

Some Basic Genetics

Human beings possess about 23,000 genes. The DNA sequence of nucleotide pairs that makes up these genes differs in about one in a thousand between individuals. The ways in which we differ from each other depends on these small differences creating different variants or alleles of the genes. The reason why we are tall or short, have blue eyes or brown, have type A, B, AB or O blood group, have cystic fibrosis or not, or have greater or lesser susceptibility to autism or schizophrenia depends on the particular allele of one or more genes we carry. Some traits such as cystic fibrosis depend on variations in a single gene, whereas others such as height or virtually all psychological/behavioural/psychiatric traits depend on multiple genes. A recent estimate places this number at hundreds to thousands of genes contributing to the liability to schizophrenia

(Flint et al. 2010: 110). Only some genes are expressed at any one time in particular cells or tissues. This is why blood cells differ from cells in the immune system, the liver or the kidney – all cells in an individual carry the same DNA, but many genes are differentially expressed in the different tissues. Genes are also differentially expressed at different times during development. This is likely to be crucial for our understanding of psychology, but we know almost nothing about it with respect to behavioural genes.

Estimating Heritability

With a small number of exceptions, most behavioural traits are partly determined by genes and partly by the environment, a term which includes upbringing, culture, education, diet, exercise, etc – all the non-genetic effects. The proportion of variation in the population due to genes is called the heritability of that trait; it is defined as the proportion of the total variance that is due to genes. Heritability can be estimated in two ways. One is through twin studies - comparing identical (monozygotic, MZ) twins who share 100% of their DNA with non-identical (dizygotic, DZ) twins of the same sex who share 50% of their DNA. To the extent that MZ twin concordance is greater than DZ twin concordance, a greater genetic influence is implied. The second way in which heritability can be estimated is through adoption studies. Genetic and environmental effects can be distinguished because adoption creates pairs of individuals of known genetic relationship who do not share a common environment. Their similarity reflects the contribution of genetics to family resemblance. Adoption also produces family members who share family environment but are not genetically related. Their similarity reflects the contribution of environment to family resemblance.
The heritability for a variety of behavioural traits, ranges from (surprisingly) no genetic component for mate selection to greater than 90% heritability for autism (see table below).

Psychiatric disorders are diagnosed as either/or dichotomies. Familial resemblance is assessed by concordance: e.g. a sibling concordance of 10% means that siblings of probands (identified cases) have a 10% risk for the disorder. One way to estimate heritability for disorders is to use the liability threshold model to translate concordances into correlations on the assumption that a continuum of genetic risk underlies the either/or

Trait	Heritability (of Liability) (%)
Schizophrenia	80
Bipolar Disorder	90
Major Depression	42
Generalised anxiety disorder	69
Autism	>90
ADHD	75
Shyness (childhood)	75
Separation Anxiety (childhood)	40
Separation Anxiety Disorder (childhood)	73
Panic Disorder	40
Obsessive-Compulsive Disorder	Zero to moderate
Antisocial Personality Disorder (adulthood)	40
Antisocial PD (adolescence)	10
Alcoholism	50-60
Drug Abuse	30-70
Openness to Experience*	40
Conscientiousness*	55
Extraversion*	45
Agreeableness*	35
Neuroticism*	55
Sexual Orientation	Highly variable results

Data from Plomin et al. (2008).
Unless otherwise stated, all studies were performed on adults.
*The heritability figures for these five personality traits (OCEAN) are based on self-report ratings on personality questionnaires.

diagnosis. Heritability of liability is a construct based on the hypothesis of continuous liability and does not refer to the risk of actual diagnosis. For example, in the case of schizophrenia, the heritability of liability is about 80%, but the concordance for identical twins is only 48%.

It is important to understand that heritability refers to the contribution of heredity to variation in a trait *in a particular population at a particular time*. If the environment were made uniform for a group, then there would be no variation due to environment and heritability would be 100%. The higher heritability of antisocial personality disorder in adults than in adolescents suggests that adults have a more uniform environment than adolescents. Genetic variation in a given group of people does not change with time (though if the population of Dublin, for example, changes by immigration or emigration, then of course genetic variation changes), but variation within the relevant environmental factors can.

Heritability information must be applied with caution to individual clients. The figures apply to a population, so that 45% of the variation in extraversion may be due to heredity and 55% to environment in a population as a whole. However, for one individual their extraversion could be mainly due to environmental triggers, while for another it might be mainly due to heredity. Behaviour is multifactorial, caused by a large number of different genes and experiences. So why bother with genetics at all if it (currently) tells you so little about the individual? First of all, I think it is important for therapists (and parents) to recognise that our ability to change in particular ways is highly variable, and 'stuckness' should not be labelled and judged as resistance. Secondly, awareness of genetics can allow the individual to accept or forgive themselves for who they are. Thirdly, for attributes with extremely high heritability estimates, there is a very good chance that the individual has a genetic predisposition to this condition, and there are likely to be severe biological limits on the possibility of changing this trait. This is not to say that such a client cannot be helped towards self-acceptance with regard to a particular inherited tendency, or to change in all sorts of other ways – we are all much much more than our labels.

