GENES AND HUMAN BEHAVIOR: THE EMERGING PARADIGM

by Allan P. Drew

Abstract. The physical properties of human beings and other organisms as well as their social behavioral traits are manifestations of both genetic inheritance and environment. Recent behavioral research has indicated that certain characteristics or behaviors—such as schizophrenia, divorce, and homosexuality—are highly heritable and are not governed exclusively by social environment. A balanced view of human behavior includes the effects of social learning as well as of genetically determined behavior. A new paradigm promotes enhanced understanding and acceptance of human diversity, be it cultural, racial, or sexual, and has the potential to unite scientists and theologians by creating common grounds of understanding.

Keywords: behavior; diversity; genetics; homosexuality; inheritance; sociobiology.

Since Charles Darwin's *Origin of Species* ([1859] 1968) it has been understood that the observable properties of an organism are a result of the interaction between two forces: the process of natural selection, which favors specific genotypes, and the influence of the organism's environment, which modifies the expression of an individual's genes to create certain outwardly visible properties, collectively referred to as the *phenotype*. Body weight and height of human beings, leaf shape and height growth of trees, and tail length of mice are traits of organisms that result from the interaction of genetic and environmental effects. Other traits—such as hair, eye, and skin color in human beings—depend more on genetic than environmental effects and, hence, are highly heritable.

Edward O. Wilson wrote in *Sociobiology* (1975) that social behavior of animal populations has a biological basis that may be systematically studied. His own work on insect communities—as well as other work with bird, monkey, rodent, fish, and other populations—suggested that

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social behavior and social organization were manifestations of underlying biological principles that had both genetic and environmental bases. Learning, socialization, play, and tool using could be traced to varying roles of both factors. Humans, being governed by the same evolutionary forces, were said to have social behavior traits that were heritable. The relative roles of nature (genes) and nurture (environment) in controlling such behaviors as intelligence, aggression, and altruism, however, have been difficult to define. Conventional wisdom has been that, nearly without exception, all cultural variation is a product of social environment (of factors causing learned changes during individual lifetimes), rather than of genetic origin. This view was reflected in the extreme behavioralism of B. F. Skinner (Skinner 1971).

Behavioral Genetics Research

In the past several years, studies in psychology, neurobiology, and molecular genetics have used refined techniques to provide additional evidence regarding the basis for observable variation in human behaviors (Bouchard Jr. et al. 1990; Hamer et al. 1993; McGue and Lykken 1992; Oberle et al. 1991; Plomin et al. 1994). It is obvious in cases of genetic diseases such as dwarfism, Down's syndrome, and other forms of mental retardation that the disabilities were predisposed at birth through errors in the transmission of genes from parents to offspring. Often, a single defective gene is implicated in these cases, but the normal trait may be the result of multiple genes working together (Scott 1989). The most common form of mental retardation, fragile X syndrome, recently has been linked to abnormalities on the long arm of the X chromosome (Oberle et al. 1991; Yu et al. 1991). Mental illnesses—specifically, schizophrenia and, recently, obsessive-compulsive disorder—have been linked to deficiencies in brain-produced chemicals and, additionally, in the case of the former, to a gene on chromosome 6 (Wang et al. 1995). Brains of obsessive-compulsive people have low levels of a chemical called serotonin (Jenike et al. 1990). The illness is treatable through medicine or behavior-modification therapy (Dewan 1992; Jacobs 1994). Low levels of serotonin may be the *result* of the psychiatric illness, however, and not the *cause*, if a result of environmental influences.

In the case of schizophrenia, studies of identical male twins show that a healthy individual has a 30.9 percent risk of developing the disease when his sibling has the disease. For fraternal twins the rate has been shown to be 6.5 percent (Kendler and Robinette 1983). For the general population the incidence is about 1 percent. A strong genetic component influencing the onset of the disease has been demonstrated, whether it shows up early in life or later. However, 30 percent is a long way from 100 percent, which would be the incidence of schizophrenia if

it were entirely heritable. Compare 30 percent with a physical trait such as the rate of growth in height, where the heritability based on studies of identical and fraternal twins is 90 percent, of which 10 percent is a result of nongenetic, presumably environmental, effects.

Recently, other human behaviors have been shown to have significant genetic components. Suicide incidence has been shown by Brent (1992) to have a moderate tendency to run in families. He concludes that a person from a family of someone who attempts suicide has a higher risk of suicide than someone from a family with no suicide attempters. Again, the brain neurotransmitter serotonin seems to be associated in low amounts with a disposition to commit suicide (Coccaro 1992).

