Part I: If you’ve ever known identical twins, you know that they are remarkable similar, yet also different from one another. In fact, identical twins are often different in many small ways at birth. Explain how environment interacts with genes to produce identical twins that are different. Consider both prenatal and postnatal factors.

An individual’s life takes different directions and their behavior changes due to the complex interplay of biological, environmental and psychosocial factors. Life circumstances and opportunities determine and alter the course of a person’s mental health. Behavior varies along a continuum and over time; meaning, psychological disorders can range from mild to serious conditions.

An individual is an essential and integral piece to their own biological map or genotype. As a generalization, identical twins, also termed called monozygotic (MZ) twins, both individuals acquire the exact same genotype. Genes are programmed by DNA, the molecular machinery of cells. The cell is an example of a structure which can be studied microscopically. Hereditary factors influence the life of the cell and the behaviors an individual will possess.

An individual’s genotype can predispose him or her to disturbing behaviors. The biomedical model states abnormal behavior is incited by biological dysfunction at the microscopic level (Seligman et al., 2001). Acquired biological vulnerability is inherited and refers to imbalances or defective interconnections in brain structure and biochemistry. Neuroanatomy can change depending on if a person is stimulated by an enriching or stressful environment. Atypical circumstances capitalize on the vulnerability. Unusual situations determine if certain genes get expressed or if they remain unexpressed.

A gene interprets irregularity in the form of excesses and deficiencies. A prime example is the overproduction or underproduction of key neurochemicals; such as messenger molecules called neurotransmitters. Behavioral pathologies have been related to imbalances in: catecholamines, including norepinephrine, epinephrine and dopamine; serotonin; and amino acids such as GABA and glutamate (Seligman et al., 2001). Imbalances are attributed to a malfunction in how these neurotransmitters communicate. Mechanisms that are normal and regulate neurotransmission, such as synthesis, release and re-uptake, become faulty.

During prenatal development, biochemicals come in the form of hormones. Proper concentrations of hormones control the phenotype, or the way a gene expresses the specific behavioral or physical traits, of the child. Monozygotic twins can differ phenotypically for other reasons. Twin phenotypes, that are uniquely dissimilar at birth, can be due to environmental factors. Environmental variables (both inside and outside the cell) regulate the fate of cell.

One perspective, called the interactional point of view, believes environmental factors influence biology and vice-versa. The diathesis-stress model embodies an interactional perspective but it is also similar to the biological vulnerability model. The diathesis-stress model indicates predisposition to stressors sets the stage for future health issues. In utero, a twin may confront different stressors than their co-twin. Stressors induce behavioral abnormalities. Stress can take the form of inadequate oxygen uptake, undernutrition, cellular and chemical imbalances, viral
infections and exposure to neurotoxins (i.e. chemicals and metals with qualities that are very harmful to the nervous system, destroy nerve conducting cells and damage brain functions). A fetus will negatively respond the stress response of the mother, too. This is of consequence in the short and long-term. Psychological disorders can manifest more easily in a child born to a mother under constant stress and, in the future, a psychological illness may surface. Sensitivity to drugs may be different in a child exposed to stress prenatally. On the other hand, depending on the events during pregnancy, the twins may separately or jointly encounter beneficial, or buffering environments. Normal behavior, in the womb, is a product of favorable circumstances, like an optimal body position for the proper quantity and quality of nutrients and gases.

Genetic mutations, or anomalies, explain why some monozygotic twins obtain unique genotypes. The singular zygote, which refers to the mother’s fertilized egg from the sperm of the father, separates into two-cells and two amniotic sacs. The events during the separation of the singular zygote or even after the zygote has moved into the two-cell stage, can change the fate of the twins. Physical dissimilarity between twins may occur from the action of a single gene, in the form called an allele. Dominant or recessive genes that carry an abnormality can be inherited and determine physical characteristics. Many genes can contribute to a singular psychological disorder, known as polygenic characteristics. The 23rd chromosome is one example of how identical twins can be different from birth. The sex chromosome is inherited: mothers passes onto their offspring two X chromosomes, while fathers confer a X or Y chromosome. Genetic mutation can result in a female twin receiving an XX pair versus a male twin obtaining an XY pair.

Time influences brain development, a process tailored to each individual. Cortical growth may differ between twins because the cortex is not complete until the individual is approximately 30 years of age. Neuronal growth and synaptic pruning work together to shape and re-shape the connections pertinent to healthy brain function. Meanwhile, myelination, neural conduction and neural connections are refined. A brain exposed to beneficial environments and stimuli releases specific chemicals. Nerve growth factors can, in term, turn-on genes that promote optimal brain functioning. Due to developmental differences, each individual’s brain (including monozygotic twins) differs in cognitive ability. The changes that occur in the brain also determine the extent to which an individual can learn novel information, such as: how they act and behave socially and what they believe.

