Nature Versus Nurture: Nature's Genetic Code Predisposes Psychiatric Disorder Onset

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Essay Prompt

The grand question of Nature (genes and DNA) versus Nurture (environment, parenting) has been debated for a long time. Historically, psychiatrists used to think that schizophrenia was caused by "bad" mothering (1). If generalized, one might conclude that any or all mental disorders may be caused by "nurture." In class, so far, you have seen three different patients with three different disorders (depression, schizophrenia, and addiction). Choose either "nature" or "nurture" as your stance and write an essay persuading the reader that one is more important than the other in terms of causing mental illness. Using examples from *Whatever became of the schizophrenogenic mother?*, class interviews, optional reading, and/or your own experiences would be much appreciated!

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What shapes an individual? A question that has plagued philosophers, scientists, and thinkers since the inception of humanity's curiosity with its own self. This simple question has led to an impasse between the question; is it nature or nurture that are the largest influences in creating one's identity and perception of the world? Regarding the genesis of an array of mental illnesses, most cases such as schizophrenia, attention deficit hyperactivity disorder (ADHD), and mood disorders seem to result from an interplay between genetic and environmental factors. Recent advancements in the field of neuroscience have allowed further understanding of how genetics influence one's health and resilience to environmental stress. Subsequently, it is argued that nurture is dependent upon nature as the primary contributor to an individual's development of identity and behavior.

Many psychiatric disorders are long known for their hereditary prevalence, for example, in the case of schizophrenia, it is widely known that having a direct family member with schizophrenia can increase the probability of onset (2). Recent advances in characterizing the human genome have led to the understanding of the mechanisms by which genetic predisposition is prevalent to the onset of many additional psychiatric disorders such as obsessive-compulsive disorder (OCD),

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anxiety disorders, ADHD, and mood disorders. Interestingly, genetic components appear to also play a role in psychiatric disorders that are thought to stem from purely environmental circumstances, such as major depressive disorder (MDD) and post-traumatic stress disorder (PTSD) (3, 4). In addition, new understandings of cellular mechanisms within neural networks allows us to look at the potential genetic factors that could influence onset and severity of diseases thought to previously be attributed solely to the influence of nurture. For instance, emerging hypotheses concerning the etiology of schizophrenia implicate the glutamatergic N-methyl-D-aspartate (NMDA) receptor dysfunction in the cerebral cortex (5). As a consequence, there is a downstream dysregulation of the ventral tegmental area (VTA), which ultimately engenders disruption of the mesocortical and mesolimbic pathways resulting in the classical presentation of schizophrenia (5). The origin of the possible NMDA receptor dysfunction is unknown, however, genetics and environmental factors such as perinatal infections have been suspected (5). What is known are the mechanisms by which receptor modulation occurs, which is dictated by cellular cascades dependent upon specific genes, regardless of genetic or environmental causes. Receptor modulation is crucial in neuronal functions, especially, neuroplasticity.

The method by which neural networks respond to environmental influences is dependent upon mechanisms regulating neuroplasticity. Broadly, neuroplasticity is the method by which neurons can change their excitability, and in turn functionality, to tailor the overall circuitry of a network. Commonly, neuroplasticity is the basis for learning and memory functions within neuronal systems. One of the major mechanisms often featured in synaptic plasticity is long term potentiation (LTP), which relies upon receptor modulation. The growth factor, brain-derived neurotrophic factor (BDNF), is heavily implicated in regulating neuroplasticity, synaptogenesis, and altering excitability within neurons (6). BDNF expression is regulated by multiple genetic transcription factors, including the cAMP response element-binding protein (CREB) and the nuclear factor of activated T-cells (NFAT), which are dependent upon the activation of cellular signaling cascades by external stimulation of neurons (7-9). Further, disturbance of promoter IV of the BDNF gene—which requires NFAT for proper expression—has revealed depression analogous behavior in mice models (7, 10). Both the transcription factors and the proteins involved in the cellular cascades are produced via the expression of a multitude of genes. The regulation of BDNF expression is essential for neuronal responses to environmental stimuli, however, environmental stimuli are dependent upon pre-existing cellular cascades and transcription factors to induce change in neural networks. Another factor that is widely known to correlate with the onset of neuropsychiatric disorders is the maintenance of serotonergic signaling between neural circuits. Common treatments for many neuropsychiatric disorders such as depression, schizophrenia, and PTSD involve the administration of selective serotonin reuptake inhibitors (SSRIs). Interestingly, alterations in BDNF expression are tied to alterations in serotonergic gene expression (11).

Genes are responsible for the construction and formation of nervous tissue and cells. Thus, how the brain reacts to inputs is dependent upon its architecture derived from genetic material. For instance, if environmental influences were thought to engender certain mental illnesses, then an individual would first have to have the neural architecture to generate the output of a mental disorder. Any diminishment of “stress resiliency” is based upon dysregulation of the genes that are meant to help neurons function during times of high environmental stress (12). Oftentimes, changes in brain structure due to environmental influences are only possible because of the ability to respond. Nature must be present to allow for nurture to induce change. Moreover, the discussion of whether nature or nurture impacts the development of an individual should be rephrased in a more nuanced context. Specifically,

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the extent to which genetics responds to environmental influences should be of greater focus.

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