**GENETIC INFLUENCES, EARLY LIFE**

The nature-versus-nurture debate is an important conceptual framework because it simplifies the very complex reality of genetic and environmental influences on development. The cost of this simplification is that individual differences are described as a function of either environmental or genetic characteristics rather than the simultaneous influence of genetic and environmental factors. This entry describes the ways in which researchers examine genetic influences among children and adolescents and then makes a case for simultaneously considering genetic and environmental causes. Although several relevant outcomes are linked to genetic factors such as personality, mental and physical health, and health-related behaviors, this entry focuses on cognitive functioning because of the reliability of the measure, the consistency of the findings, and the importance of the topic for social and behavioral researchers. In doing so, this entry reviews two important concepts that characterize the interplay between genes and environments. These concepts describe a situation in which a person’s genes cause their environment (gene-environment correlation) or environmental settings that change the influence of someone’s genes (gene-environment interaction). Following a discussion of these concepts, this section concludes with some general comments about this field.

**STUDYING GENETIC INFLUENCES AMONG CHILDREN AND ADOLESCENTS**

The scientific world of human genetics is rapidly changing, and hundreds of methods are currently available to researchers that describe the ways in which individuals are influenced by their genes. The complexity of this research, however, can be summarized by considering two broadly defined bodies of work: studies of twins and siblings in which genetic material is not available and studies in which study participants provide a physical specimen (e.g., saliva, blood, or tissue scraped from the inside of the cheek) that can be used to identify an individual’s genes. The purpose of this entry is to introduce these two methods and summarize some of the

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**BIBLIOGRAPHY**


major findings with respect to the influence of genetic factors among infants, children, and young adolescents.

Quantitative Genetic Studies Behavioral genetics is an interdisciplinary field composed of behavioral, social, and biologic scientists who are interested in describing the extent to which differences in individuals are explained by differences in their genes, differences in their environments, or some combination. The bulk of the research in this area is based on the straightforward observation that two siblings are more likely than two unrelated people to resemble one another in terms of their physical appearance, behavior, personality, and well-being, because full siblings are often raised in very similar settings (i.e., a similar environment) but they also inherit half their genes from the mother and half from the father; thus, they share about half the same genes. This same logic is extended to the comparison of twin pairs in which identical twins share all their genes and fraternal twins, similar to the manner in which full siblings only share (on average) half their genes. If one assumes that same-sex fraternal twins and identical twins are raised in relatively similar environments, then the excess similarity of identical twin pairs compared with fraternal twin pairs is believed to be due to the excess genetic similarity among these pairs.

Based on the results of these studies in siblings, the most consistent evidence for pronounced genetic influences is in the area of cognitive development even among very young infants. In one of the earliest studies (1972) to make this point, Ronald S. Wilson compared the statistical association between the test scores of two twins for the Bayley Mental Development Score among twin pairs from the ages of 3 months to 2 years. He demonstrated a greater similarity among identical twins ($r = .84$) compared with fraternal twins ($r = .67$) even as young as 3 months. Sandra Scarr (1993) made a similar point when she compared the similarity of IQ scores among identical twins ($r = .86$) and showed that this association is nearly the exact same as for the same person tested twice ($r = .87$)! Even more striking is that identical twins who are raised in different families ($r = .76$) still report a stronger correlation than fraternal twins who are raised in the same families ($r = .55$).

Cognitive functioning also emerges as one of the most heritable characteristics among children and early adolescents. Using data from the Colorado Adoption Project, Stacey Cherny and Lon Cardon (1994) demonstrated that genetics may account for 39% of reading skills among 7-year-old children and 36% among 12-year-old children. In one study David Reiss and colleagues (Reiss, Neiderheiser, Hetherington, & Plomin, 2000) assessed more than 700 twin and sibling pairs from the ages of 10 to 18 years. They collected information on psychopathology and competence and then compared the similarity of these characteristic among pairs of identical twins, fraternal twins, full siblings, half-siblings, and unrelated siblings. They found that genetic factors increased in salience over time and suggested that genes may account for two thirds of individual differences in cognitive agency. Similar results were reported by François Nielsen (2006) using data from high school age adolescents for grade point average and a somewhat lower estimate for verbal IQ.

Quantitative geneticists often use these designs to calculate a value called the heritability estimate. These estimates describe the degree to which differences among people are due to genetic differences; they range from 0 (in which genes are not relevant) to 1 (in which genetic
factors are fully responsible for a trait). Figure 1 provides a summary of heritability estimates for a number of different outcomes among very young children from the MacArthur Longitudinal Twin Study.

