

# The Genetics of Human Behavior

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Behavioral disorders arise from environmental, lifestyle, and genetic factors. Past studies have shown evidence for the heritability of several major behavioral neuropsychiatric disorders, such as schizophrenia, depression, and bipolar disorder. In these cases, certain genetic defects are passed down from parental generations and increase an offspring's risk of inheriting a specific disorder. While neuropsychiatric disease susceptibility cannot be attributed solely to genetics, it is important to study how one's genetic makeup can affect various facets of human behavior. Uncovering this link between genes and behavior could lead to the discovery of new biological factors involved in the development of highly prevalent neurological responses and disorders.

A recent study in behavioral genetics has shown that there may be a genetic basis for irrational phobias. It highlights the possibility that phobias are a form of inherited defense mechanism passed down through familial genes. In this study, researchers Dias and Ressler from the Emory School of Medicine subjected mice to fear conditioning by exposing them to the scent of chemical acetophenone, which smells like cherry blossoms, before administering electric shocks to the mice. Offspring of these mice (which were not exposed to the same conditioning as their parents) showed fearful responses to the odor of acetophenone, even when smelling it for the first time. This demonstrated that they had acquired a phobia of the chemical odor.

Structural abnormalities were also discovered in the olfactory bulbs of the offspring mice. Upon sequencing the mice's sperm DNA, Dias found that the gene encoding M71, an odor receptor activated by acetophenone, was methylated in the conditioned parental and direct offspring generations. However, it is unknown whether this epigenetic alteration in sperm DNA was responsible for the offspring's heightened odor sensitivity. It is possible that different biological mechanisms worked in conjunction to translate the inherited ancestral experiences to irrational phobias in the offspring.

Other studies in behavioral genetics have shown that some neuropsychiatric disorders are less heritable—or have a weaker genetic component—than others. For example, while genes may account for more than half of the risk for certain neuropsychiatric disorders, such as schizophrenia or bipolar disorder, the heritability of anxiety and depression appear to be lower. According to Dr. Pine at the Cold Spring Harbor Laboratory, approximately 30-50% of the risk for anxiety and depression is genetic, while the other 50% to 70% of the risk may be attributed to environmental factors, such as substance use, stress, diet, and childhood experiences.

Anxiety disorders are the most common form of mental illness in the U.S., affecting 18% of the total population. Depression is also common, with around 10% of Americans experiencing a major depressive disorder at some point in their lives. Despite the high prevalence, genetic disposition for anxiety and depression is weak when compared to other neuropsychiatric disorders. As scientists, we must determine why this is the case. Is it due to a difference in the number of gene defects? For example, are there less genetic variations linked to anxiety and depression than to other more heritable diseases? Or are depression/anxiety genes less evolutionarily conserved? Only by answering these questions can we get a firm understanding of the genetic root of these conditions and develop ways to prevent or fight the disorders.

We must examine the gene defects themselves. Perhaps, in behavioral disorders with relatively low heritability, the gene variations only minimally disrupt the major pathways of the brain. In such cases, it would be wise to study non-genetic factors that trigger the behavioral response. In addition, a psychodynamic treatment approach – alleviating a patient's mental tension with the help of a psychiatrist—may be more helpful than invasive medical procedures. On the other hand, personalized medicine, such as gene therapy, may be the best option for treating significantly inheritable disorders, like schizophrenia. Through advancements in gene testing, doctors are able to conduct pre-symptomatic diagnostic tests to see the risk for patients with a family history of inherited neurological disorders. Tests can detect abnormalities, which may include missing or heavily altered sections of a gene, or genes that are inactive or lost, in DNA or RNA samples of patients. In other cases, a test may detect excessive RNA from a single gene, indicating that it is overexpressed in the body. Identifying and fixing these problematic sequences in the genetic code requires extensive knowledge of the human genome. Physicians providing personalized medicine must take into account a patient's genetic makeup to determine the best form of targeted treatment for an illness.

Through genetic research, we are slowly beginning to unravel the biological basis for many neuropsychiatric disorders. Understanding the role of genes in highly prevalent neurological responses, like anxiety and phobias, is crucial for designing effective treatments tailored to patients who are suffering these conditions. Specifically, by identifying the genetic markers associated with inheritable neuropsychiatric diseases, we can analyze a patient's risk of disease inheritance and responsiveness to existing medical treatment. This knowledge will make a powerful impact on the medical community and the future of medicine.