In the case of alcoholism, males younger than age twenty have substantial heritability for alcoholism. The genetic influence on alcohol predisposition seems to be very age-gender specific, with only modest effects seen in older men and in women (McGue et al. 1992). This finding suggests that some individuals may have to face a genetic-behavioral challenge in young and mid-adulthood that, if successfully withstood, will eventually provide relief as the effects of the gene(s) are outgrown. Comings et al. (1991) report finding a 42–55 percent increase in the prevalence of a dopamine receptor gene, which may increase the severity of symptoms, among people with alcoholism. The same gene may be involved in a wider range of addictive disorders, as Noble et al. (1993) have found it associated with cocaine addiction in Caucasian males. In these and other mentioned studies in behavioral genetics, ingenious statistical techniques separate genetic from environmental effects among a large sampling of twins or otherwise-related family members (Bouchard Jr. et al. 1990; McGue and Lykken 1992).

Divorce is another behavioral attribute on which there seems to be substantial genetic influence. McGue and Lykken (1992) surveyed the incidence of divorce in a group comprising 1,500 pairs of identical or fraternal twins and their spouses. The occurrence of divorce among these couples was correlated with divorce rates among the twins' siblings—whether fraternal or identical—and also among the parents of both spouses. Statistical calculations predicted that a couple where both spouses were identical twins, but unrelated to each other, had only a 22.5 percent probability of lasting marital success if the twins' siblings and the parents of both spouses all experienced divorce. At the other extreme, if the siblings and both sets of parents all maintained an intact marriage, then the subjects' marriage had a 94.7 percent chance of permanence. Concordance for divorce was significantly greater among identical than fraternal twins. Using good statistical reasoning to separate the environmental and genetic factors with confidence, the heritability for divorce was found to be 52 percent. Although the study did not specify the mechanism that

generates the association, the inherited basis for divorce risk probably rests in multigenic factors related to personality characteristics, personal values, and individual capacity for happiness, the subject of the authors' continued work.

Homosexuality may, in addition to those conditions already mentioned, have a basis in human genes. A study of the brains of homosexual men revealed that the anterior hypothalamus, the part of the brain that governs sexual behavior, had the anatomical form found in women rather than that found in heterosexual men (LeVay 1991). Schoenfeld (1991), however, has pointed out that the brain is a product not only of genetic directions but of early experience and social environment, and LeVay's study has yet to be replicated by other researchers. In other work, however, Bailey and Pillard (1991) estimated the genetic component of homosexuality to be between 30 and 70 percent. Of 161 homosexual men whose brothers were identical twins, fraternal twins, or adopted, 52 percent of the identical twins were homosexual, as opposed to 22 percent for the fraternal twins and 11 percent for the adopted brothers. Current thinking is that homosexuality is about 50 percent inherited. Many homosexual persons say that they felt somehow "different" from other children (Isay 1989).

Most recently, Hamer et al. (1993) have shown through pedigree studies of families of seventy-six homosexual men that the trait was more common on the maternal side of the family. From DNA linkage analysis of families of forty homosexual brothers, the authors showed with 99.5 percent certainty that a small stretch of DNA on the X chromosome, inherited exclusively from the mother, contained the gene or genes that predisposed a male to become homosexual. Yet all male homosexuality was not explained by the one site. The researchers' evidence suggested that other causes, genetic as well as environmental, must be involved.

There is an element of controversy surrounding the preceding series of examples illustrating the genetic bases for human behaviors, more so in some cases than in others. Homosexuality is mentioned because it is a current topic of considerable interest to laypeople and researchers. Thomas J. Bouchard et al. are engaged in a continuing study of 100 sets of identical and fraternal twins reared apart. They have concluded, regarding the sources of the psychological differences between people, that "(1) genetic factors exert a pronounced and pervasive influence on behavioral variability and, (2) the effect of being reared in the same home is negligible for many psychological traits" (Bouchard et al 1990). Their general finding so far is that 70 percent of the variation in IQ has a genetic basis. In recent work, Bouchard (1994) showed that about two-thirds of the measured variance in personality traits is a result of

genetic influence. Robert Plomin et al. (1994), summarizing many quantitative and molecular genetics studies to date, have concluded that inheritance plays a major role in behavior. Although much of what is known about the genetics of complex human behavior comes from studies in quantitative genetics, it is the merger with molecular genetics that will point the way to future progress.