High heritability does not necessarily equate with genetic determinism. Environmental change is possible, sometimes even for single gene disorders such as phenylketonuria, where the genetically-mediated mental retardation can be avoided by eliminating phenylalanine from the diet. The multifactorial nature - multiple genes and environmental triggers all interacting in complex ways - of psychological traits makes them far more susceptible to environmental change. Furthermore, variants of genes associated with disorders are not necessarily 'bad': for example, an allele associated with novelty-seeking may facilitate useful and/or antisocial behaviour. Likewise, schizophrenia and creativity may be related: Albert Einstein, James Joyce and James Watson (who along with Francis Crick discovered the structure of DNA) all had children with schizophrenia (Flint et al. 2010: 9).

Shared and Nonshared Environment

Genetic studies have revealed something surprising about environment - and about family dynamics. The role of environment can be divided into the contributions of shared and nonshared environment. The former is defined as the sum of environmental factors responsible for resemblance between family members living together. The latter is the sum of environmental influences that do not contribute to resemblance between family members, but is unique to the individual. It turns out that *for most psychological traits, family resemblance is almost entirely due to shared heredity rather than shared environment*. Although family environment does not contribute to the similarity of family members (shared environment), it could contribute to their differences (nonshared environment). This supports what family therapists have observed for some time now, that siblings take on individual roles within families. The few exceptions to this rule are cognitive ability, attachment and separation anxiety disorder and possibly conduct disorder, all of which display a significant influence due to shared environment.

Rutter (2006: 84-87) critiques the methodology involved in distinguishing between shared and nonshared environment. Nevertheless, he concludes that 'despite these methodological and conceptual considerations, the basic message remains valid and important. That is, it is usual for family-wide influences to impinge differently on the children of a family. For example, when one parent is depressed and irritable, it will often be the case that just one of the children receives the main brunt of the parental irritability' (Rutter 2006: 87).

One conclusion we can draw from this is that a client's desire to emulate a more-favoured sibling is doomed to failure. Such an attempt will be sabotaged by both the family system and by the self, because we have strong needs to behave and to treat each other as unique individuals. Furthermore, it is questionable whether the ostensible reason why one child is or appears to be favoured over another is in fact the real reason.

Genetic Overlap between Disorders

Patients with one psychiatric condition have nearly a 50% chance of having an additional disorder within a 12 month period. It has been shown that the same collection of genes is responsible for a number of different disorders. For example, there is substantial genetic overlap between generalised anxiety disorder, panic disorder, agoraphobia and social phobia, and the differences between them are caused by nonshared environmental factors. The greatest similarity is between major depression and generalised anxiety disorder. These are identical genetically (correlation of 1.0), while nonshared environmental factors partially differentiate the two conditions (correlation of 0.51). Genetic research implies two broad categories of disorder. Internalising disorders, which include depression and anxiety, are an extreme form of the neuroticism personality trait; these are twice as prevalent in women. Externalising disorders include alcohol and drug abuse and antisocial behaviour and are more common amongst men. Again, it is nonshared environment that contributes to the different manifestations. (See Plomin et al. 2008: 220-223 and Flint et al. 2010: 64-66 for a more detailed discussion). The gender differences probably depend on differential regulation of gene expression in men and women - mediated by sex hormones, and possibly also by differences in the social environment.

Since genetic risk factors impact on groups of disorders rather than individual diseases, it may well happen that during treatment one set of symptoms is replaced by another. Because of this, psychotherapy may need to be targeted to the disorder group: for example, internalising disorders as a whole, rather than depression as a single manifestation.

Genotype-Environment (G-E) Correlation and Interaction

Human behaviour is not simply the result of the *sum* of our genetic and environmental influences. Heredity and environment are *intertwined* in two different ways. Firstly, there is a modest genetic influence on *exposure* to environment (heritability of 27% across 35 measures). This correlation implies that people create their own experiences, in part for genetic reasons.

Furthermore, there is a genetic *susceptibility* to environment: the effects of the environment can depend on genetics and the effects of genetics can depend on the environment. There are a number of well-studied examples of this G-E interaction. One of these depends on the interesting finding that there is a genetic risk for crimes against property, but not for violent crimes. Adoptees at genetic risk for this kind of criminal behaviour (i.e. with biological parents who were criminal) were found to be more sensitive to environmental risk (adoptive parents who were criminal) than adoptees who did not have this genetic risk. A second example concerns the gene coding for monoamine oxidase A (MAOA) which metabolises a wide range of neurotransmitters. A variant in this gene is associated with antisocial behaviour, but only when the individual has suffered severe childhood maltreatment. Neither the gene variant alone nor childhood abuse alone lead to subsequent antisocial behaviour; only the interaction between the two produced the behaviour. A third example of G-E interaction concerns the gene coding for catechol-O-methyltransferase (COMT), which along with MAOA, is involved in degrading the neurotransmitter dopamine. Cannabis use has been found to be associated with later psychotic symptoms, but only in individuals with a particular allele of the COMT gene.

