

The Impact of Genetics, Personal Experiences, and Human Drive on Intelligence

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The argument concerning whether your genetic inheritance or the environment in which you have encountered influences your intelligence is an ongoing debate among cognitive psychologists. Some psychologists have concluded that a person's cognitive abilities are related to the genes passed down from their parents while others believe that knowledge is generated by the experiences that a person encounters. These ongoing debates in the area of cognitive psychology are known as nature versus nurture (Cherry, n.d.). Scientists who believe that intelligence is based on genetic inheritance alone are known as nativists; while, empiricists are scientists who believe that intelligence is based on a person's experiences and learning by observing others. In addition to heredity and personal experiences, other researchers identify an individual's drive or motivation as a key factor when determining if a person can reach their fullest intellectual achievement. Duckworth, Peterson, Matthews, and Kelly (2007) refer to the motivation to succeed as "grit" and define it as perseverance to achieve difficult goals by focusing talent on long term goals over an extended period of time. The information presented in this paper will support that heredity, the environment, and individual drive all contribute to shaping a person's intelligence.

Background

What is intelligence? In order to understand intelligence, we can first look at the phenotype, or behaviors that have been observed in research on intelligence and how scientists have determined to measure a person's intelligence.

According to Deary, Spinath, and Bates (2006) fifty-two cognitive psychologists characterized intelligence as the following:

Intelligence is a very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience. It is not merely book learning, a narrow academic skill, or test-taking smarts. Rather, it reflects a broader and deeper capability for comprehending our surroundings – ‘catching on,’ ‘making sense’ of things, or ‘figuring out’ what to do. (p. 690)

The first attempt to measure a person’s intelligence was in 1905 when Alfred Binet created the first practical intelligence test (Deary et al., 2006). Today, the most widely used Intelligence Quotient (IQ) tests utilized for adults is the Wechsler Adult Intelligence Scale III or WAIS-III and utilized for children is the Wechsler Intelligence Scale for Children III (WISC-III). Dr. David Wechsler, the creator of the assessment, believed that the examination should measure a person’s intellectual performance or functioning and how one uses his/her intelligence; therefore, his intelligence test consists of thirteen separate tests and takes into consideration various categories of intellectual functioning. According to Deary et al. (2006), the cognitive domains assessed in “the WAIS-III are: verbal comprehension, perceptual organization, working memory, and processing speed” (p. 690). The outcome or measurement of performance on these cognitive domains was presented by Charles Spearman as *g* or a person’s general intelligence. Spearman also concluded that a person’s scores were found to be comparable on all thirteen tests (Deary et al., 2006). Individuals who scored high in one domain had the tendency to score high in the other domains, while those who performed badly on one test were prone to perform badly on others. Thus, this is why Spearman believed that a person’s *g* or general intelligence could be represented by a number or his/her IQ. An IQ score falling in the range of 85 to 115 has been determined as an average IQ.

Some interesting statistics that Deary et al. (2006) suggest are that a person's IQ stays similar from childhood to late adulthood. In addition, they concluded that a person's IQ reflects a person's success in school, and that IQ is the best indicator as to whether a person will be successful in their career. And last, IQ has been connected to the lifespan of a person. If IQ or a person's general intelligence correlates to so many aspects, then what factors impact a person's intelligence? Can educators have an impact on a child's intellectual or cognitive abilities?

Historical Perspective

During the past century, researchers have frequently changed their beliefs back and forth from genetics, or nature, to environment, or nurture, as the leading influence on intelligence. In the early 1900's, Mendel's law of inheritance began the argument by stating that "there is no escape from the conclusion that nature prevails enormously over nurture" (Plomin and Petrill, 1997, p. 53). However, in the 1930's and with the rise of behaviorism, the view was taken that heredity could not influence behavior.

