

Hereditv Versus Environment: Twin, Adoption, and Family Studies

[Avi G. Haimowitz](#)
[Rochester Institute of Technology](#)

A plethora of internal and external variables combine to create individual personalities, behaviors, and psychopathologies supposedly unique to every human being. The argument of genetic makeup versus environmental influences, however, has researchers working to determine what really shapes us. Some say genotypes control how people think, feel, and behave. Others believe it is the environment alone that is responsible for molding humans into who they are. There is much unknown in this field, but the perusal and review of twin, adoption, and family studies is a significant stepping stone in better understanding this topic. Even today, the sole sculptor of human personality, behavior, and psychopathology remains unknown; modern research indicates that a combination of biology and environment constructs us all.

Studying how genes and our surroundings may or may not form the personalities, behaviors, and psychopathologies of human beings is probably the most obvious way to approach the argument of heredity versus the environment. It is often the tendency of humans to polarize themselves and choose a specific side when a question like this is introduced. Despite this common inclination, it is probably not the wisest method of deciphering the basis for the three main variables that construct human beings; who is to say that a single factor is the source of all our differences? It is more logical to examine the distinctions between biology and the environment, and to figure out in what ways the two may intertwine to form the singular entities that are our personas.

Because of this palpable meshing together of two variables, it is then plausible to establish what aspects of personality are linked to genes, and what aspects most likely exist due to environmental leverage. It has been said that heredity and the environment both contribute 50% to the makeup of an entire human being, but much debate exists about specific percentages and the existence of higher percentages of one factor in different age groups than others (Petrrill et al., 2004). Some tactics that have been used in attempts to figure out the many characteristics of human beings include adoption studies, family studies, and twin studies. A review of different topics in human behavior and psychopathology, from human attitudes to the mental disorder schizophrenia, is a beneficial way to broadly explore the argument. Loose conclusions may be derived from these studies, but much more investigation needs to be done,

both in creating new research projects and in analyzing previous methodologies and results, before this argument has any potential of being resolved.

Twin Studies

Twin studies are a vastly important tool in dissecting the nature versus nurture argument. Identical twins, or monozygotic twins, are siblings whose genotypes are duplicates of each other. They are most likely the best indicator of whether biology affects traits and psychopathology in human beings. For example, if one twin has dark hair, then the other twin has dark hair as well; this concept of identical genes would ideally distribute itself toward the phenotypes of behavior and personality of identical twins (Plomin, DeFries, McClearn, & Rutter, 1997).

Fraternal twins, or dizygotic twins, share exactly half their genes with each other. They are not as optimal as identical twins for deciphering the degrees of genetic influence, but they are a very good basis for comparison for identical twins. Fraternal twins are similar to first-degree relatives, except they are sure to share the exact same age, as do identical twins. Twin studies usually rely on samples of identical and fraternal twins; if biology has a greater hand than environment, then identical twins should behave or possess psychopathology similar to each other more so than fraternal twins (Plomin et al., 1997). This is an example of the heritability coefficient coming into play: the estimate of how much someone's specific trait in comparison to other people's traits under one characteristic is attributable to genes (Olson, Vernon, Harris, Aitken, & Jang, 2001). This coefficient ought to be higher in identical twins than in fraternal twins. Then again, it is possible for identical twins to express different phenotypes (external expression of genetics) for the same genotypes (genetic makeup). This is representative of their nonshared environments; even though identical twins possess the same genetic makeup, they may go through different experiences throughout their lives that shape their personality, behavior, and psychopathology in ways that make them unique relative to each other (Hughes et al., 2005).

Attitudes

One particular study sought to determine the heritability of attitudes among twins, as well as the genetic variables, such as intelligence, that could affect attitudes among pairs of twins. A questionnaire was provided to the participants, in which they were asked to rate their personality traits, physical abilities, and physical attractiveness. They were also asked to note their academic achievements (Olson et al., 2001).

The results of the study showed that differences between attitudes of the participants were at least partially correlated to genetic factors. It also showed that attitudes related to self-reported perspectives or to activities were often correlated. For instance, the survey asked subjects to rate themselves on the trait of sociability. That trait was correlated with 5 out of 6 attitude factors subjects had toward sociability. Attitudes toward athleticism highly correlated with findings on self-reported athletic abilities.

The causal model was expressly supported in these findings, because athletic skill (the mediator), for example, seemed to be linked with attitudes toward athleticism. Of course, this model is not without its problems: one cannot assume that X is the cause of Y in every single situation. Case in point: attitudes toward leadership seemed to be related to high self-ratings of physical attractiveness, sociability, and aggressiveness. Because of these numerous factors, it is still not possible to always accurately assume direct, singular relations between genetic traits and attitudes (Olson et al., 2001).