It is likely that many more examples of G-E interaction will emerge as more genes are identified that have an impact on behaviour. They should make us very wary of any simplistic genetic determinism. The effects of a single gene depend on environmental factors – as well as on the genetic background in which they are set.

Behavioural Gene Expression

Genes are not expressed all the time or under all conditions. They are susceptible to temporal regulation, tissue-specific and environmental regulation. Unfortunately, almost nothing is known so far about the environmental factors that may regulate expression of genes that play a role in behaviour or psychological state. This is partly a result of the very large number of genes implicated in psychological traits, which has made them difficult to identify. Furthermore, it is not easy to study gene regulation in the living human brain, and well-matched environmental controls are very

difficult to generate in human populations. However, Michael Meaney and colleagues have pioneered this kind of work in rats. It turns out that there is considerable variation amongst rat mothers in nurturing behaviour (licking, grooming and 'arched-back' nursing), which is not associated with *time* spent with pups. These variations in maternal behaviour were correlated with the baby rats' behaviour and response to stress: good nurturing produces less stressed progeny. Maternal behaviour influenced tissue-specific expression in the offspring of genes involved in the endocrine response to stress. Good nurturing resulted in the methylation and resultant down-regulation of a glucocorticoid receptor gene in the hippocampus part of the brain; this had knock-on effects on the activity of the neurotransmitter serotonin. This stable alteration in gene expression resulted from maternal behaviour only during the first week of life (see Rutter, 2006: 212-216 for a description of Meaney's experiments), but had long-term effects on the offspring of these mothers.

These epigenetic effects are very unlikely to be limited to this particular example in rats. Rutter speculates that 'the most plausible extrapolation is to effects from environments in utero and in the early postnatal period that have enduring effects that persist into adulthood. This would apply to effects of diet, toxins, drugs (including alcohol) and probably sex hormones' (2006: 216). He goes on to suggest that epigenetic marking is most likely to apply to developmental programming whereby early experiences lastingly affect later development. It is probable that in future years genetics will provide a molecular description for what psychotherapy already intuits about the effects of early upbringing on the creation of adult psychology and behaviour.

Conclusions

The major models of psychotherapy view psychopathology as resulting from psychosocial adversity, causing either childhood deficits or inner conflicts. Both of these views imply that the environment – particularly the parental environment - is at fault. Jang (2005) cites Livesley (2001) who suggested that 'conflict and deficit models need to be supplemented with a vulnerability model of psychopathology that explicitly recognises genetic predispositions' (Jang 2005: 13). Livesley suggests that inherited psychopathology can be treated by helping the client towards acceptance, including developing a creative awareness of the adaptive features of their condition: e.g. greater sensitivity, creativity or access to an inner life. Remembering that the environment *interacts* with our genetic predispositions should help us avoid genetic determinism: so that if we are exceptionally sensitive to stress for example, we can still avoid stressful situations to some extent, control our environment by learning assertiveness, and learn relaxation skills to attenuate expression of our susceptibility to stress.

An awareness of inherited predispositions towards particular traits or conditions brings the psychotherapist to a greater acceptance of human frailty that applies to all of humanity, not just some clients who have acquired a label. We all have an inheritance that makes us more adapted to some environments and less so to others; we are variously vulnerable, depending on the situation in which we find ourselves. What genetics teaches the psychotherapist is an acceptance of the individual for who he/she is and a willingness to be learn from the client not just about what is desirable, but also what is possible for them. Any residual beliefs about client resistance or malingering should be shelved: clients in therapy do the best they can. This is not to say that they cannot be educated into new and more creative ways of living. Therapy is, indeed, the art of the possible.

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REFERENCES

Flint, J., Greenspan, R.J. & Kendler, K.S. (2010). *How Genes Influence Behaviour*. Oxford: Oxford University Press.

Gerhardt, S. (2004). *Why Love Matters: how affection shapes a baby's brain*. Hove: Brunner-Routledge.

Jang, K.L. (2005). *The Behavioural Genetics of Psychopathology*. New Jersey: Lawrence Erlbaum Associates.

Plomin, R., DeFries, J.C., McClearn, G.E. & McGuffin, P. (2008). *Behavioural Genetics*, 5th ed. New York: Worth.

Rutter, M. (2006). *Genes and Behaviour*. Oxford: Blackwell.