Plomin and Petrill (1997) referenced one of the most famous quotes by J.B. Watson supporting the idea of behaviorism and the influence of environment:

Give me a dozen healthy infants and my own specified world to bring them up in, and I'll guarantee to take any one at random and train him to become any type of specialist I might select—doctor, lawyer, artist, merchant-chief and, yes, even beggar and thief, regardless of his talents, penchants, tendencies, abilities, vocations, and race of his ancestors (p. 54).

However, in the 1960's the rise of the influence of nature began to dominate. This swing was attributed to such findings as the revealing of the DNA code and the discoveries on the cause of

Down's syndrome being contributed to an additional chromosome being present in a person's DNA make-up. In the 1970's, the dominance of genetics continued to thrive as more DNA studies detected genes that were accountable for disorders, such as the Fragile X chromosome in mental retardation. In 1987, conclusions from a survey of over 1,000 scientists and professional educators indicated that they acknowledged both genetics and the environment as having an influence on intelligence (Plomin & Petrill, 1997). They also agreed that general intelligence can be determined as the cognitive functioning or *g* that is measured by an IQ test. In the next sections, specific examples of how genetics, personal experiences in the environment, and the motivation a person exhibits all contribute to a person's intellectual achievement.

Influence of Genetics on Intelligence

Brain Structure and Intelligence

Toga and Thompson (2005) explain that brain structure is genetically controlled, and cognitive abilities can be directly associated with specific brain structures. Thus, strongly suggesting that intelligence is inherited. They referenced research which concluded that magnetic resonance imaging (MRI) scans measuring the total volume of the brain, of individual lobes of the brain, and the volume of grey and white matter related to cognitive abilities and test scores on intelligence (Toga & Thompson 2005). As technology advances, more and more research is being conducted in the relationship between brain size and cognitive abilities.

An example of research comparing brain size and cognitive abilities was conducted by Andreasen, Flaum, Swayze, O'Leary, Alliger, Cohen, Ehrhardt, and Yuh (1993) which made a very complex concept of brain structure, brain mapping, and the relationship to intelligence understandable to the average person. Andreasen, et al. (1993) researched the relationship

between intelligence and brain structure using MRI measurements and suggested there may be an association between the two. The study consisted of sixty-seven adults averaging thirty-eight years of age. Out of sixty-seven adults, thirty-seven were male, and thirty were female. Their average education was 14.5 years. The average full-scale IQ of the group was 116; the average verbal score was 114; and, the average performance IQ was 114.

Overall, results found relationships among domain specific skills indicated on IQ tests and many of the specific brain structure sizes as well as overall brain volume. Three IQ domains were found to directly relate to the volume of the cerebral hemisphere. Total IQ and verbal IQ were linked with the volume of the right and left temporal, hippocampal, and cerebellar. Other relationships included the volume of gray matter in conjunction with IQ in the verbal and performance domains as well as total IQ. Studies on both male and female adults indicated significant relationships with brain structures, gender, and domain specific intelligence. For example, females had correlations with verbal IQ and brain structures, while males had more correlations with brain size and performance IQ. Basically, brain structures indicated that females are stronger in information retrieval from memory, while men have high levels of visual processing such as distance and depth perception, navigation, and visuo-spatial construction (Andreasen, et al., 1993).

In conclusion, the overall results indicated that the larger a person's brain, the higher their IQ (Andreasen, et al., 1993; McDaniel, 2005). However, an important disclaimer in the study pointed out that although the size of a person's brain indicates significant influences on IQ, other factors beyond the scope of this study should be considered.

Study on Genetic Influence and Age

Research indicates that genetic influence is more prevalent as a person ages (McGue et al., 1993; Plomin, et al., 1994; Plomin & Petrill, 1997). Genetics influences about 40% of a child's intelligence, 60% of a young adult, and reaches 80% later in life. A recent study of 60 year old Swedish twins who were raised apart and twins that were raised together reveals results that correlate with the percentages of genetic influence on intelligence throughout a person's lifespan. The results indicated that both sets of 60 year old twins had a high heritability rate of 80% for general cognitive ability. Plomin and Petrill (1997) find this interesting because it would appear that the twins growing up in different families would be exposed to different environments, thus, they would have more dissimilar IQs as they grew older. Because of this outcome, it can be determined that genetic influence on cognitive abilities turns out to be more and more significant during the course of a lifetime (McGue et al., 1993; Plomin, et al., 1994; Plomin & Petrill, 1997).