Studies with Measured Genetic Information Since the early 1990s, the field of behavioral genetics has changed dramatically. The availability of molecular information describing an individual’s genetic makeup is now readily (and affordably) available to researchers. Carefully designed studies can identify broad regions of the human genome (the entire set of all chromosomes), specific genes (smaller sections of the human chromosome that carry genetic information), and even very small pieces of the human genome called single nucleotide polymorphisms (SNPs) that may be associated with the trait of interest.

It is beyond the limits of this entry to detail the complexity of the molecular studies that are currently underway; however, there are two main study designs currently employed by researchers. When specific genes are believed to be causally linked to some outcome, then it is relatively easy to measure an individual’s genetic composition at a specific location on his or her entire genome. After an individual’s genes are measured at that location, it is simply a matter of comparing the genes of people who exhibit a particular behavior with those of a carefully constructed control group who do not exhibit the behavior. These studies are called candidate gene studies.

There are hundreds of candidate genes that have been linked to cognitive functioning and related outcomes, but efforts have primarily focused on the dopaminergic and serotonergic systems. Dopamine is one of a large number of neurotransmitters that is involved in the nervous system; this system is believed to mediate the reward pathway in the brain. Serotonin is also a neurotransmitter that is involved in brain development. The serotonergic system is linked to behavioral disinhibition, which has important implications for aggressiveness and impulsivity. Results from these studies focus on genes that influence the function of the receptors and the transporters for these two systems. Thus, although there are two main systems, multiple domains exist within each system that may operate independently from one another at times, but mostly they act in concert with one another. These systems are believed to influence cognitive development through more proximate behaviors such as temperament and hyperactivity.

The second type of molecular analysis involves studies that use information from the entire human genome to identify genetic risk (or protective) factors. Two
distinct types of studies are conducted in which large amounts of genetic information are used: linkage analysis and genome wide association studies. Linkage analysis is used to identify the location of broad chromosomal regions that may contain genes (called quantitative trait loci or QTLs) that are in some way responsible for the emergence or stability of some trait. Danielle Posthuma and Eco J C de Geus (2006) reviewed findings from five whole-genome linkage scans designed to identify chromosomal locations that are associated with cognition. These studies found that areas on chromosomes 2 and 6 consistently predict both cognition and academic achievement, but results by Plomin et al. (2005) were far less conclusive among children.

Although linkage analyses are designed to identify the general location on the chromosome, genome-wide association studies are designed to identify specific alleles that may influence complex behaviors. The human chromosome is composed of nearly 8 billion bits of information, and people differ from one another when a protein at a specific location is different in the two people; each of these minute proteins is an SNP. The goal of genome wide association studies is to identify SNPs that are causally linked to the increased risk of a disease or disorder. To date, a very limited number of studies have identified SNPs that significantly influence cognitive functioning, and the effects are very small, accounting for less than 1% of the variance (Butcher, Davis, Craig, & Plomin, in press).

SOCIAL INFLUENCES ON GENETIC EFFECTS

The preceding discussion described ways to conceptualize genetic influences on children’s development, and thus far the results have been structured around the nature-versus-nurture dichotomy. As described previously, this conceptual model serves an important purpose but is problematic because it does not consider several ways in which genes and environments interact. Genes do not exist outside of environments; environmental determinants have to go through people to affect some outcome. Therefore, to consider the effects to be independent or to be additive is to misinterpret the relative and combined influence of both sets of effects. Indeed, it is only the most basic behavioral genetics model in which characteristics are decomposed into only genetic and environmental components. Two important cautions exist with respect to gene-environment interplay that have important implications for social scientists. The first is called social mediation; it describes a situation in which specific genetic factors are regularly associated with a particular type of environment. The second is called social moderation, which is a situation in which specific genetic factors react differently in different environments. Also called gene-environment correlation and gene-environment interaction, respectively, these social influences bear heavily on the theoretical mechanisms that are behind genetic influences in early life.

Social Mediation Robert Plomin, John DeFries, and John Loehlin (1977) developed a typology of social mediation (also called gene-environment correlation) that has withstood the test of time largely intact. The first form of social mediation is called evocative correlation, which describes a situation in which people with given genetic characteristics tend to evoke similar reactions from other people. These reactions, in turn, shape that person’s social context (or his or her environment). The most widely cited example of evocative correlations comes from work in which children who are genetically predisposed to have relatively irritable dispositions may be more likely than more peaceful children to evoke hostility and impatience from their parents, siblings, peers, or teachers.