Interestingly, nonshared environment experiences between pairs of twins seemed to be the strongest cause of attitude variances, overshadowing genetic predispositions as well as shared environment experiences (Olson et al., 2001). Nonshared environment is a term used to refer to something in the environment that directly affects one twin but does not impact the other at all (Van den Oord, Boomsma, & Verhulst, 2000). The study did indicate that some nonshared environment experiences were very much connected to attitudes and self-reports of physical characteristics and intelligence (Olson et al.). This study leads to further questions about nonshared environments: why is it that different environments have so much effect on twins' behaviors and personalities? And why are some attitudes apparently rooted in genetics, while others are not? As previously stated, it is clear that much more research must be conducted on twins before any solid answers can be found.

Theory of Mind

Mental states are made up of beliefs, intents, and desires. A child usually acquires a theory of mind, which is the understanding that objects and situations can be falsely interpreted or represented by their own mental states, by the age of four. The question for research here is: between biology and environment, what accounts the most for the differences in how much individual children vary in false-belief comprehension? It has been shown that children from large families experience accelerated acquisition of theory of mind, but deaf children born to hearing adults experience decelerated acquisition of theory of mind. This points to cultural influences, and thus, to environmental influences. Inversely, children with the highly transmissible disorder autism have also been found to possess impaired theory of minds, as do girls with the chromosomal disorder Turner's syndrome. This points to genetic influences (Hughes et al., 2005).

A study was created to investigate this topic, using both identical and fraternal twins. It measured socioeconomic status, verbal ability, and more importantly, the theory of mind of each participant. The first part of the test given to the subjects contained questions that examined their abilities to connect a mistaken belief about a character in stories provided. The second part tested the subjects' abilities to make inferences and their tendencies to attribute a false belief to a belief about characters within the provided stories (Hughes et al., 2005).

Most of the variation between theory of minds of the pairs of twins resulted from nonshared environments. The percentages of influence in decreasing order were attributed to shared environments, verbal abilities, and then genetics. Families with twins are often highly charged with competitiveness, and the more the families discuss conflicts, the more accelerated theory of minds tend to be. This emphasis on environmental influences does outweigh genetic influences on the development of theory of minds in children, but it does not outweigh genes' existence and role entirely (Hughes et al., 2005).

Genotype-Environment Interaction

A study was performed using a portion of the identical twins that participated in the Swedish Adoption/Twin Study of Aging (Bergeman, Plomin, McClearn, Pederson, & Friberg, 1988). These researchers were interested in the relations between phenotypes and genotypes of twins reared apart, which was the experience of all the participants in the Swedish study. One twin's phenotype should be the biggest indicator of the other twin's genotype, because the study examined the experiences of pairs of twins who had been separated their whole lives (Bergeman et al., 1988). If anything was similar about the pair, it ought to be correlated to their shared genes, because they certainly did not share the same environment.

The study was designed to measure personality traits of extraversion and neuroticism among the twin pairs, traits of impulsivity and monotony avoidance, and family environment and socioeconomic status. Using this information, and taking into consideration that a study like this had never been done before, the researchers came to three different conclusions in regards to genotype-environment interaction. Genotype-environment interaction is a term used by many researchers in relation to twin studies, referring to the potential for people with different genetic makeup to respond differently toward the same external situation (Bergeman et al., 1988). This is an important concept in twin studies because genotype-environment interaction can also be applied to how people with the same genotypes might respond to the same environment.

One particular genotype-environment, labeled Type I, indicates that the environment has more of an impact on individuals with a genotype for low scores on a specific personality trait. Individuals who had low genotypes for extraversion would also score low on extraversion if they perceived their families as high in control or organization, as opposed to individuals who had high genotypes for extraversion. The latter individuals expressed that high extraversion trait regardless of the perceived level of control or organization of their respective families (Bergeman et al., 1988).

Type II genotype-environment interaction was essentially the opposite of Type I. Individuals who have genotypes that cause them to score high on a specific trait were affected by their environments, while individuals with genotypes that caused them to score lower were not affected by their environments. For example, an individual who possesses a high genotype for impulsivity will have that trait increased if she or he lives in a conflict-filled environment (Bergeman et al., 1988).

Finally, Type III genotype-environment interaction was a category only derived from the researchers' study on mice; it was not derived from the Swedish twins. Type III genotype-environment interaction occurs when the environment influences individuals with genotypes that cause them to score higher on traits as well as individuals who have genotypes that cause them to score lower on traits. An environment high in parental control, for example, will restrict the expression of a genotype, while a permissive environment will allow a genotype to emerge as a strong phenotype (Bergeman et al., 1988).

