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"Nature Versus Nurture" : The Lesson of Natural Succession in Heredity and Variation

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ABSTRACT

The nature versus nurture debate involves the relative importance of an individual's innate qualities (nativism) in relationship to personal experiences (nurture) in determining individual differences in physical and behavioural traits. The interactions of genes with the environment, called gene-environment interaction, are another component of the nature-nurture debate. Measurements of the degree to which a trait is influenced by genes versus environment will depend on the particular environment and genes examined. Most scientist in the 20th century believed that nature and nurture combine in a complex mixture to produce human behaviour. In many cases, it has been found that genes may have a substantial contribution, including psychological traits such as intelligence and personality. Yet these traits may be largely influenced by environment in other circumstances, such as environmental deprivation. Heritability quantifies the extent to which variation among individuals in a trait is due to variation in the genes those individuals carry. It is quite interesting that a compromise was made and Biodeterminism and environmentalism have combined to become interactionism.

INTRODUCTION

The issue of what causes individual differences in intelligence goes beyond psychology, and involves moral, political, ethical, educational, social, physiological and statistical issues to name just a few. The issue of how differences in intelligence come about between individuals and groups is a topic of much fascination and controversy - it can arouse strong reactions and elicit personal beliefs and biases. Galton first used the phrase "Nature versus Nurture" in 1871 [1-3].

Heredity has been defined as the transmission of traits from parents to off spring. Genes generally express their functional effects through the production of proteins, which are complex molecules responsible for most functions in the cell. However, though genes contain all the information an organism uses to transfer traits to its offspring, the environment also play a prominent role in determining the ultimate phenotype of an organism. The philosophy that humans acquire all or most of their behavioural traits from nature is known as "tabula rasa" (blank slate). In recent years both nature and nurture have come to be recognised as great factors playing interacting role in trait development.

"Nature versus nurture" in its modern sense was coined by the English Victorian polymath Francis Galton in discussion of the influence of heredity and environment on social advancement. Galton was influenced by the book "The Origin of Species" written by his cousin, Charles Darwin. Psychologist Donald Hebb is said to have once answered a journalist's question of "which, nature or nurture, contributes more to personality?" by asking in response, "Which contributes more to the area of a rectangle, its length or its width?" [4,5]. The answer simply explains that neither nature nor nurture explains a creature's behaviour in a sort of single caused fallacy [6].

Historical trends in the nature versus nurture traits acquisition

From late 19th century - early 20th century

From the mid to late 1800's through to the early 1900's opinions rested in the nature camp. This was consistent with the scientific discoveries of the role of inheritance and natural selection by Mendel and Darwin.The major contributor to the psychological argument was Francis Galton in his book "Hereditary Genius: Its Laws and Consequences (1869). Galton had observed that the gifted individuals tended to come from families which had other gifted individuals. He went on to analyse talent in science, the professions, and the arts, ran in families.

Galton took this observation one step further, to argue that it would be "quite practicable to produce a high gifted race of men by judicious marriages during several consecutive generations".

This suggestion became known as eugenics, "the study of the agencies under social control that may improve or repair the racial qualities of future generations, either physically or mentally."

Galton wanted to speed up the process of natural selection, stating that: "What Nature does blindly, slowly, and ruthlessly, man may do providently, quickly, and kindly.

Finally, Galton was convinced that "intelligence must be bred, not trained". However, Such arguments have had massive social consequences and have been used to support apartheid policies, sterilization programs, and other acts of withholding basic human rights from minority groups.

Post World War I: (1920-1930)

After World War I, careful reanalysis of the mass of intelligence test data took place. This began to challenge the commonly held view that intelligence was directly, genetically linked to racial differences: e.g. blacks from Illinois (USA) had higher IQ scores than whites from 9 southern states - a finding difficult to reconcile with the simple idea that whites are intellectually superior to black. This evidence now seemed to support a closer link between social class and intelligence, rather than race and intelligence. As a result, a number of psychologists in the 1920s and 1930s shifted their position towards the environmental camp. The shift against nature (genetics) views was given momentum by the backlash against the social consequences of government policies.

From 1940s-1990s

From the early 1940's, it seemed there was a rejection of simplistic nature or nurture views, with more common recognition of their complex interplay. Nevertheless, social prejudices and inequalities were still evident and growing.

However, the focus of the problem was shifted away from the individual as the cause of the problem, and centered on social determinants. The pendulum swung towards the nurture/environmental end and away from the nature/genetic end. Efforts were made to arrest poor educational achievement through special schooling, and to alleviate poor living condition through welfare. It became politically correct to minimize talk and discussion of the role of 'nature' in contributing to any individual differences, let alone intelligence. The evidence of differences in intelligence between socioeconomic groups and racial groups, however, did not go away.

The controversy of genetics/environment dominance of human traits and behaviour continued to gain momentum until it suffered its strongest challenge with the recent publication 'the bell curve'.

"The Bell Curve" controversy

Jensen,(1969) present and interpret evidence of IQ differences between groups [7]. This publication triggered several comments from the public and among scientific communities. However, Herrnstein and Murray, (1994) released the most recent controversial publication in the nature versus nurture debate in the book called "The Bell Curve". This book provided momentum to swing the pendulum in the direction of nature[8].