In addition, genetic inheritability has been related to cognitive abilities according to a longitudinal study involving twins and adoption data. This study compared the inheritability of IQ by comparing the change in IQ at various ages. A person's genes can have various effects on IQ as they turn off or on while a person is developing throughout their lifespan. Longitudinal genetic studies indicate that genes turn on and off during stages of life: early childhood to middle childhood and middle childhood to late adolescence. The results of the research indicated that IQ generally stays constant and that parent, offspring, and siblings show similar IQ scores at various

stages throughout childhood to adulthood (Fulker, Cherny, & Cardon, 1993; Plomin & Petrill, 1997).

According to Plomin and Petrill (1997), “the genetic influence on individual differences in intelligence is significant and substantial” (p. 53).

Influence of Environment on Intelligence

Categories of Environmental Influences

Anastasi (1958) classifies environmental influences on intelligence into two categories: First, organic effects, which can be influenced by disease or nutrition, and second, behavioral effects, which can be influenced by a behavior that elicits a consequent behavior. Organic and behavioral effects can both change a characteristic that is inherited from a parent. For example, Cherry (n.d.) explains that a person, who has the genetic characteristic to be tall, may not reach their potential height because of poor nutrition or a health issue. This is an occurrence where an organic effect of the environment has influenced a genetic trait. In addition, Anastasi (1958) gives an example of a mousy brown-haired girl who decides to dye her hair and turns into a gorgeous blonde as being a behavior that affects the outcome of another behavior. For example, Anastasi (1958) explains that the reactions from other coworkers could boost the girl’s self-esteem; therefore, the actions could change her behavior or motivation to be more social and outgoing leading to becoming more successful in the future. Anastasi (1958) lists other environmental conditions that could impact other behaviors such as someone being handicapped and unable to attend school on a regular basis could impact their education. Unstable home conditions, parental marital status, socio-economic status, and poor health which could be brought on by the inability to see a doctor can all impact a student’s ability to participate in activities and develop personal experiences which influence personality development. The

environmental conditions listed above influence the personal experiences that each individual is involved thus contributing to their overall intelligence (Anastasi, 1958; Sternberg and Grigorenko, 1997).

Studies on Sets of Monozygotic Twins

What evidence is available that indicates the environment or personal experiences have an impact on intelligence? A study conducted by Newman, Freeman, and Holzinger (1937) of 20 identical twins raised apart provides some evidence that different environments can influence intelligence (Sandiford, 1937). The study consisted of twenty monozygotic twins (genetically identical) that were raised apart after birth. The three authors concluded that the educational and social influences accounted for seventy-two percent of the variance in IQ difference. When four sets of twins were eliminated from the overall results, then environment accounted for twenty percent in the variance in IQ difference. Their conclusion identified that when monozygotic twins are raised in different environments the unique personal experiences greatly influence intelligence. In addition, they found that when twins are raised together, genetic differences are the factors that influence intelligence (Sandiford, 1937).

Another study supports intelligence is influenced by environmental factors is a study by Scarr and Weinberg (1976) that includes children from poor birth parents whose IQ was an unknown factor. Middle-class parents with IQs in the range of 118–121 adopted some of the children from the poor biological parents. The remaining children were raised by their birth parents. Once the children reached adulthood, researchers found that the adopted children had an IQ of 105 while the children that were raised by their biological parents had an IQ of 90. The IQ of the children that were adopted was lower than their adoptive parents; however, the significance was that their IQ was 15 points higher than their siblings who remained with their

biological parents. This study also concludes that environmental factors impact a child's intelligence.