Adoption Studies

A very significant portion of studying heredity and environmental effects on human traits and psychopathology is devoted to adoption studies. Adoption studies are important because they include two sets of factors that may account for differences in behavior, personality, and psychopathology: biological parents and environmental parents. Of course, any links between the biological parents and the child that is given away is usually explained by genetics, and any links between the adoptive, or environmental parents, to the adopted child is usually attributed to environment (Plomin et al., 1997).

Schizophrenia

The first adoption study performed on schizophrenia showed that family environment contributes little to a child's risk for a disorder such as schizophrenia. This study was performed through interviews of adopted-away children of biological mothers who suffered from schizophrenia, and interviews of adopted children whose birth parents

did not suffer from any mental disorders. Several of the adopted away children of schizophrenic mothers suffered from schizophrenia themselves, while the adoptees whose parents didn't have schizophrenia also did not have schizophrenia themselves. This supports the theory that it doesn't matter what specific environment a child is raised in; if its parent or parents suffer from a mental disorder, the risk for suffering from the same disorder will be equal regardless of if the child was raised with its biological parents or with its adoptive parents (Plomin et al., 1997).

Another adoption study showed that a high percentage of proband adoptees, or adoptees whose birth parents had schizophrenia, also suffered from chronic schizophrenia or displayed schizophrenic-like behaviors. None of the control adoptees, or adoptees whose biological parents did not suffer from schizophrenia, had schizophrenia themselves, and only a small percentage of them displayed schizophrenic-type symptoms. A current study is also supporting these results, because a significant percentage of proband adoptees displayed some psychotic symptoms, while only a small percentage of control adoptees displayed these types of symptoms. This study also showed that the adoptees whose biological parents suffered from schizophrenia had a higher likelihood of schizophrenia or other related disorders when the adoptive families were low functioning. This speaks volumes for the genotype-environment interaction theory, because of the expression of a genotype being linked to the type of rearing environment (Plomin et al., 1997).

Despite all of this information, it is still very much uncharted territory as to what explicitly causes schizophrenia, and how it may or may not be expressed among adopted children. One of the main difficulties subsists in the deficiency of knowledge on a gene that carries the disorder schizophrenia. It is unknown whether such a gene exists, and doubly unknown to what degree this possible gene influences these types of adoption studies (Loehlin, Willerman, & Horn, 1988).

Infant Shyness

An adoption study was conducted to disentangle the reasons behind why some infants are open and responsive to attention right away, some take time to open up, and still yet, some others are fearful and withdrawn. It is difficult to tell whether babies are shy because their mothers are shy and thus do not take them out very much, or because the shy mothers pass down their shyness traits. Measures of this study attempted to clarify the relationship between the infants and adoptive and biological parental shyness, parental sociability, and parental introversion-extraversion (Daniels & Plomin, 1985).

Adoptive parents were given questionnaires that asked them to rate their infants' shyness levels, and then to rate themselves on the traits listed previously. It must be noted that the self-reported ratings of the biological were performed before the birth

of the infants, and the scoring of the infants' shyness were performed by the adoptive parents when the babies were two years old. The results showed that in nonadoptive families, the parents who reported high rates of shyness, low rates of sociability, and high rates of introversion also had shy infants. This was also seen in adoptive families whose parents rated similarly, indicating that a combination of home environment and genetics must come into play. One significant conclusion was made in this study that was based on the fact that biological mothers rated high in shyness, and their adopted-away babies were also shy. This strengthens the possibility of a genetic link overshadowing family environment, but of course further research must be done (Daniels & Plomin, 1985).

Children's Adjustment to Divorce

A study was performed to investigate the possible connection between genetic factors and children's adjustment to parental divorce. Interviews, questionnaires, and standardized tests were administered to probands and their parents. Interviewers also rated the social behavior of the probands at the time of their interviews (O'Connor, Plomin, Caspi, & DeFries, 2000).

Measures of the study included age of the probands at the time of separation and/or divorce, self concept (self-esteem) of the probands, social ability, academic ability, behavioral and/or emotional problems, loneliness, and substance use. Of course, the type of adjustment processes that children from biological families went through could be attributed to biology or environment, while adjustment for probands would have had to be linked to environmental processes. The results showed that probands' adjustment to divorce in terms of social ability, self-concept, and academic accomplishments were at least partially genetically influenced, but that their psychopathology could be attributed to environmental factors (O'Connor et al., 2000).