In summary, if many human behaviors are rooted in the distinctness of human genes, it must be concluded that the predispositions to such behaviors are present at birth even though the phenotype is not manifested till later in the life cycle. It is genes that determine the extent to which behavior may be expressed and the environment that creates either limited or full opportunities for expression. Nevertheless, to suggest that human behavior is affected and determined exclusively by social environment is to ignore much recent work regarding the biological roots of behavior as well as older classical studies. Although research on medical disorders has provided strong evidence of the genetic role, a wide range of "healthy" personality traits must also be linked to genes.

A New Paradigm

Perhaps it is necessary to understand that each of us carries into this world from birth genetically ordained behaviors, some of which may be uplifting and life fulfilling and others detrimental to the human condition. Indeed, if investigators such as Bouchard et al. (1990, 1994) and Plomin et al. (1994) are correct, many of the psychological differences between individuals are present at birth, changes in personalities over whole lifetimes being largely predetermined by gene action. Thus, we are not each endowed at conception with identical (genetic) potential to become successful mature human beings in family and society, as the prevailing social environment model would suggest. Rather, much of the psychological and social behavioral variation that we exhibit as adults may very well have been largely present at birth—unnoticed yet indelibly imprinted in the DNA of each set of genes, awaiting outward expression. It should not be assumed that any two individuals at birth, if other factors such as family nurture and education are taken to be constant, have equal potential to contribute to society and to live satisfying, fulfilling lives. Yet this is the behavioral model or paradigm that seems to be most accepted by Western culture. Its origin may stem from the eighteenth-century-Enlightenment teaching that all people were created equal. We seem not to be ready to accept the thought that we have been born into this world with a depth of psychological and social difference that transcends apparent outward qualities of male or female sex, blue or brown eye color, curly or straight hair, yellow or black skin, or differences in body form.

Beyond the recognizable physical qualities in each of us lie a broad spectrum of gene-related, yet-to-be-expressed personal qualities that add depth and understanding to sex and phenotypic difference. To suggest the presence of such unapparent qualities is to state a biological fact; to attach a value judgment is to make a statement of morality. Wilson spoke of "the morality of the gene" (1975, 3). An organism, in his terms, does not live for itself; its importance is as a carrier of genes from one generation to the next.

Natural selection is the slow process by which certain useful, adaptive genes are inserted into the next generation. Adaptation may occur at genetic, physiological, behavioral, or social levels of organization. Environment exerts selective pressure to ensure that the right genes are in place to maximize individual fitness in interbreeding populations. If behavioral or organismic evolution is to occur, differential survival at those levels must "feed back" into physiological processes that are genetically determined, allowing natural selection to occur. As John P. Scott (1989) discussed, differential survival may occur on every level of organization.

Does the emerging paradigm suggest a different way of associating the consequences of individual action with the person performing those acts? If behavior is mediated through genes present at birth, genes perpetuated in the family lineage by the successful life of ancestors, that ancestry must bear some responsibility for present-day actions of the descendent. It matters not whether the behavior under consideration is 70 percent or only 30 percent inherited, one's forbears assume at least some of the responsibility for the genes, and hence for the behavior, passed upward along the lineage. As grandparents, parents, and their offspring possess similar genes, behavioral similarities must be present. Perhaps, as Wilson (1975) implied, we should speak of the morality of the family lineage.

As we develop increased understanding based on the emerging paradigm and start to view ourselves in a different light as social beings, we should become more tolerant of one another's actions. Knowing that we often act in genetically predetermined ways, rather than in ways for which we as individuals may be rendered presently accountable, changes the perspective on moral behavior. The new understanding may foster a sense of community, if recognition of our genetic roots in the lives of ancestors leads to increased awareness of a common behavioral heritage. If we appreciate the depths and origins of behavioral diversity that define "civilized" human beings, we are less likely to look askance at those whose outward behavior or appearance seems at odds with some predetermined view. Prejudice—whether manifested as sexism, racism, nationalism, or any other -ism—cannot survive where diversity is seen and understood as the norm rather than the exception.

The theologian Walter Wink suggested that "in the popular mind there are two kinds of people: normal and abnormal; normal and deformed; normal and disabled" (Wink 1993, 1). The idea of normalcy arises from the thinking that, because all persons were created equal, it is the individual's own fault if he or she has a mental or physical disability. The Enlightenment doctrine of equality has contributed to the dichotomous, prejudicial view of humanity as "we-they"—the "we" being those who are normal and the "they" those who are abnormal—rather than the view of ourselves as organized along a continuum of individual uniqueness. The new paradigm that explains psychological and social behavior in terms of modern biology and the role of genes promotes the concept of human diversity present at birth, undermining the false notion of normalcy.

