2.5: Behavioral Genetics

**Behavioral Genetics** is the scientific study of the interplay between the genetic and environmental contributions to behavior. Often referred to as the nature/nurture debate, Gottlieb (1998, 2000, 2002) suggests an analytic framework for this debate that recognizes the interplay between the environment, behavior, and genetic expression. This bidirectional interplay suggests that the environment can affect the expression of genes just as genetic predispositions can impact a person’s potentials. Additionally, environmental circumstances can trigger symptoms of a genetic disorder. For example, a person who has sickle cell anemia, a recessive gene linked disorder, can experience a sickle cell crisis under conditions of oxygen deprivation. Someone predisposed genetically for type-two diabetes can trigger the disease through poor diet and little exercise.

Research has shown how the environment and genotype interact in several ways. **Genotype-Environment Correlations** refer to the processes by which genetic factors contribute to variations in the environment (Plomin, DeFries, Knopik, & Niederhiser, 2013). There are three types of genotype-environment correlations:

- **Passive genotype-environment correlation** occurs when children passively inherit the genes and the environments their family provides. Certain behavioral characteristics, such as being athletically inclined, may run in families. The children have inherited both the genes that would enable success at these activities, and given the environmental encouragement to engage in these actions. Figure 2.3 highlights this correlation by demonstrating how a family passes on water skiing skills through both genetics and environmental opportunities.
**Evocative genotype-environment correlation** refers to how the social environment reacts to individuals based on their inherited characteristics. For example, whether one has a more outgoing or shy temperament will affect how he or she is treated by others.

**Active genotype-environment correlation** occurs when individuals seek out environments that support their genetic tendencies. This is also referred to as *niche picking*. For example, children who are musically inclined seek out music instruction and opportunities that facilitate their natural musical ability.

Conversely, **Genotype-Environment Interactions** involve genetic susceptibility to the environment. Adoption studies provide evidence for genotype-environment interactions. For example, the Early Growth and Development Study (Leve, Neiderhiser, Scaramella, & Reiss, 2010) followed 360 adopted children and their adopted and biological parents in a longitudinal study. Results have shown that children whose biological parents exhibited psychopathology, exhibited significantly fewer behavior problems when their adoptive parents used more structured parenting than unstructured. Additionally, elevated psychopathology in adoptive parents increased the risk for the children’s development of behavior problems, but only when the biological parents’ psychopathology was high. Consequently, the results show how environmental effects on behavior differ based on the genotype, especially stressful environments on genetically at-risk children.

Lastly, **Epigenetics** studies modifications in DNA that affect gene expression and are passed on when the cells divide. Environmental factors, such as nutrition, stress, and teratogens are thought to change gene expression by switching genes on and off. These gene changes can then be inherited by daughter cells. This would explain why monozygotic or identical twins may increasingly differ in gene expression with age. For example, Fraga et al. (2005) found that when examining differences in DNA, a group of monozygotic twins were indistinguishable during the early years. However, when the twins were older there were significant discrepancies in their gene expression, most likely due to different experiences. These differences included susceptibilities to disease and a range of personal characteristics.

Box 2.2 The Human Genome Project
In 1990 the Human Genome Project (HGP), an international scientific endeavor, began the task of sequencing the 3 billion base pairs that make up the human genome. In April of 2003, more than two years ahead of schedule, scientists have given us the genetic blueprint for building a human. Since this time, using the information from the HGP, researchers have discovered the genes involved in over 1800 diseases. In 2005 the HGP amassed a large data base called HapMap that catalogs the genetic variations in 11 global populations. Data on genetic variation can improve our understanding of differential risk for disease and reactions to medical treatments, such as drugs. Pharmacogenomic researchers have already developed tests to determine whether a patient will respond favorably to certain drugs used in the treatment of breast cancer or HIV by using information from HapMap (NIH, 2015).

Future directions for the HGP include identifying the genetic markers for all 50 major forms of cancer (The Cancer Genome Atlas), continued use of the HapMap for creating more effective drugs for the treatment of disease, and examining the legal, social and ethical implications of genetic knowledge (NIH, 2015).

From the outset, the HGP made ethical issues one of their main concerns. Part of the HGP’s budget supports research and holds workshops that address these concerns. Who owns this information, and how the availability of genetic information may influence healthcare and its impact on individuals, their families, and the greater community are just some of the many questions being addressed (NIH, 2015).