



Playing with genes

Craig Hassed, MBBS, FRACGP, is Senior Lecturer, Department of General Practice, Monash University, Melbourne, Victoria.

The debate on the relative importance of 'nature' versus 'nurture' or genetically predetermined versus behavioural and socially determined, has raged as long as history itself.

On balance and evidence, one would have to say that both are obviously important. If we get 'dealt our hand' at birth we certainly get the chance to play the hand out as we live and in the process make the best or worst of what we started with.

Mental state and gene expression

It is easy to become fatalistic about our genetic makeup. 'If it is written in the genes then it must be so'. But genes seem to be far more complex than that. For example, there are surprising connections between our genetic makeup, mind and behaviour that suggest genes are far more responsive and malleable than we think. Initial research from animal studies^{1,2} and more recent research from human studies suggests that mental state affects genetic function and expression. Negative mental states have been found to increase the number of genetic mutations. Furthermore, they seem to also impair the body's ability to repair mistakes which has implications for things such as the genesis of cancer and other diseases.^{3,4} These effects may be mediated by a variety of mechanisms such as elevations in chromosomal aberration and effects on DNA repair enzymes like methyl transferase. The ability of the cell to repair this damage is measured by what is called DNA repair capacity (DRC). Studies done on healthy medical students confirmed that during high stress periods,

such as during exams, compared to low stress periods, such as after vacations, there was an increase in DRC in most subjects. This implied an adaptive response to increased DNA damage associated with the stress of exams. Interestingly, the students who had higher and more chronic levels of stress and mood disturbance had no change or a reduction in DRC during the high stress period suggesting that the repair mechanism had been impaired in some way, ie. the body was losing its ability to compensate.

Also important is the observation that psychosocial factors affect genetic expression and influence the development of various diseases, predisposing to addictive behaviours,⁵ cardiovascular reactivity,⁶ depression,⁷ schizophrenia,⁸ asthma⁹ and many other things. This begins to explain why stress and depression are such a common trigger for many illnesses. It would seem that genetic disposition is often lying dormant but can be triggered by events which lead to its playing out, rather like clicking onto an icon on a computer to start up a program.

'New genetics'

If one was to name a field of endeavour in the biological sciences which heralds the new millennium it would have to be the role of the 'new genetics'. Recently the human genome has been mapped leading to a flurry of excitement and activity in many areas: clinical medicine, pharmaceutical development, ethics, business and patent attorneys. The public is experiencing somewhat mixed emotions ranging from fascination to fear. Indeed, the new genetics may have

opened up a brave new frontier of medical science or a Pandora's box, but either way the enthusiasm and promises almost seem to run unbridled.

There will be enhancements to life span, alterations to personality, like intelligence. In the not-too-distant future, it will be looked at as kind of foolhardy to have a child by normal conception.

*Gregory Stock, Director,
Program on Medicine,
Technology and Society, UCLA.¹⁰*

One can picture the scene now; a young couple sitting in a showroom examining display models and thumbing through catalogues of desirable features they would like their new 'designer baby' to have, perhaps even wondering if they can afford some of the 'extras'.

Whether or not this is a good thing for society to pursue is debatable but it is likely that much of the drive is economic. Perhaps it is just another example of the commodification of something which nature, in her generosity, provides free. It may be we are trying to find expensive and complicated solutions to problems which have far simpler causes? Justifying the push into the genetics age are often unquestioned assumptions that we can actually understand what we are reading in the genetic code and that we can do a better job than nature.

No one would ever invite the human genome to a party. It is long winded, highly repetitive and frustratingly full of intriguing stories that it has no idea how to tell in an organised way.

*Nicholas Wade,
The New York Times science columnist*

Does nature know best?

Does this quote reflect the long windedness and disorganisation of nature or does it reflect how little we understand about genetics? If I were a betting man I would put my money on the chance that nature does nothing without a reason whether we know what it is or not. And if we know little about something then can we really use it safely? Will we inadvertently create problems on a major scale? As a parallel, it was early in the 20th century that following the discovery of radium and uranium a myriad of potential uses were being touted for these new 'wonder elements'. In a way, they heralded a previous 'new age' of scientific discovery, the 'nuclear age'. Radium was used for everything from removal of skin blemishes to the tinting of hair and making watch faces glow at night.¹¹ It was, of course, some decades later until the harmful effects of radium were recognised and its use curtailed. Marie Curie herself was thought to have died from the effects of radiation exposure. Apart from limited uses such as in medical settings and some power generation, the great legacies of the nuclear age have been huge arsenals of unimaginably destructive weapons and stockpiles of incredibly toxic nuclear waste materials waiting for hundreds of thousands of years to pollute food chains and water supplies.

One wonders if there will be a similar legacy of the new genetics in a few decades from now if experimentation goes on unbridled and if so, what will it be? Will we open doors to disease vectors such as viruses for which we have no immunity and which, until now, had been barred entry due to genetic incompatibility? Will we run down the important gene pool and diversity of species in food chains? Will it be an economic burden as we pay for things that were once free, such as patented seed? Will we think that we are releasing 'friendly' species into the environment which time will reveal to be about as environmentally friendly as the cane toad? Well, at least it seemed like a

good idea at the time. Perhaps least tangible but potentially most important, do we subtly diminish what it means to be human by dissecting ourselves in such a reductionist way?

We will not understand important things like 'love' by knowing the DNA sequence of homo sapiens... If humanity begins to view itself as a machine, programmed by this DNA sequence, we've lost something really important.

*Francis Collins,
Head of the Human Genome Project¹²*

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