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Personality Disorders and Epigenetics

Julie Zaccagnino
Germanna Community College

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Abstract

Personality Disorders are characterized by chronic and pervasive maladaptive patterns which cause emotional distress to the individual, his/her relationships, and society. The purpose of analysis is to understand the causes of personality disorders. Genetic influence on personality is not a simple cause-and-effect. Several genes have been identified to be associated with personality traits but not cause personality traits. Personality disorders have been also associated with childhood trauma. Evidence in research has shown that childhood maltreatment is marked by DNA methylation of genes which promote glucocorticoid receptors in the synapses of the hippocampus and as well as serotonergic pathways. The conclusion is the combination of genes and early childhood development (Epigenetics) play a role in the development of personality disorders. After this examination, more clinical research of epigenetics and personality disorders is suggested. Research is also suggested for epigenetic inheritance and evolutionary consequences.

Keywords: personality disorders, epigenetics

All of the presidents in U.S. history illustrate a perfect spectrum of different personality types. Examples include the two most distinguished presidents, George Washington and Abraham Lincoln, noted as humble and honest introverts; but the Oval Office has known plenty of affable, eloquent-speaking presidents, too, like FDR, Ronald Reagan, and Barack Obama. Outspoken, yet blunt and tactless, presidents have also treaded the White House corridors, such as Andrew Jackson and 45th president Donald Trump. The number of unique personalities number the all of the people who have ever walked the planet. Unfortunately, some people struggle with maladaptive personalities which cause distress in their daily routine. These personalities are labeled as personality disorders for the ongoing, negative disruption that they cause to the individual and/or society (Durand, 2016). In order to better understand personality disorders, exploring the role of genetics, genetic expression and the role of social dynamics are imperative. First, a brief summary of personality disorders will be addressed, followed by a summary of how gene expression works. Lastly, a discussion of how epigenetics affect personality, namely disorders, will be examined.

The term "personality" is a bit broad as the Merriam-Webster dictionary defines personality as "the quality or state of being a person". Personality connotes deeply innate and ingrained qualities of a human being. What does this mean for personality disorders? Are personality disorders purely genetic? *The Diagnostic and Statistical Manual of Mental Disorders (DSM-5)* recognizes 10 different personality disorders, which are divided into three clusters, Cluster A, Cluster B, and Cluster C. Cluster A consists of the "Odd or Eccentric" disorders: paranoid, schizoid, and schizotypal. Cluster B includes the "Dramatic, Emotional, or Erratic Disorders", borderline, narcissistic, histrionic, and antisocial personality disorder. Lastly, Cluster C includes the "Anxious or Fearful Disorders" of avoidant, dependent and obsessive-compulsive

personality disorders. Like every personality, personality disorders are unique in their characteristics, both behaviorally and genetically. Establishing an understanding of what mechanisms contribute to personality is the overall purpose of this research.

The debate of "Nature vs. Nurture", originally coined by Sir Francis Galton, is seemingly everlasting (McLeod, 2007). Since the completion of the revolutionary Human Genome Project, answers to human behavior may be finally unlocked. Studies have shown that genes may correlate with personality traits but do not directly cause traits (Jablonka, 2014). Several genes have been identified to correlate with certain personality traits, both good and bad; but genes alone do not determine the behavior of a human being (Jablonka, 2014). With that said, epigenetics may be the exact revelation to put, the sometimes obnoxious, "Nature vs. Nurture" argument to rest.

Deoxyribonucleic Acid (DNA) is commonly perceived as the formula for all living organisms. DNA is made of nucleotides, which have three ingredients: a pentose sugar, a phosphate and a nitrogenous base (Mader, 2016). These nitrogenous bases include the complementary base pairs of cytosine(C) and guanine (G) and adenine (A) and thymine (T), which are bonded together by hydrogen bonds (Mader, 2016). For the well-known double helical structure of DNA, the base pairs form the rungs of the ladder and the sugar and phosphates form the "backbones" (Mader, 2016). After Watson and Crick built their model of DNA, they made the assertion that the structure of the DNA could be easily copied (Mader, 2016). They were, and are, correct.

Biologists believe that the information of the DNA bears the code of the amino acid sequence to build proteins (Jablonka, 2014). While the information of the DNA stays constant, expression and regulation of the DNA can be altered. Single-stranded Ribonucleic Acid (RNA) performs the important task of transcribing and then translating DNA into amino acids, the

monomers of proteins. This phenomenon is known as the central dogma (Mader, 2016). Additionally, DNA is wrapped around histones and accessibility determines if DNA can be transcribed. If DNA is too tight around the histone, then DNA cannot be transcribed (Mader, 2016). Also, histones can have tails made of amino acids, which can be acetyl or methyl groups (Mader, 2016). Methylated histones can result in methylated DNA. In DNA, the methyl group attaches to the cytosine site and usually turns the gene off (Mansuy, 2011). Acetylation of a histone has the opposite effect. Acetylation is associated with increased expression of a gene. These are just a couple of examples of interest in the massive, new field of science, Epigenetics (Weinhold, 2006).

Epigenetics is the bridge between Nature and Nurture. Epigenetics involves the mechanism and application of "gene-environment interactions" or GxE (Weaver, 2017). With billions of neurons, the central nervous system would certainly be affected by the environment as the brain directly receives input from the environment, integrates the information, and then responds (Mader, 2016). This information implies that the environment can, and does, impact the biochemical markers of neurons of the CNS; therefore, the environment does affect an individual's mental health. Examining the impact of environment on the human body is essential to understand mental health. Since personality is typically viewed as ingrained, the focal point of analysis is personality disorders.