Antisocial Personality Disorder

Many studies have been composed to attempt to discover if children who are at risk for antisocial personality disorder are more likely to develop symptoms in an adoptive family environment, or if that environment will protect them from the disorder's development. It has been shown through these various studies that antisocial personality disorder is, indeed, more likely to present itself in adoptees that already have biological risk factors (at least one biological parent had a background of criminality or antisocial personality disorder). The adoptees that are born with no risk of developing the disorder do not usually develop it while living in an adoptive environment. The adoptive family environment combining with the preexisting biological risk seems to make antisocial personality disorder quite prevalent among adoptees (Roth & Finley, 1998).

It was also found that adoptees experienced an even higher risk for antisocial personality disorder if both their biological parents and their adoptive parents came from criminal backgrounds. However, methodological problems exist with these kinds of studies because there are so many factors to consider. For example, it has yet to be clarified whether this disorder is more likely to be carried through the biological mother, or the biological father. Most of these adoption studies were conducted using only information from the biological mother, and not the other half of the equation: the biological father. Information is also vague regarding a criminal background as an instant checkmark for antisocial personality disorder in biological and adoptive parents. It is often assumed that the existence of a biological parent's criminal background immediately means that that parent has antisocial personality disorder, and also has definitely passed it down to the adopted-away offspring. The problem is, it also cannot be assumed that the lack of a criminal background points to a lack of the disorder itself (Roth & Finley, 1998).

Interpreting the results of adoption studies is very difficult for the aforementioned reasons, and it is also challenging to make valid conclusions due to the fact that adoptees already display a higher rate of antisocial personality disorder as compared to the general population. Ironically, the adoptive family environment is often better in terms of care, education, stability, and health in comparison to families in the rest of the population. Adopted-away children, however, are often placed in adoptive family environments similar to their original, biological family environments. Genetic factors are thus "simulated" when the adoptive family environment is similar to the biological environment (Rhee & Waldman, 2002). With all of these discrepancies and uncertainties, it is undoubtedly a complex process to try to figure out what factor has the most effect on the development of antisocial personality disorder.

Family Studies

Family studies are not as oft cited as twin and adoption studies, but nonetheless they are still a valid and important piece in the puzzle of heredity versus the environment. Family studies are mostly used to identify the degree of risk of relatives developing mental disorders that other family members suffer from. Case-control family studies are employed, including estimates of relative risk and population relative risk of a mental illness. Relative risk compares how large the likelihood is that one relative of a person with a mental disorder will also develop the disorder than the relative of a person with no mental disorder. Population relative risk calculates approximately how much risk there is that the relatives of a person suffering from mental illness will also be affected as opposed to relatives of a person who does not suffer from any mental illness (Jang, 2005).

These kinds of studies are most often used to determine the risk of passing down mental disorders to offspring within families. It must also be taken into consideration that these types of studies do not tangibly express outside factors, such as family environment and culture. These studies are performed using molecular genetic studies, where DNA is extracted from participants' blood samples and the correlation between the DNA and the observed behavior is projected. The most common molecular genetic study is called linkage analysis. This type of study tries to locate a specific gene on a chromosome in the human body. If a gene for a particular mental illness is being searched for, researchers identify an already-recognized gene on the chromosome and label that as a marker. That marker's location, and the location of the actual diseased gene, is very important: the closer the two are, the higher the likelihood that the disease and marker genes will be passed on together, or linked together (Jang, 2005).

Bipolar Disorder and Schizophrenia

Bipolar disorder and schizophrenia share many similarities, from the average age of onset to the courses of the illnesses. Family studies, including molecular genetic studies, were conducted to decipher how much overlap exists for the genetic risks for both these disorders (Berrettini, 2000).

Studies carried out on bipolar disorder showed that first-degree relatives of people with bipolar disorder suffered a higher risk for some related mental disorders including bipolar I disorder, bipolar II disorder, schizoaffective disorder, and recurrent unipolar disorder. However, there was not an increased risk for schizophrenia itself (Berrettini, 2000).

Studies carried out using first-degree relatives of people who suffered from schizophrenia showed similar results. Those relatives were at higher risk for schizophrenia, schizoaffective disorder, and recurrent unipolar disorder, but not for bipolar disorder. Interestingly enough, first-degree relatives of people who suffered from both bipolar disorder and schizophrenia did experience higher risk for schizoaffective and recurrent unipolar disorders. This indicates an overlap and suggests a possible partial overlap in familial risk for bipolar disorder and schizophrenia (Berrettini, 2000). A larger-scaled study needs to be conducted before this can be fully determined.