The second form is called passive correlation, and it emphasizes the fact that children inherit genetic and environmental factors from their parents. As described earlier in this entry, cognitive ability may be a highly heritable trait, and children raised by relatively intelligent parents may be more likely to be raised and socialized in an intellectually stimulating environment. Thus, the children passively inherit both the genetic characteristics related to cognitive development and the genetically influenced enriching environment. Finally, active correlation describes a situation in which someone’s genes influence the type of social environment in which he or she chooses to interact. For example, children with genetically oriented cognitive skills may be attracted to more complicated games that require and build problem-solving skills, which in turn influences positive cognitive development.

One of the central tenets of the sociologic perspective on the life course is the role of human agency: people actively construct their lives by means of those behaviors that they exhibit at different stages. Therefore, children are highly subject to the passive processes in their family, but over time they acquire more latitude in choosing and shaping their environments. Because passive and evocative gene-environment correlation (GEC) denote less agency and because the extent to which everyone’s behaviors are limited by the relevant institutions in which they reside, people at either extreme of the life course are less likely to select into social groups as a function of their genes. In contrast, adults choose their settings—that is, with whom to associate, organizational memberships, and extent and quality of involvement—and, after those choices are made, they tend to evoke reactions within those chosen contexts.
One important example is the formation and maintenance of intimate relationships that involve assortative mating. Genetic Influences, Early Life

ENCYCLOPEDIA OF THE LIFE COURSE AND HUMAN DEVELOPMENT 203

Social Moderation

The gene-environment interaction perspective poses two related models: situations in which genetic effects depend on the environment and situations in which established environmental effects vary in their influence as a function of individual’s genes. These models can be thought of as social moderation and genetic moderation, respectively. This section deals with the first orientation. The most relevant orientation for sociologists is that the environment serves as a trigger for the expression of a particular gene; a gene related to a particular outcome may only manifest as a cause in the presence of a triggering agent (strong triggering) or is expressed markedly more so in the presence of the agent (weak triggering).

In an example of weak triggering, Guang Guo and Elizabeth Stearns (2002) showed the realization of genetically oriented verbal IQ is higher among children from families with greater access to social and economic resources. Specifically, they calculated a higher heritability of verbal IQ among adolescents for whom both parents were employed compared to those with at least one unemployed parent. They showed a similar association by race in which heritability estimates are higher among White children compared to Black children. Their argument is that family stability, educational resources in the home, school-level differences, and parental educational status denote critical resources to enable genetic factors to do their work. This perspective is central to a sociologic interpretation of gene by environment interaction effects because, as Bruce Link and Jo Peltan (1995) argued, the environment should be characterized as a “fundamental cause.” That is, although genetic factors are critical to the etiology of antisocial behavior, these genetic factors depend on the social environment to initiate the cascade of events called genetic expression.

Rather than enabling genetic tendencies, the social control model refers to norms and structural constraints placed on people that limit their behavior; control stems

NATURE VS. NURTURE DEBATE

The nature versus nurture debate reduces the cause of individual differences to either genetic (nature) or environmental (nurture) differences. Some scientists can answer this question by breeding animals with known characteristics across controlled environments to obtain a very precise measure of genetic and environmental influence. The task of determining the influence of genes is more difficult among humans because it is not possible to experiment with environmental factors such as school quality, neighborhood safety, family stability, or health. Similarly, one cannot manipulate an individual’s genes and then measure changes in his or her behavior. Therefore, a common way to describe genetic and environmental influences is to study twins, siblings, cousins, and adopted siblings. Because identical twins share all of their genes and fraternal twins share (on average) one-half of their genes, excess similarity of identical twins is believed to be due to their genetic similarity. These studies estimate a value called “heritability,” which ranges from a score of zero (where genes have no influence) to one (where genes are completely responsible). This heritability measure is a rough indicator of the “nature” effects, and the remaining amount is due to “nurture.”

According to these estimates, genetic factors account for 47% of the variation in cognitive ability at age 1 year. Because the nature versus nurture debate focuses on either nature or nurture, it overlooks the more realistic observation that both nature and nurture matter; for example, sometimes nature causes people to be nurtured differently and sometimes the effects of nature depend on the nurture that one receives. Therefore, it is important to recognize that the interplay between genes and environments is far more complicated than the nature versus nurture paradigm.
from social structures or processes that maintain the social order (whether for the moral good or not). These controls might stem from strict legal enforcement, clear behavioral limitations associated with religion, highly organized and controlled educational settings, or broad macrolevel systems of stratification that limit particular individuals’ mobility. Clear evidence for the broad social control model was presented in a study by Heath et al. (1985) that reviewed educational attainment among three birth cohorts in Norway. According to their estimates, the heritability of educational attainment was roughly 40% for men and women born before 1940. For men, changes in the traditional educational hierarchy provided greater access to the education system: The heritability increased to roughly 70%. For women, however, the heritability remained at 40%, reflecting the continuation of social norms and opportunities that controlled the educational opportunities and behaviors of women. The results of the study argued that the degree to which educational attainment was heritable was controlled among women but not men.