"The work's main thesis is that an individual's intelligence - no less than 40% and no more than 80% of which is inherited genetically from his or her parents - has more effect than socioeconomic background on future life experiences [9]. In addition to the premise that measured intelligence (IQ) is largely genetically inherited, a second important premise was that IQ is correlated positively with a variety of measures of socioeconomic success in society, such as a prestigious job, high annual income, and high educational attainment; and is inversely correlated with criminality and other measures of social failure. It was suggested that SES successes (and failures) are largely genetically caused. In general, "The Bell Curve" support a view that intelligence is largely heritable [8].

Factors that influence individual Intelligence

Despite the submission of the bell curve which favours nature against nurture, several other factors have been found to play influential role in intelligence. Some of the other circumstances and attributes that have been found to vary to a greater or lesser (but always significant) extent in relation with IQ abound[10,11]. Nevertheless, not all of these factors support an environmental view.

Intelligence has been found to vary with:

- Infant malnutrition (negative)
- Birth weight
- Birth order
- Height
- Number of siblings (negative)
- Number of years in school
- Social group of parental home
- Father's profession
- Father's economic status
- Degree of parental rigidity (negative)
- Parental ambition
- Mother's education
- Average TV viewing (negative)
- Average book-reading
- Self-confidence according to attitude scale measurement
- Age (negative relationship, applies only in adulthood)
- Degree of authority in parental home (negative)
- Criminality (negative)
- Alcoholism (negative)
- Mental disease (negative)
- Emotional adaptation

"It is essential to note that no single environmental factor seems to have a large influence on IQ. Variables widely believed to be important are usually weak. Even though many studies fail to find strong environmental effects, most of the factors studied do influence IQ in the direction predicted by the investigator. Environmental effects are multi factorial and largely unrelated to each other"[10].

So, it would appear that there are many psychological and biological factors each contributing a small a small fraction to the variance in IQ scores.

EUGENICS

Eugenics is coined from the Greek words eugeneia (nobility of birth) and genesis (production). It is defined as the science which deals with the influences, especially prenatal influences, that tend

to better the innate qualities of man and to develop them to the highest degree[12]. It is also referred to as the study of the agencies under social control that may improve or repair the racial qualities of future generations, either physically or mentally [13].

In 1869, Galton published his own highly controversial work Hereditary Genius. This work by some has been named as the starting point of the "Nature versus Nurture" controversy. Although it may not be the starting point but it certainly brought this controversy into the limelight. Galton's first words in the book explain his purpose:

"I propose to show in this book that a man's natural abilities are derived by inheritance, so it would be quite practicable to produce a highly gifted race of men by judicious marriages during several consecutive generations."[14].

In this work Galton immediately took the side of Nature (biodeterminism) in this debate. The following describes his viewpoint:

I have no patience with the hypothesis occasionally expressed, and often implied, especially in tales written to teach children to be good, that babies are born pretty much alike and that the sole agencies in creating differences between boy and boy, and man and man, are steady application and moral effort.[13].

Galton, totally disagreed with the commonly held idea that a child was born into the world a blank slate, a "tabula rasa" in the words of British Empiricist David Hume [15,16]. By Galton's time Hume's philosophy, which would now be called "environmentalism," was the quite prevalent [17,1]. So it was against this "environmentalist" viewpoint that Galton resisted and proclaimed his new "science" of Eugenics.

Galton began by identifying the most "eminent" men of his day. These "eminent" men were those that he considered to be the brightest individuals of the land. This of course could all be shown and documented with statistics. To support his claim Galton calculated the relatedness of these "eminent" individuals [13]. Galton referred to the most famous person in a family as a "referent", and determined the likelihood that a referent would be related to another by blood. In an effort to quantify his findings Galton made the first steps to develop the correlation method that we now use in statistics[18].

Initially Galton's ideas were not well received and were thought to be highly controversial. However due in part to his efforts, the latter half of the 19th century saw a rise in the popularity of hereditability of traits. The heredity of intelligence took two paths based upon the emergence of two new sciences (Genetics and Psychology) that finally recombine in the late 20th century in a new version of the Nature/Nurture debate.

BIOLOGICAL DETERMINISM/ SOCIOBIOLOGY

Many scientists feel that the very question opposing nature to nurture is a fallacy. Already in 1951, Calvin Hall in his seminal presentation remarked that the discussion opposing nature and nurture was fruitless [19]. If an environment is changed fundamentally, then the heritability of a character changes, too. Conversely, if the genetic composition of a population changes, then heritability will also change.

As an example, we may use Phenylketonuria (PKU), which causes brain damage and progressive mental retardation. This mutation that causes phenylketonuria disrupts the ability of the body to break down the amino acid phenylalanine, and thus causes a toxic build-up of an intermediate molecule which has lethal effects to the body. PKU can be treated by the elimination of phenylalanine from the diet. Hence, a trait (PKU) that used to have a virtually perfect heritability is not heritable any more. If modern medicine is available (the actual allele causing PKU would still be inherited, but the phenotype PKU would not be expressed any more). Similarly, within, say, an inbred strain of mice, no genetic variation is present and every character will have a zero heritability. If the complications of gene-environment interactions and correlations are added, then it appears to many that heritability, the epitome of the nature-nurture opposition, is "a station passed" [20].