Suicide

Suicidal behavior is increased among relatives of suicide victims, but the singular cause of this is unclear. A study was conducted to figure out if the cause for this increased risky behavior was due to family heritability. It compared relatives of

suicide victims with relatives of demographically similar adolescents; both groups were examined for Axis I and II disorders, histories of aggression, and histories of suicidal behavior (Brent, Bridge, Johnson, & Connolly, 1996).

First-degree relatives of suicide victims, also called suicide probands, had a greater likelihood of suicide attempts, but it also has to be taken into consideration that they also had an increased risk of other psychological disorders. The suicide probands who had high rates of aggression also had higher risk for attempts at suicide. The increased risk for suicidal behavior in suicide probands, it was concluded from this study, is probably a trait independent of Axis I and II psychiatric disorders (Brent et al., 1996).

Eating Disorders

Anorexia nervosa and bulimia often exist comorbid with other psychiatric disorders, such as depression, anxiety, and obsessive-compulsive disorder. A study was performed to attempt to figure out if eating disorders were comorbid through family genetics. Interviews of relatives of eating disorder victims and best-estimate conclusions were conducted throughout the study. Interviews of a control group, or a group of relatives whose family members did not suffer from any eating disorders, were also carried out. The interviews determined whether the eating disorder probands themselves had eating disorders, and whether they suffered from mood, anxiety, substance abuse, and specific personality disorders (Lilenfield et al., 1998).

This study's results showed that eating disorder probands experienced a higher risk of eating disorders, major depressive disorder, and obsessive-compulsive disorder. Substance abuse disorder was placed at higher risk for bulimia probands than for anorexia probands, and obsessive-compulsive disorder was placed at higher risk for anorexia probands than bulimia probands (Lilenfield et al., 1998).

It was concluded that there was definitely a link between people who suffered from eating disorders and their relatives' risk for suffering from the same problems. A plausible connection between the probands' risk for major depressive disorder, substance abuse disorder, and obsessive-compulsive disorder, however, could not be proven. The only theory that could be somewhat supported was that the traits for obsessive-compulsive disorder could cause a familial risk for anorexia (Lilenfield et al., 1998).

Conclusion

It is clear from the brief summaries provided on twin, adoption, and family studies that there is no black or white answer to the age-old question of what contributes to human behavior, personality, and psychopathology. In reviewing a multitude of twin,

adoption, and family studies broaching a large variety of topics, it is clear to see that the foundation for each human being is diverse in structure. For some cases, genetics seem to dominate; in some other cases, environment explains all. In still more situations, it is a strong combination of the two factors that mold people to be who they are. This is a strong indicator that there will never be an umbrella response to the question, and that personality and psychopathology may always have to be rationalized on a case-by-case basis.

Peer Commentary

Nature Versus Nurture: Are We Really Born That Way?

Heather A. Blout
Rochester Institute of Technology

I read Haimowitz's article "Heredity Versus Environment: Twin, Adoption, and Family Studies." Her conclusion of the heredity versus environment debate was very logical and I must at least partly agree. Based on the current research, specifically the studies explained in the article, it seems that the only answer to this debate may always have to be rationalized solely on a case by case basis. However, there has been research that shines new light on the age-old debate.

The heritability coefficient was casually mentioned in the discussion of twins and the number of genes that they share. Haimowitz made it seem that it was a simple fact and was not subject to change. I, however, strongly disagree. The heritability coefficient sounds like it answers the nature versus nurture question, but it only scratches the surface. The answer to the question "Are traits caused by the environment or genetics?" is usually both. Even a heritability coefficient of 1.0 does not mean that the environment cannot affect the trait, which is what is implied by a coefficient of 1.0. She also mentioned the heritability coefficient in the introduction to the topic of twin studies, but never related it to the studies. She should have either omitted the topic from the paper or related it to the studies. If she connected the heritability coefficient to the studies, then that might have provided more solid evidence from which to draw conclusions. The data could still be refutable, but at least we would be able to attribute a specific amount of genetic cause for each study.

Personality was also transiently brushed upon in the paper, but I think that this is one of the most important reasons for the existing nature versus nurture debate, because it directly relates to behavior. I thought the three types of genotype-environment relations that were discussed were confusing and should have been embellished a bit more. I think this idea is very important in reference to personality. It was not clear

what the results of the study actually were or what the frequencies of each type of relation were found to be in this study. The types of personality did not have a clear connection with how the genotype-environment interaction came into play. The conclusion arrived at was that when participants score low for a personality trait, they are more susceptible to environmental impact. However, the study did not further discuss anything about how people obtain their personality traits. I also did not think that the results of the study were necessarily valid, because they derived the Type III interaction from mice as opposed to humans, like the first two types. I do not feel that this is applicable to personality in humans.