Genetic Moderation Genetic factors unique to individuals cause them to react differently to the same environmental stimuli. This gene-environment interaction perspective is shared by several genetic epidemiologists and is summarized in the following comment by Moffitt, Caspi, and Rutter (2006):

Thus, findings of [gene-environment interaction studies] reframe the scientific question for environmental researchers. The question is not ‘‘Is there any environmental risk?’’ or ‘‘How big is the average effect of an environmental pathogen across all people exposed to it?’’ but rather ‘‘Who is at the greatest risk from an environmental pathogen?’’

In two of the most widely cited examples of this perspective, Caspi and colleagues (2003) showed that well-established environmental risk factors operate differently as a function of individual’s genes. In one example (Caspi et al., 2003), an adult’s risk of major depression increases with the number of stressful life events that he or she may have experienced. However, among those people with two long alleles of a gene responsible for serotonin transmission (5-HTT), no clear association exists between chronic exposure to stressful life events and poor mental health. That is, people who are homozygous for this allele are particularly resilient to stressors that may otherwise lead to a major depressive episode. In a related study (Caspi et al., 2002), the researchers showed that childhood maltreatment does not appear to predict later forms of antisocial behavior among adults who have a genotype that is linked to the level of monoamine oxidases (MAO).

CONCLUSION

Because social scientists are primarily interested in describing broad group-level relationships and interdependencies, very little emphasis has been placed on the role of genes. Emphasis is almost exclusively placed on micro-, meso-, and macro-level environmental factors, and the debates revolve around the ways in which ascriptive characteristics place people within risky or supportive environments. Recently, however, interest has been renewed among sociologists in exploring the possibility that biologic characteristics are related to complex behaviors such as smoking, sexual behavior, and academic success (Gio an Tong, 2006; Nielsen, 2006). Because of the significance of the social environment in understanding the ways in which genes operate (e.g., moderation, mediation, identification), the long sociologic tradition of measuring and monitoring social environmental factors denotes an important contribution to behavioral genetic inquiry. Although heritability estimates have historically represented fixed parameters, sociologists are pushing for the understanding that they represent average values with a great deal of variation. Genes are important for understanding individual differences, but these influences can only be understood when they are situated in a particular context.

SEE ALSO

Volume 1: Academic Achievement, Cognitive Ability, Health Behaviors, Childhood and Adolescence; Health Differentials/Disparities, Childhood and Adolescence; Volume 2: Genetic Influences, Adolescence; Volume 3: Genetic Influences, Later Life.

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**GRANDCHILDREN**

This entry reviews the scholarly research about grandchild and grandparent-grandchild relations within the context of multigenerational families. Because being a grandchild is the joint product of two family transitions, the nature of this family role cannot be separated from the roles that grandparents and parents perform, as well as the relationship between them. Where grandparenting and parenting are action verbs for how grandparents and parents enact their respective roles, being a grandchild has no comparable term. Thus, the roles played by grandchildren are more passively constructed and necessarily dependent on experiences within the wider family system.

**GRANDPARENT ROLES IN RELATION TO GRANDCHILDREN**

The study of grandparenting as an independent branch of inquiry emerged in the 1940s and 1950s as highlighted by several historical events—World War II (1939-1945) and the postwar baby boom. On the one hand, observers noted that grandparents helped their children's families adapt to the dislocations and hardships caused by war, and subsequently provided child care assistance to the growing number of households with young children. On the other hand, some argued that grandparents had become less relevant during the postwar economic expansion as a result of their children's geographic mobility and increasing reliance on professional sources for childrearing advice and help (Szinovacz, 1998).

Inspired by pioneering research on grandparenting styles by Bernice Neugarten and Karette Weinsteins (1964), social scientific investigations into grandparenting surged in the 1980s when several important volumes were published on the topic by Vern Bengston and Joan Roberston (1985) and Andrew Cherlin and Frank Furstenberg (1986)—Grandparenthood and *The New American Grandparent*, respectively. These works were instrumental in directing the attention of scholars to what had still been a somewhat marginal area in family research. Much of the literature of that period focused on characterizing grandparent roles themselves, using such descriptive labels as fun-loving, companionate, formal, and remote to describe how grandparents stylized their relationships with grandchildren and their families. Issues of race, class, gender, and timing (whether the role occurred at the typical stage in the life course, versus significantly earlier or later) were examined in relation to grandparenting styles.

In Cherlin and Furstenberg's national study of grandparents, no particular style emerged as a majority, underscoring the diverse and normatively ambiguous nature of the roles that grandparents play in the lives of their grandchildren and their families.