The role of epigenetics in childhood development is crucial to mental health. The first years of a person's life are the most important years. The cells of the body are multiplying exponentially. At birth, a tiny infant's brain contains billions of neurons and the first two years of life involve establishing connections between those neurons. The development of synapses is based upon life experiences and continues into adulthood (Feldman, 2014). Psychologists have long believed that maternal and infant attachment plays an important role for the health and well-being for an

individual. Studies in rats have shown that mother-pup bonding leaves epigenetic marks and these trends have been confirmed in humans (Weaver, 2017). The rat pups who were adequately nurtured demonstrated a healthy expression of the glucocorticoid receptor in the hippocampus (Weaver, 2017). The hippocampus is a structure of the limbic system in the brain and is associated with memory and emotions (Mader, 2016). On the other hand, rat pups who were not adequately nurtured demonstrated less glucocorticoid receptors and displayed increase stress to situations (Weaver, 2017). This result was due to decreased expression of the gene associated with the glucocorticoid receptor through DNA methylation (Weaver, 2017). An additional study with mice that removed mothers from offspring altogether showed the same results, and the mice were anxious and depressed (Mansuy, 2011). Without intervention, the animals demonstrated an increase in stress hormones throughout life and the epigenetic marks of decreased histone-acetylation and increased DNA-methylation can be passed down generations (Weaver, 2017). This phenomenon is commonly known as epigenetic inheritance (Mader, 2016).

A mother's life choices can be passed down to her children. In utero, the placenta protects a fetus from teratogens, and this time period of safety is marked by a period of demethylation reprogramming (Keverne, 2015). Even still, not all genes that will be expressed in the CNS will undergo demethylation and these qualities will be expressed postnatally (Keverne, 2015). Most of the neocortical brain development takes place after birth to adapt to the physical environment (Keverne, 2015). With the evidence of epigenetic inheritance, the speculation of evolutionary consequences would be another worthy topic of research.

As earlier stated, human epigenetic alterations as a result of an adverse childhood have been confirmed. Researchers have found an alteration in the gene associated with stress hormones in children who were victims of abuse. Like the research discovered in animals, methylation of the

gene affected glucocorticoid receptors in victims of childhood abuse (Blue Knot Foundation, 2017). The same results were found in brain samples taken from suicide victims who suffered from childhood abuse (Mansuy, 2011). Personality disorders are too often influenced by childhood trauma (Huff, 2004).

Besides genetic factors, childhood adversity also may influence personality disorders (Blue Knot Foundation, 2017). If childhood maltreatment does affect personality disorders, logical reasoning suggests that methylation of the genes are associated with glucocorticoid receptors would also affect people with PDs who have endured childhood abuse. Some studies have proven this assumption to be true. Studies of Borderline Personality Disorder (BPD) show the correlation of childhood maltreatment and modification of gene expression. The results have been repetitively replicated (Perroud, 2017). Studies of antisocial personality disorder (ASPD), a maladaptive disorder that is usually treated by the justice system, have suggested that an adverse childhood dampens the expression of gene which codes for the enzyme, monoamine oxidase A (MAOA). Monoamine oxidase is responsible for acting as the catalyst for the serotonergic pathway for serotonin, dopamine, and norepinephrine (Reichborn-Kjennerud, 2010). Maltreated children with a lower expression of the MAOA gene possessed the maladaptive traits of antisocial personality disorder (Reichborn-Kjennerud, 2010). Furthermore, even without the quantitative evidence of tissue extraction, schizotypal, paranoid, and schizoid personality disorders are believed to be alternative phenotypes of Schizophrenia. Schizophrenia is a well-researched psychological disorder with sufficient evidence to be a disease as a result of genetic and environment interactions (Durand, 2016). Schizotypal personality disorder (SPD) is like Schizophrenia except SPD is not characterized by delusions and hallucinations (Durand, 2016).

Like BPD and ASPD, schizotypal personality disorder is linked to a past of childhood mistreatment (Durand, 2016). Certainly, epigenetics does play a role in personality disorders.

While DNA is the blueprint for life after all, “genes don’t work in a vacuum” (Huff, 2004). DNA codes for each amino acid, which build the proteins that perform the functions of each and every cell in the body (Mader, 2016). However, life experiences do impact genetic expression. When genetic expression is inhibited, these experiences then can disrupt the flow of biochemical processes, such as increasing glucocorticoid stress hormones and hampering the transmission efficiency of neurotransmitters. People who live with personality disorders have not adapted well to society as a result of both their genes and poor childhood upbringing. However, prognosis in the case of DNA methylation is not bleak whatsoever. Researchers in the study of epigenetics have introduced medicine that can counteract DNA methylation (Mader, 2016; Mansuy, 2011; Weaver, 2017; Weinhold, 2016). For people who have not adapted well to society as a result of poor childhood treatment, this is wonderful news. The characteristics of personality disorders can be reversed through treatment.

. Epigenetics is the marriage of DNA and environment. An unfortunate combination of genetic factors and life events play a role in the life of a person with a personality disorder. With this point established, every personality type can be assessed, by not only genes, but by the interaction of genes and the environment. From the president of the United States to the penniless student trying to pass biology class, each person’s biological composition is unique. Understanding the underlying mechanisms of personality is not only important in theory. In light of all the intricate processes that makes a human a human being, every person should be celebrated and appreciated.

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