Personality is a good example of a trait that has been studied in twins. Identical twins reared apart are far more similar in personality than fraternal twins. These observations suggest that personality is heritable. However, the environment must also be looked at. There are two kinds of environmental effects: shared experiences and nonshared experiences. Although identical twins are genetically identical and share the same family environment, identical twins raised together do not have identical personalities. These differences must then be explained entirely by nonshared environmental effects.

I feel that disorders should be discussed in relation to the heredity-environment debate, because the better-understood their causes are, the more efficiently and effectively they can be treated. One such disorder that is currently being heavily researched is depression. Depression is very common, so it is important to understand the relation between genetics and environment in depression. According to a recent twin study of depression, the concordance between identical twins was the highest when compared to other familial relationships (Kendler, Walters, & Truett, 1995). This implies that depression can largely be attributed to genetics.

The nature versus nurture debate is a highly sensitive topic for a lot of scientists and still creates passionate opinions for one side or the other. Haimowitz briefly discussed in the conclusion that we may never know the answer to the great genetic versus environment question. It seems that the answer we get will be determined by the situation that we set up. There is no doubt that more studies will be conducted to inform scientists more on the topic and maybe finally will create an umbrella response to the question of the effects of heredity and environment on personality and psychopathology.

Peer Commentary

How Identical Twins Grow Up To Be Different

Caitlin M. Jones
Rochester Institute of Technology

In the paper, "Heredity Versus Environment: Twin, Adoption, and Family Studies," Haimowitz reviewed relevant research regarding the debate over how personalities are shaped. This issue is surrounded by contention between behavioral geneticists and personality researchers. As the author states, there is still much unknown in this field to determine whether one side is right or wrong. But certainly, for those who understand both sides of the debate, it seems possible that they are both right, and in fact there is a relation between heredity and environment.

Although the author made good points and revealed the different methods for measuring heredity and environmental influences, I wish to question one study mentioned. Haimowitz explained a study that was conducted to determine the heritability of attitudes among twins. The researchers concluded that there was variance between individuals on a number of the measured attitudes that could be traced to genetic factors (Olsen, Vernon, Harris, & Jang, 2001). They also found that the nonshared environment contributed even more variance within the sample. After reading the study, I became aware that the sample was an adult population of monozygotic (MZ) and dizygotic (DZ) twins with an average age of 30.4 years (Olsen et al., 2001). I realize that by this age twins should have countless experiences apart from one another, which could account for the variance attributed to the non-shared environment. However, I do not agree with that assumption and believe that the variance associated with the nonshared environment should not be so large.

Attitudes, beliefs, and norms are constructed during adolescence and made more concrete over time (Harris, 1995). This process of socialization most notably occurs through the contact that adolescents have with their peer groups. The theory of group socialization posits that the peer group and other outside-the-home socialization are responsible for shaping the personality of adolescents and teenagers (Harris, 1995). The fact that siblings reared in the same home environment have very distinct personalities could be attributed to each sibling's different peer groups. Now the question is, does this theory apply to twins as well?

For the most part, or at least from my experience, twins tend to stick together when they are in their adolescent and teenage years. As a result of being together they would also share the same peer group. Combining these ideas and the group socialization theory, it seems logical that if twins share the same peer group then they would also share the same attitudes, beliefs, and norms. And if what we learn in our early years becomes a part of our personality, how could twins have different attitudes, beliefs, and norms when they are older?

This question seems to relate more to MZ twins than to DZ twins, because DZ twins are comparable to normal siblings in that they only share half of their genes. Perhaps the variance is greater for the nonshared environment because of the DZ twins, who are more apt to have different peer groups. Another explanation could be that both MZ and DZ twins had individual life experiences that changed how they thought and what they believed.

Even with these explanations, which are only guesses, I am still unsure why there was greater variance across the sample for certain attitudes that were attributed to the nonshared environment. I am sure further research could answer these questions.

Peer Commentary

Addictive Behaviors: Heredity or Environment?

Samantha P. Lumbert
Rochester Institute of Technology

For a commentary on Haimowitz's paper, "Heredity Versus Environment: Twin, Adoption, and Family Studies," I thought it would be useful to examine the association of addictive behaviors in twins and the connection to heredity and environment. Haimowitz devoted a section to schizophrenia under adoption studies, and its link to heredity and environment. I thought that research on addictive behaviors with twins would also be a worthwhile matter to explore in search for influences of genes and surroundings. A fascinating article I discovered explored the question of whether smoking was connected with schizophrenia itself, the treatment of the illness, or the mere vulnerability to the illness. To study this, the researchers used two dozen people affected with schizophrenia, and their unaffected, healthy twins. Because of their genetic similarity, the unaffected twins would clearly be susceptible to the illness. The researchers also used control participants to compare with the results given by the twins. It was found that the unaffected twins had higher daily rates of smoking than the controls, the schizophrenic and unaffected twins were more often unsuccessful in attempts to quit than were the controls, and both types of twins reported more frequent, negative symptoms following their successful attempt at quitting than did the controls. The study found evidence to support that the addictive behavior of smoking is indeed linked to the susceptibility to schizophrenia, rather than the illness itself (Lyons et al., 2002).

