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Nature vs Nurture

The Impact of Genes And Environment on Behavior



Written by Ashley Xu
Illustrated by Maria Altier

Nature or nurture? Are we shaped more by our genetics or by our environment? This is one of the fundamental questions of psychology. How do we study a question like this? How can scientists determine what behaviors are the product of one's social environment or upbringing and what behaviors are due to genetics? The answer is twin studies. Twin studies, especially studies on identical twins separated at birth, are a great way to study the question of nature versus nurture. Since identical twins have the same genetic makeup, scientists can attribute any differences in the twins to the different environments in which the twins were raised in. So, are we influenced more by nature or nurture? To answer this question, let's take a dive into the history of twin studies by investigating what they show about the basis of human behavior and how they advance the study of diseases and disorders.

Jim Lewis and Jim Springer are identical twins who were separated at 3 weeks old and reunited at age 39 in 1979. After talking, they found out that they both were named James by their parents, had a dog named Toy growing up, suffered from headaches, liked math and carpentry in school, drove a Chevrolet, and vacationed on the same beach in Florida. Jim and Jim both grew up in Ohio, a mere 45 miles apart from each other. Additionally, both twins had married a woman named Linda, then divorced Linda to marry a woman named Betty. Jim Lewis named his child James Alan Lewis, and Jim Springer named his child James Allan Springer. News of the Jim twins got to the University of Minnesota, and Thomas Bouchard Jr., a psychologist at the university, was intrigued by the Jim twins and invited them into his lab for testing.

Bouchard's team of researchers at the University of Minnesota was conducting a longitudinal study, which measures changes over a long span of time. The goal of the research was to find as many pairs of identical twins as possible in order to compare the personality differences between the twins. Over the span of 20 years, from 1979 to 1999,

The Minnesota Twin Family Study followed the lives of 137 pairs of twins. Participants in the Minnesota Twin Study were evaluated on traits such as personality, interests, family/social relationships, religion, health, physiological measurements, academic ability, mental health, and criminal record. 81 pairs of the twins were monozygotic or identical twins, meaning that the twins developed from the same egg in the womb, and 56 pairs of the twins were dizygotic or fraternal twins, meaning that the twins developed from two different eggs. These twins were all reared apart, meaning that the twins were separated at a young age (typically only weeks old) and raised in separate households by separate families, with no interaction with one another. The main finding of the Minnesota Twin Study was that identical twins who were raised apart had striking similarities in personalities, interests, and attitudes. So, the Jim twins are not an exception to the rule, even if they are an extreme example.

Researchers specifically targeted studying identical twins because identical twins share 100% of their genetic material, which allows researchers to calculate the heritability of certain traits. Fraternal twins share around 50% of their genetic material, meaning that researchers can also form a general idea of the impact of genes on fraternal twins' behaviors. If identical twins are more similar in a certain



E trait than fraternal twins are, scientists can attribute genetics to being the main influencing factor in developing that trait. However, if identical and fraternal twins are equally likely to share a trait, then environmental factors are likely more influential in the development of that trait.

Identical twins allow scientists to study the exact degree to which environment affects an individual's development because any difference in the twins can be directly and completely accredited to environmental influences. Through examining all of the twins, Thomas Bouchard and his fellow researchers consistently found that genetic and environmental influences play roughly equivalent roles in terms of importance in the development of human behavior. For example, in twin pairs who have schizophrenia, 50% of identical twins share the disorder, whereas only around 15% of fraternal twins

do. The fact that there is quite a high chance of one identical twin developing schizophrenia if the other has it shows that there are genetic influences that may increase susceptibility to schizophrenia, but there are also other factors at play (such as environmental influences) because identical twins do not both develop the disease 100% of the time.

The Minnesota Twin Study was not the first twin

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TwinsUK registry showing that common diseases such as cataracts, osteoarthritis, and back pain are influenced by genetics. In 2001, the Michigan State University Twin Registry was founded to study the effects of genetics and environment on medical and psychological disorders. These researchers found that some eating disorders, such as anorexia, have genetic influences rather than solely environmental causes.

A modern-day twin study is that of identical twin astronauts, Scott and Mark Kelly. In March of 2016, Scott Kelly returned to Earth after 340 days on the International Space Station (also known as the ISS, one of NASA's habitable satellites in low orbit around

study conducted. The origin of twin studies dates back to around 1875, when Francis Galton, one of the first people to investigate human twins and heritability of traits, published his research paper, "The History of Twins." Galton coined the terms "nature and nurture", and his paper was the starting point of today's nature vs. nurture debate. However, it is worth noting that Galton went down a dark path when his research led him to the staunch belief that intelligence was due to nature, which resulted in him advocating for the breeding of humans to create an "improved" human race. He invented the term "eugenics," which is a set of beliefs and practices that aims to selectively breed humans to have the most desirable genetic characteristics.

Twin studies have progressed since Galton and have generally left eugenics for a more moral understanding of nature and

Earth)—the longest time an American has spent in space. During this same span of time, Scott's brother Mark Kelly stayed on Earth. Mark is a retired astronaut who has spent 54 days in space over his career, after four space shuttle missions to the ISS. Since each of these space missions lasted only for a short span of time, the trips did not affect Mark's ability to act as a control subject on Earth to compare to Scott on his almost year-long trip in space. Since Scott Kelly landed on Earth, researchers from NASA and a host of different universities have been running numerous tests on the twins, both physical and psychological, to understand the effects of long-term space travel on the human body. This is the first study to be done on twins in space, and NASA is hopeful that it may be instrumental in one day sending humans to Mars. Although the sample size of only Mark and Scott Kelly is a small one, scientists hope that studying the

differences between Mark and Scott can lead not only to creating safer environments for astronauts traveling to space, but also open the door to future twin studies in space.

Twins also give scientists a chance to investigate the field of epigenetics, the study of changes in chromosomes that affect gene expression but do not alter DNA sequences. The epigenome consists of all chemical compounds and proteins that are added to human DNA (the genome) and tells the genome what to do by regulating gene expression. Epigenetics can account for the small physical differences that sometimes can be seen in identical twins, such as one twin being several inches taller

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than the other. Epigenetics causes these small differences because environmental factors such as physical activity, diet, stress, or exposure to toxins (through behaviors such as smoking) may cause the expression of some genes in one twin, but not in the other. Epigenetics research performed on twins is vital to science because the epigenome may influence the development of certain diseases such as cancer. Further research into the epigenome may lead to discoveries on how to cure or better treat diseases.

Scientists have been studying nature and nurture for decades, and at this point, there is a general consensus on this fundamental question of psychology. In recent years, psychologists have realized that asking the question of exactly *how much* of behavior is due to one's genetics and *how much* is due to one's environment may not be the right question to ask because the line between nature and nurture is a blurry one. All human behaviors are affected and influenced by *both* nature *and* nurture, such that scientists cannot say exactly what percentage of a behavior is due to heredity and exactly what percentage is due to one's upbringing. It is impossible to say that any specific behavior is entirely due to genetics or entirely due to the environment. Nature and nurture are undeniably and inextricably intertwined, and the two are in constant interaction to form the complexities of human behavior. ●