GENES AND THE ENVIRONMENT

It's in the genes -- and their response to nature by Gene Robinson

'THE right genes make all the difference.' Or so declares an advertisement, as a boy portraying the son of Andre Agassi and Steffi Graf holds his own in a match against professional Taylor Dent. While neither science, nor this television commercial, can explain much about how the genes of the stars' son might affect his tennis game, people are comfortable linking genes to athletic prowess.

Many people, however, are leery of attributing other components of behaviour to genes - personality or intelligence, or social traits like fidelity. They are troubled by the ethical implications of genetic determination; it is as if giving a nod to genes diminishes the role of the environment and free will automatically. It is nature versus nurture: A debate that has spawned extremist views on both sides, from Nazism (nature) to Marxism (nurture).

The truth of the matter is that DNA is both inherited and environmentally responsive, and recent findings from animal studies go a long way towards resolving nature versus nurture by upsetting the assumption that the two work differently. The discoveries emphasise what genes do (producing proteins that are the building blocks of life), rather than simply who they are (their fixed DNA sequence).

The results hold the promise of breakthroughs in our understanding of human behaviour and what factors might influence it. They also pose challenges for policymakers: New types of genetic profiling to try to predict behaviour could produce more debates about balancing personal privacy with the need to protect the public.

The studies show that some genes cause the brain to respond differently depending on inheritance or environmental factors. For example, fruit flies inherit different versions of a gene that helps make them slow- or fast-paced foragers for life. But this very same gene that is fixed forever in these different types of flies can change in the honeybee depending on the needs of the hive, allowing a bee to shift from working in the hive to collecting food from flowers.

Monogamy is another behavioural trait that is influenced by inherited factors, at least in voles. Some species of voles are more faithful to their mates than others. The genes show

inherited differences in activity in the brain, but the activity is dynamic and dependent on the voles' experiences.

Some genes that are affected by environmental conditions have life-long consequences. Rat pups that are cared for poorly by their mothers show profound changes in brain gene activity and are bad mothers themselves.

These animal behaviours may be simpler than human behaviours, but they are complex and are performed over days, or weeks, or lifetimes, with learned components. And they all involve molecules known to operate in human brains.

What these studies show is that the genome is responsive over different scales of time. Like the voles and fruit flies, individuals may differ in gene activity because of DNA variations they inherited. These differences evolve over very long periods of time, from generation to generation. This is nature.

Individuals may also differ in gene activity because of variations in their environment, like the rats and honeybees. These differences occur over shorter times, within individual lifetimes. This is nurture.

Much as people like to divide themselves into nature or nurture camps, what genes actually do in the brain reflects the interaction between hereditary and environmental information. Both sides could find crucial common ground by appreciating the responsiveness of the genome over different time scales.

The odds are long that young Jaden, the Agassis' son, will grow up to be a tennis star. But maybe he will. If so, my bet is that this will be a result, in part, of both his Grand Slam heritage and tennis lessons, both influences acting on his brain to create connections between gene activity and tennis activity.

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