THE ROLE OF INTERACTION IN TRAIT EXPRESSION

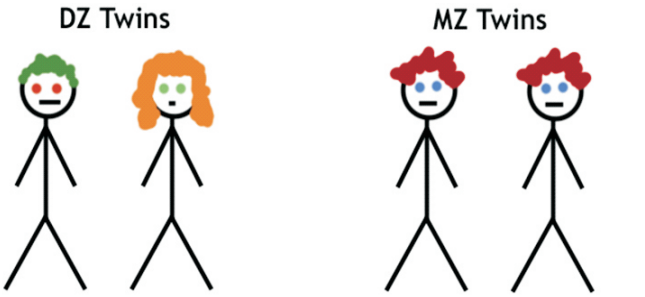
An under researched area, while the nature- nurture debate has raged, is the contribution of interactions between genetics and environment on IQ variance.

In the over focus on nature vs. nurture issues, the attempts to estimate the relative contribution rests on the somewhat naive notion that there is a constant, true value. In reality, "gene expression is environment dependent" and it's impossible to obtain pure estimates of genetic and environmental contribution - one could not exist without the other. The environment a child experiences is partly a consequence of the child's genes as well as external factors. To some extent a person seeks out and creates his or her environment. If she is of a mechanical bent she practices mechanical skills; if a bookworm, she seeks out books. Thus genes may create an appetite rather than an aptitude. Remember that the high heritability of short-sightedness is accounted for not just by the heritability of a gene for short sightedness but by the heritability of literate habits. Thus, a future area for research which blends those in the nature camps with those in the nurture camps would be examine which environmental components allow people to optimally realise their genetic potentials for a variety of areas of cognitive performance [21].

NATURE VS NURTURE IN PERSONALITY TRAITS

Personality is a frequently cited example of a heritable trait that has been studied in twins and adoptions. Identical twins reared apart are far more similar in personality than randomly selected pairs of people. Likewise, identical twins are more similar than fraternal twins. Also, biological siblings are more similar in personality than adoptive siblings. Each observation suggests that personality is heritable to a certain extent. However, these same study designs allow for the examination of environment as well as genes. Adoption studies also directly measure the strength of shared family effects. Adopted siblings share only family environment. Unexpectedly, some adoption studies indicate that by adulthood the personalities of adopted siblings are no more similar than random pairs of strangers. This would mean that shared family effects on personality are zero by adulthood. As is the case with personality, non-shared environmental effects are often found to out-weigh shared environmental effects. That is, environmental effects that are typically thought to be life-shaping (such as family life) may have less of an impact than non-shared effects, which are harder to identify. One possible source of non-shared effects is the environment of pre-natal development. Random variations in the genetic program of development may be a substantial source of non-shared environment. These results suggest that "nurture" may not be the predominant factor in "environment". Twin Studies in relation to nature and nurture

A twin study is one of the method used to evaluate influences of nature and the environment on character. There are two types of twin: dizygotic (DZ) who are regular fraternal twins; and then monozygotic (MZ) which are identical twins and so have exactly the same DNA as each other, i.e. the genotypes are identical. The figures below summarizes what the various findings would mean.



If inteligence is the same it must be due to the environment.	If inteligence is the same it must be due to genetics.
If inteligence is different it must be due to genetics.	If inteligence is different it must be due to the environment.

Source: www.scienceaid.net

Fig 1: Twin Studies in relation to nature and nurture

Based on various finings in research carried out on twin studies, both nature and nurture play an important role, however perhaps that the environment is the deciding factor.

The idea used to describe it is the Rubber Band Hypothesis. It says that the potential (length of the band) is decided by genetics. However the environment stretches this band, so that someone with a low potential could be stretched beyond someone with a high because of environmental differences. However if someone with a high and someone with a lower genetic potential had the same environment, that person with the higher genetic potential would be able to 'stretch' their intelligence to a higher level.

HOMOSEXUALITY, IS IT A PRODUCT OF NATURE OR NURTURE ?

Claims from homosexuals argue reasonably that they are different biological entity, i.e. composed of different genes which confer in them homosexual traits. This hypothesis has led to controversy on whether homosexuality should be legalised or not. Other questions regarding homosexuality include; To what extent is it a product of nature or nurture?

Current perceptions are a legacy of the nineteenth century, when sexual activities were first used to define the people who engaged in them. As Michel Foucault observed, "The sodomite had been a temporary aberration; the homosexual was now a species." Instead of being something that people did homosexuality became who they were: a different biological creature than heterosexuals.

CONCLUSION

Nature and nurture are essential and interwoven in personality development. As the famous psychologist Donald Hebb once answered a journalist's question of "which, nature or nurture, contributes more to personality?" by asking in response, "which contributes more to the area of a rectangle, its length or its width?". This answer simply explains that neither nature nor nurture explains a creature's behaviour in a sort of single cause fallacy.

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