With age, psychological stress becomes possibly the largest provoker of our biological constitution. Humans and animals are vulnerable to stress. Stress diminishes mental health and physical capacity. Stress sustained over time can lead to higher incidences of abnormal behavior and sensitization.

According to the reciprocal gene-environment model, the actions of genes and the environment are bidirectional. Genotypes and phenotypes identify the individual. Genes govern the choices an individual makes, such as: the way a person acts; the environments they seek; the relationships they cultivate; and how the past is interpreted; and how life is remembered (explicit memories of objects, people and events and implicit recall of motor skills and perceptions). Yet, these same life experiences can dictate which genes are then expressed or remain latent. An individual’s biological constitution and the way they live their lives is equally telling of behavior.
Part II: Explain why, in half the cases, a person who has an identical twin with schizophrenia does not becomes schizophrenic.

Some psychological illnesses, such as schizophrenia, are more common in persons who are genetically related. Monozygotic twins, who share the exact same genotype, are more likely to both develop the disease because genes control the advent of the disorder. Discordant twins are twins that have distinct genotypes and phenotypes, even if the dissimilarity is minimal. In this example, twin and co-twin would also differ in their mental abilities and behavior. Schizophrenia can appear in only one of the two MZ twins for numerous reasons.

Research has found schizophrenia is inherited only 70% of the time (Craddock et al., 2005; Sullivan et al., 2003). MZ twins do not inherit the disease consistently and the disease does not coincide with high percentage rates (Cardno and Gottesman, 2000; Craddock and Jones, 1993). This means other factors, not only genes, are part of the disease’s etiology. According to Pidsley and Mill (2011), the etiology of schizophrenia relates to mechanisms outside of changes in DNA, such as during cellular differentiation (Dempster et al., 2011). DNA sequence can be unaltered while substantial variability in DNA methylation (hypomethylation) and changes in chromatin structure occur. This is a process referred to as epigenetic dysfunction and is found in discordant MZ twins (Dempster et al., 2011).

The environment for monozygotic twins, in utero, may be substantially different. This is due to the effect the environment has on the fetus. One twin may be deprived of adequate nutrients and oxygen while the other is not. In the prenatal environment, one twin’s access to nutrients and oxygen would remarkably affect a predisposition to schizophrenia, postnatally. The body position of the fetus may affect this outcome. Schizophrenia has been linked to these stark environmental differences in the womb. Stressful events, postnatally, could induce the manifestation of schizophrenic behavior in the child who was made susceptible in utero. This is an example of the diathesis-stress model, which gives stress as the main reason for the activation of certain behavioral illnesses.

The amount and degree of stress in a pregnant mother can affect the health of one or both MZ twins. Stress is a a cascade of biological events. First, neurohormones called glucocorticoids are secreted from the adrenal glands, these molecules then latch onto regions in the brain with receptors, such as in the hippocampus. High levels of circulating glucocorticoid in the mother increase the likelihood the child will develop aberrant behavior. These unusual patterns of behavior may become evident either immediately after birth or appearing later in life.

As the child matures, stress can also result in markedly decreased mental and physical capabilities. The hypothalamic-pituitary adrenal (HPA) axis also is activated in the stress response. If HPA stimulation endures over a long period of time, the degree of the disordered behavior can increase. Cortisol, a glucocorticoid, can augment the activity of an important neurotransmitter called dopamine. Brain function is altered by levels of dopamine, a response directly linked to schizophrenia. Thus, a summation of stressful events may trigger the disease in one twin but not the other. Brain images of discordant twins show dissimilarity. Schizophrenia’s physical damage can be measured in the brain by a larger than normal size of the ventricles, the
cavities of the brain that circulate cerebrospinal fluid. Research on schizophrenia has
distinguished the role the frontal cortex. As the brain develops, the way a person behaves
changes. Once the brain is mature, clinical signs of schizophrenia may become visible.

Twins not reared together, even if they have remarkably similar DNA, can be very different due
to the influence of the family environment. Research in the adoption method has revealed the
prominence of genes and how they can trigger schizophrenia. A child whose adopted into an
unhealthy family and has a biological parent who is schizophrenic, is more likely to develop the
disease. An exception to this case occurs if the adoption takes place while the child is still an
infant and reared by a healthy family. Circumstances foster human attachment bonds between the
parent and child, either biological or adopted, which influences the psychological constitution of
the child. A supportive and stable family environment also has been shown, through research, to
facilitate recovery from illness.

Some scientists suggest schizophrenia is unique to the human species. Since research on human
subjects is limited by moral and ethical constraints, certain features of the disease are still very
mysterious. For example, current research proposes the evolution of the disorder and relates to
human communication capacities such as language (Seligman et al., 2001). More research is
needed to better understand the etiology of schizophrenia and find effective prevention and
treatment methods.

References


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