Another interesting study considered alcohol expectancies in twins. It was found that positive alcohol expectancies shared by twins were mostly due to shared experiences,

and a great part of the expectancies were due to non-familial factors. This study demonstrated that positive attitudes towards consuming alcohol are mostly a result of environmental factors (Slutske et al., 2002).

In her paper, Haimowitz also devoted a section to antisocial personality disorder; another article I examined explored this disorder and its connection to another addictive behavior: gambling. The researchers found that pathological gambling was highly associated with the antisocial behavior disorders of antisocial personality disorder, child conduct disorder, and adult antisocial behavior. These behaviors appeared to be explained mostly by genetic factors, suggesting that there is a genetic vulnerability for developing antisocial behaviors which may also lead to addictive behaviors such as pathological gambling (Slutske, et al., 2001).

I believe that these three studies add an interesting perspective that considers addictive behaviors such as smoking, alcohol consumption, and gambling, and their connection with psychological disorders in twin studies. As was mentioned in Haimowitz's paper, there is no clear-cut explanation for whether these behaviors are genetic or environmental, but studies indicate that some addictions appear to be mostly due to genetics, whereas some attitudes toward addictive behavior are due to environment. Examination of heredity versus environment regarding addictive behaviors would make an interesting addition to Haimowitz's paper.

Peer Commentary

Nature or Nurture: The Inexhaustible Debate

EmilyAnn A. O'Coin
Rochester Institute of Technology

The commonly disputed topic of nature versus nurture has been an ongoing deliberation that dates back to Darwin. In "Heredity Versus Environment: Twin, Adoption, and Family Studies," Haimowitz exhibited many compelling research findings that help us understand the roles that environment and genetics play; however, I found that some of her studies held little relevance in the search for a "black and white" answer.

Although I agree that neither genetics nor environment is the sole determinant of how a person behaves or develops schizophrenia, I am skeptical of particular ways in which Haimowitz claimed that this is true. One issue that I am dubious toward is the topic of genotype-environment interaction. I am critical of the way Haimowitz portrayed this material for several reasons. It is illogical when documenting the three

types of genotype-environment interaction to document a study that is not consistent with the people being tested. The first two types discussed were based on studies from human twins, whereas the third type was formulated based on research using mice. Humans and mice may not be correlated in a study that is investigating extraversion, neuroticism, impulsivity, monotony avoidance, and family environment let alone socioeconomic status. Despite the lack of an appropriate study, it is important to emphasize the usefulness of identical twin (as opposed to fraternal twin) studies on this dimension because of the great degree of validity associated with the results. Identical twins share 100% of their genetic information (as opposed to only 50% in fraternal twins); therefore, any discrimination between the twins can be attributed to environmental factors.

A further concept that I had difficulty accepting was the discussion of children's adjustment to divorce under the topic of adoption studies. First, it is extremely difficult to validate a study basing its results on information received at the time of an event (separation/divorce) without considering background knowledge of the participants' attitudes and behaviors prior to the event. Without the awareness of how a person behaved or socialized prior to the experience of parental separation/divorce, it is insufficient to base conclusions on that person's personality after the often-upsetting event of experiencing a parental separation/divorce. Although it is sufficient for Haimowitz to state that "the type of adjustment processes that children from biological families went through could be attributed to biology or environment...", it is completely inappropriate to assert that "...adjustment for probands would have had to be linked to environment processes" without any valid arguments to purport this claim. One's genetic makeup provides the potential for the development of behavior among individuals. The environment in which one develops helps to shape the person that they become. Therefore, to argue that an adopted proband is affected by their adopted parental separation or divorce, only due to the environmental factors that influenced their behavior is groundless.