As an example, if the sexual tendency toward homosexuality is registered from birth in genes, it is not fully an acquired behavior based on successive personal choices during an individual's lifetime. Rather, the predilection to homosexuality may be very strong in some individuals, 4.1 percent of males and 2.6 percent of females in the population, according to a recent French government survey of more than twenty thousand people aged 18 to 69. (Aldhous 1992). Understanding that sexual preference may be linked to genes may remove or limit the element of choice. Whether we view homosexuality as right or wrong and therefore a matter of morality, as public debate would have it, may not be the fundamental question. The real question may relate to why significant numbers of genes for the expression of homosexuality are present in human populations to begin with, indicating some selective advantage, and what benefit they may confer upon the species.

Wilson (1975) envisioned male homosexuals in primitive societies functioning as helpers either in hunting in company with other men or in carrying out domestic duties. By so doing they increased the reproductive success of related individuals, thereby countering their negative effect on population fitness through their own failure to reproduce (Trivers 1974). Genes favoring homosexuality could then have been sustained at a high equilibrium level by kin selection.

That there may be little homosexuals can do to alter sexual preference, even if they want to, changes the focus on the issue. It then becomes necessary to accept human sexual diversity rather than to find ways to limit it. The question becomes less a moral one and more a statement of biological fact. Diversity is seen as fundamental and, therefore, acceptable; an increased community may result from that common awareness.

A Balanced View

The emphasis of the foregoing discussion has been on the roots of human behavior inherited via the carrier DNA. It should by no means be construed that inherited behavior is not amenable to change if deemed inappropriate by the individual or society. A new paradigm relating genes and behavior would have to account for the potential of individuals to alter their own actions through personal choice. Decisions to abstain from alcohol, return to school for a higher degree, or join Weight Watchers effect positive outcomes for individuals and for society at large. The basic principle involved is fundamental to the success of societies' judicial and penal systems, the science of psychology and psychiatric treatment, and of religion in transforming human lives. What is suggested by the new paradigm is a balanced view; that is, that much of our behavior is indelibly imprinted in our genes at birth, yet human beings have the capacity to modify and change their behavior in the interests of themselves and society. We can celebrate that diversity, present from birth, that is rooted deep in the ancestral lineage.

How can such a paradigm be found acceptable by members of today's society? The basic premises of animal behavior that have been established as fact for decades and well understood by sociobiologists and other scientists somehow seem not to apply to human beings, even though their evolution has been governed by processes no different from those of animals lower on the evolutionary ladder. Industrialized society has set itself apart from, and often in opposition to, the natural world and its inherent order and function. The emerging paradigm has the potential to unite scientists and theologians by creating common grounds of understanding. The new paradigm has much to say to those who study the spiritual foundations of human morality as well as to those who study its biological basis. Judeo-Christians would do well to examine the emerging scientific findings concerning the heritability of behavior and its implications for a new sense of moral understanding.

Sociologists and psychologists may more readily accept these new tenets than others further removed from a sociobiological interpretation of the place of human beings in the biosphere. In fact, workers in psychiatry and other behavioral sciences began to embrace a balanced view of the roles of nature and nurture in human behavior back in the 1970s. Recently, Jerome Kagan (1989) discussed inhibited and uninhibited temperament types in children and adults in which differences in disposition were attributed to behavioral as well as biological variables such as brain biochemistry.

Current resistance to the newly emerging paradigm may be seen among those who reject attempts to coordinate research aimed at identifying the social, psychological, and biological factors that lead to human

violence, the so-called violence initiative (Roush 1995). There is fear that we may learn some things about the human species that we will not like, that we may open a Pandora's box of problems we will later regret. Examples of the misuse of genetic understanding abound in the recent history of mankind. The eugenics movement in the early 1900s comes to mind, in which the science of genetics was used to justify legislation on sterilization of immigrant groups (Ludmerer, 1972). Then, there is the more-recent misuse of genetics associated with Nazi Germany in the mid-1900s.

Advances in understandings of the human species' gene pool arising from research by behavioral and molecular geneticists and others have brought us out of these dark ages of our past. Although the truth may be a double-edged sword, the potential benefits to understanding who we are as a species and insights into why we act as we do far outweigh any possible misinterpretations or distortions of what truth may emerge. With time, as scientific evidence accumulates, the revolution of understanding may draw together disparate groups who discover they really have more in common as members of *Homo sapiens* than was once thought.

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