Am I an insect?

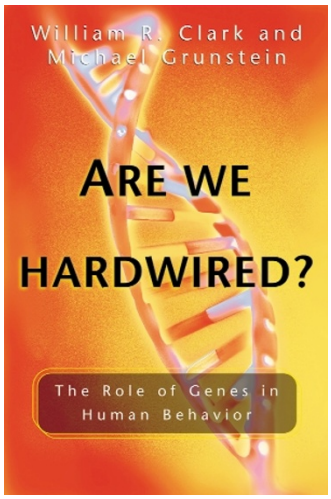
Are We Hardwired? The Role of Genes in Human Behavior
by William R. Clark & Michael Grunstein

Oxford University Press, $27.50, ISBN 0-19-513826-0, 2000

Reviewed by Jonathan Flint

Wellcome Trust Centre for Human Genetics, and Institute of Molecular Medicine, John Radcliffe Hospital, Oxford, UK

The behaviour of insects is described as being 'hardwired'. Which is not to say that it can't be complex, as seen from E.O. Wilson's description of the behaviour of a pair of burying beetles of the genus *Necrophorus*: equipped with the corpse of a small invertebrate, they "excavate the soil beneath or around the body until the prize is partly buried. At the same time they chew and manipulate the putrefying mass until it is roughly spherical in shape and can be rolled off the burrow from below, entombing themselves with the rotting ball. The female proceeds to seat out a crater shaped depression on the top of the ball and to spread her faeces over the surface. When the larvae hatch, they sit in the crater like so many baby birds in the nest." As far as we know, the parental behaviour of *Necrophorus* is hardwired. Like the complex behaviours of ants, bees and wasps, it is a biological given, almost certainly encoded in the insect's genes.



Whether or not you find a baby *Necrophorus* reaching up to its mum in a manner reminiscent of the behaviour of mammalian young, there is a long tradition, and much evidence, that says human behaviour is different. Human behaviour is flexible, characterized by freedom from genetic, or other, determination. If our infinitely more complex behavioural repertoire, our capacity to talk, to think and all that goes with those faculties, were genetically hardwired, then we should have a genome that is much more complex than that of other creatures. But we haven't. In fact, as Sydney Brenner argued, if you are interested in what genes we have, you might as well sequence the puffer fish, because its genome is much more compact than ours. Despite the fact that we have much bigger brains in proportion to body size than any other animal, we do not have that many more genes. So why would anyone ask whether *we* are hardwired, as do William R. Clark and Michael Grunstein in their book, *Are We Hardwired? The Role of Genes in Human Behavior*. Isn't there a simple answer to this question, one too short to fill a page, let alone a book?

One of the reasons is eugenics, or as Clark and Grunstein more dramatically put it: "the possibility that we may be able to purge harmful alleles of certain genes from the human species raises the spectre of defining a new category of the 'genetically unfit' in human society and has brought some to raise the red flag of eugenics before us once again." They suggest that once we have identified the genes that influence variation in intelligence quotient, aggression, sexual orientation, then some people will want to use this information to "manage their own reproductive affairs. Past history tells us that if such people gain political power, they may also try to impose their views on societies as a whole." Clark and Grunstein argue that the way to prevent such change is for us to "think very seriously about this". Their book has a political purpose: to make us think about the genetics of behaviour so that we don't "plunge headlong into a renewed and even more disturbing flirtation with eugenics".

Another reason is the remarkable story that has emerged recently, and is recounted here, of the identification of genetic mutations that have relatively specific effects on behaviour. Ever since Seymour Benzer identified behavioural mutants in *Drosophila melanogaster*, it has been clear that a genetic dissection of behaviour is possible. Now we know, in a striking parallel with the conservation of developmental genes between species, that the same behavioural genes, and the same pathways of which they are a part, are found in insects and mammals. We know that there are common components of circadian clocks in flies and mammals, and that differences in short- and long-term memory depend on the cAMP-signalling pathway in mammals just as they do in flies. In addition, complex patterns of behaviour can be related to naturally occurring allelic variants. For example, alleles of a gene encoding a cGMP-dependent kinase determine differences in foraging behaviour in *Caenorhabditis elegans*, and whether a prairie vole grows up to be monogamous or polygamous depends on which allele of the vasopressin receptor gene it inherits.

Others have told this story: personally, I prefer Jonathan Weiner's narrative in *Time, Love and Memory*. There is more of a textbook feel to Clark and Grunstein's account; they have not spoken to the scientists as much as Weiner, so one does not get a feel for just how much controversy surrounds some of this work. (For example, following the publication in *Cell* of the discovery that alleles of the *white* gene determined a fly's mating behaviour, and the observation that this might be a clue to human homosexual behaviour, Jeff Hall is quoted as saying: "It's completely silly…. The chance of this is one over the number of neutrons in the universe.") And Clark and Grunstein overlook the work on single-gene mutations that affect human intelligence. The finding that different forms of non-specific X-linked mental retardation arises from mutations that affect Rho GTPase signalling pathways is surely as relevant to their book as the genetics of obesity (which gets a whole chapter). There is also no mention in their book of the work on autism and dyslexia.

The finding of behavioural mutants raises the unwelcome thought that perhaps the behaviour of at least some of us might be subject to the direct influence of genetic mutations. Fortunately, with the exception of some extremely rare syndromes, this does not seem to be the case. In fact genetic analysis has not told us much about, well, *real* human behaviour: what makes you more emotional, more aggressive, more prone to drug addiction than I am. Clark and Grunstein are optimistic here, promising us wonderful revelations very soon—but I wonder. Genetics is good at telling us about how neurons work, which is the stuff of memory, of the basic cell biology without which we would have no behaviour. But no one really knows whether genetic mutants are a useful model for understanding how allelic variants contribute to variation in human behaviours. Clark and Grunstein concede, "genetic complexity seems an unlikely explanation of human behavioural complexity". Knowing the genetic variants associated with variation in aggression or addiction won't explain those behaviours; if we are lucky, it might allow us to design experiments to ask what does. □