Schizophrenia has been widely researched in the attempt to determine whether environment or genetics plays a more dominant role. Haimowitz reiterated the common knowledge that it is difficult to determine what genetic factors influence such a disorder; therefore we can proclaim that environmental factors inevitably contribute to the development of schizophrenia. However, I would like to expand upon this issue by arguing that we cannot generalize that environmental factors--particularly in the case of adopted probands--play a triggering role. "Perhaps because the overall size of the genetic effect is large, accounting for about 80% of variance, definite environmental factors have been difficult to pin down. It has even been suggested that 'the environment' consists entirely of epigenetic or stochastic phenomena that can never be detected by standard epidemiological methods"

(McGuffin, 2004, p. S192). It is indeed reasonable to argue that environment is a contributing factor in schizophrenia. Nevertheless, we cannot measure the numerous factors in varying environments that are conducive to schizophrenia, leaving us with the question as to which type of environmental factors play a causal role.

Although there were several issues that I felt were not adequately demonstrated, there were several significant points that Haimowitz presented. When breaking down the debate of nature versus nurture, it is essential to incorporate practices that produce clear-cut results. The most essential contention recognized was that of twin studies. If two identical twins were separated at birth and one twin developed schizophrenia but the other did not, we could conclude that schizophrenia is strictly environmental. The percentages associated with twin concordance rates cannot be disputed, thus making the choice of twin studies very useful in the case of nature versus nurture.

I found most of Haimowitz's ideas for dissecting the deliberation of nature versus nurture to be very intellectually stimulating. It was fitting to provide many different examples of research conducted under the categories of twin, adoption, and family studies. However, there was very little supportive data that contribute to this discussion in the examples of bipolar disorder, schizophrenia, or antisocial personality disorder. In these studies, Haimowitz admitted that there was not enough research conducted or information available to interpret the results. When discussing a topic that is so controversial, it is imperative that research associated with compelling findings be presented, rather than research that did not provide enough information to present a valid argument. If Haimowitz had presented her findings in a matter that supported her conclusions rather than leaving room for ambiguity from research that was immaterial, a much stronger argument would have been evoked.

Author Response

Drawing Conclusions From Behavior Genetics

Avi G. Haimowitz
Rochester Institute of Technology

I found all four of my peer commentaries very interesting. I was impressed by the concepts that they brought up, and they made me think about ways I could have presented my paper in a more logical manner.

Blout said that she believed I should have touched on the topic of the heritability more, or otherwise have completely omitted it from my paper. She made a good point

here since I only briefly mentioned the term and did not go into great detail on how it impacts research in twin studies. My only issue with Blout's argument against the way I discussed the heritability coefficient is that she thought I made it seem like a concrete fact. I do not believe I did; in fact, I described it for what it is: an estimate. I wrote that nonshared environment does play a role in twins, which invalidates Blout's statement that I did not take environment into consideration when mentioning the heritability coefficient.

It is also true I could have done a better job at explaining the study performed in relation to genotype-environment interaction. I do not think, however, that it was pointless to include the information I did on the third study done with mice; studies done using mice can often produce parallels explanations for human behavior, or they can be precursors to studies performed using humans as the subjects. I understand Blout's argument that personality often influences behavior, but I did not write this paper with the intent to cover any specific component of what makes a human being; this is obvious with the varied topics I touched upon. Blout seemed to contradict herself when she said that disorder should also be mentioned; if anything, I discussed more mental disorders than I did aspects of personality itself.

Jones brought up a good point in her commentary, in which she questioned the study I discussed related to attitude heritability in twins. She was dubious about the validity of attributing so much variability to nonshared environment because the study was performed on adult twins rather than younger twins. I agree that it is more difficult to pinpoint exactly how nonshared environment could have such a large effect if you go by the assumption that most twins tend to share the same peer groups and thus obtain the same belief systems and behaviors. However, we cannot state that as fact; it is not known in the study the history of each pair of twins and how similar their upbringings were and how much of their social lives were shared with one another. I believe that the authors of the study should have elaborated on this issue more, and I think Jones' question is worth pursuing in a different study.

I would like to thank **Lumbert** for her fascinating summary of research done on addictive behaviors related to behavior genetics. I was intrigued by the information she provided on a study done on gambling and its correlates with antisocial personality disorder. That is one study I would have liked to include in my paper if I had examined the topic of addictive behaviors in relation to the argument of heredity versus the environment.

O'Coin's criticism of the study I discussed related to mice and genotype-environment interaction is similar to the one made by Jones. I understand why she believes that study to be irrelevant to my paper, but research is often done in stages, and I would have liked to have seen the results of that study done in its latter stages with

humans, of course. I mentioned it in my paper because I thought it was worth broaching the topic, not because I thought it was conclusive. I should have been more clear about that. O'Coin's comments on the adjustment to divorce study surprised me, but when I re-read what she said I had to agree with her argument that the conclusions made by myself based on the study did not really have any foundation in rationality.

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