Influence of Human Drive on Intelligence

Although evidence has been provided that genes passed down from parents and the experiences that a person encounters during a lifetime influence intelligence, some people clearly achieve more than others even though they have similar IQ's. William James questioned, "Why do some people accomplish more than others of equal intelligence?" (Duckworth et al., 2007, p. 1087). Duckworth et al. (2007) have determined the identifying factor as an individual's "grit." They explain people with grit are able to concentrate and work on long-term projects and goals until they are accomplished even though it may take several years to complete. Gritty people are the ones that welcome challenges and stay on course overcoming failures and hardship by turning them into positive learning experiences that make them even more successful in future endeavors. The characteristics of grit include such attributes as: "creativity, vigor, emotional intelligence, charisma, self-confidence, emotional ability, and physical attractiveness along with other positive qualities" (Duckworth et al., 2007, p. 1087). Gritty people might have one of these attributes or several of them, and when an attribute is combined with the right task or job, the outcome can be extraordinarily high achieving.

Duckworth et al., (2007) conducted six studies in order to evaluate if grit was a deciding factor over IQ when determining an individual's success. The results of the study revealed several conclusions about people with grit. First, individuals that possessed grit had more education than people their same age that did not demonstrate having the characteristics of grit. Older people were found to have more grit than younger people, thus concluding that grit increased throughout life. In addition, grittier people changed their careers less often. They found

satisfaction with choosing a career in which they had an interest and committing the time needed to be the best in the field. It was also determined that college graduates with grit had earned higher grade point averages (GPA's) than their fellow graduates. When researching elementary children, it was established that gritty children applied more effort towards studies and outperformed their classroom peers. The six studies indicated that an individual's achievement was attributed not only by their IQ but to the degree of effort that they exhibited towards a specific goal. Duckworth et al., (2007) propose that, "Drive and energy in childhood are more predictive of success, than is IQ or some other more domain-specific ability" (p. 1100).

Current Issues that are Applicable

Currently, research is moving in the direction of using molecular genetics or the use of deoxyribonucleic acid (DNA) to recognize the many genes that are responsible for the genetic influences on a person's cognitive abilities (Plomin and Petrill, 1997). It is not if they will determine the genes, but when they will identify specific genes that attribute to domain specific intelligence. Currently, many single genes have already been identified that contribute to a single gene disorder for low intelligence and diseases such as Alzheimer's. In the near future, scientists will be able to detect multiple gene systems responsible for high cognitive abilities through new techniques currently being developed.

Implications for Educators

How can educators influence students to reach their fullest intellectual potential? Based on the information provided, educators can conclude that everyone has the capacity to learn. Students enter the classroom with their individual genetic inheritances, life experiences, home conditions, parental influences, socio-economic status, health, and schema development. Educators should appreciate and encourage the individual differences that each child brings into

the classroom. Everyone has a talent that is unique to them and should be given the opportunity to develop the talent to their full capacity. Educators are responsible for creating a learning environment that both supports and encourages each individual student to pursue their unique talents and interests. “Children who demonstrate exceptional commitment to a particular goal should be supported with as many resources as those identified as gifted and talented” (Duckworth et al., 2007, p. 1100).

Summarization of Findings

Research has concluded that genetics is one factor in determining a person’s IQ. Evidence has been provided in the study showing birth parents and their children have high correlations when comparing IQ scores. However, it is also evident that personal experiences influence intelligence. In a study on biological twins that have been raised in different environments, the results indicated that the twins can possess a significantly higher or lower IQ than their sibling. A combination of genetic inheritance and environment contributes to intelligence. Even though it has been concluded that IQ can predict a person’s success and outcomes in life, grit can be considered as critical to high achievement as a person’s intellectual talent. Individuals with similar IQ scores to their peers can rise to the top of their class if they possess grit. Therefore, a person’s intelligence is a combination of the genes passed down by their parents, the personal experiences to which they have been exposed to, and the individual drive that they possess.

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