GENETIC INFLUENCE ON HUMAN PSYCHOLOGICAL TRAITS: A SURVEY RESEARCH IN ENUGU STATE UNIVERSITY TECHNOLOGY, ENUGU, NIGERIA

Ejike H. Mgbenkemdi, Ph.D

Abstract

There is now a large body of evidence that supports the conclusion that individual differences in most, if not all, reliably measured psychological traits, normal and abnormal, are substantively influenced by genetic factors. This fact has important implications for research and theory building in psychology, as evidence of genetic influence unleashes a large amount of questions regarding the sources of variance in such traits. A brief list of those questions is provided, and representative findings regarding genetic and environmental influences are presented for the domains of personality, intelligence, psychological interests, psychiatric illnesses, and social attitudes. These findings are consistent with those reported for the traits of other species and for many human physical traits, suggesting that they may represent a general biological phenomenon.

Keywords*:* Behaviour genetics; heritability; and individual differences.

Among knowledgeable researchers, discussions regarding genetic influences on psychological traits are not about whether there is genetic influence, but rather about how much influence there is, and how genes work to shape the mind. Genetics is the study of heredity. Heredity is a biological process where a parent passes certain genes into their children or offspring. Every child inherits genes from both of their biological parents and these genes in turn express specific traits. Some of these traits may be physical for example hair and eye colour and skin color etc. On the other hand some genes may also carry the risk of certain diseases and disorders that may pass on from parents to their offspring.

As Rutter (2002) noted, "any dispassionate reading of the evidence leads to the inescapable conclusion that genetic factors play a substantial role in the origins of individual differences with respect to all psychological traits, both normal and abnormal". Put concisely, all psychological traits are heritable. Heritability is a descriptive statistic that indexes the degree of population variation in a trait that is due to genetic differences. The complement of heritability indexes variation contributed by the environment (plus error of measurement) to population variation in the trait. Studies of human twins and adoptees, often called behaviour genetic studies, allow us to estimate the heritability of various traits. The name behaviour genetic studies is an unfortunate misnomer, however, as such studies are neural regarding both environmental and genetic influences. That they repeatedly and reliably reveal significant heritability for psychological traits is an empirical fact and one not unique to humans. Lynch and Walsh (1998) pointed out that genetic influence on most traits, as indexed by estimates of heritability, is found for all species and observed that "the interesting questions remaining are, How does the magnitude of heritability differ among characters and species and why"?.

Why Study Genetic Influences on Human Behavioural Traits?

A simple answer to the question of why scientists study genetic influences on human behavoiur is that they want a better understanding of how things work, that is, better theories. Not too many years ago, Meehl (1998) argued that the "most so-called theories in the soft areas of psychology (clinical, counseling, social, personality, community, and school psychology) are scientifically unimpressive and technologically worthless". He listed 20 fundamental difficulties faced by the researchers in the social sciences. Two are relevant to the current discussion: heritability and nuisance variables. The two are closely related. Nuisance variables are variable assumed to be causes of group or individual differences irrelevant to the theory of an investigator. Investigators seldom provide a full theoretical rationale in support of their choice of nuisance variables to control. As Meehl pointed out, removing the influence of

parental socioeconomic status (SES, i e, treating it as a nuisance variable) on children's IQ when studying the causes of individual differences in IQ make the assumption that parental SES is exclusively a source of environmental variance, as opposed to being confounded with genetic influence. Meehl argued that this example "is perhaps the most dramatic one, but other less emotion-laden examples can be found on all sides in the behavioural sciences". His point was that knowledge of how genetic factors influence any given measure for example socioeconomic status or trait for example IQ will allow scientists to develop more scientifically impressive and worthwhile theories about the sources of individual differences in psychological traits.

Evidence of genetic influence on a psychological trait raises a series of new questions regarding the sources of population variance for that trait. All the questions addressed in quantitative genetics (Lynch & Walsh, 1998) and genetic epidemiology (Khoury, 1998), become relevant. What kind of gene action is involved? Is it a simple additive influence, with the effects of gene simply adding up so that more genes cause greater expression of the trait, or is the mode of action more complex? Are the effects of genes for a particular trait more pronounced in men or women? Are there interactions between genes and the environment? For example, it has been known for a long time that stressful life events lead to depression in some people but not others. There is now evidence for an interaction. Individuals who carry a specific genetic variant are more susceptible to depression when exposed to stressful life events than individuals who do not carry the genetic variant (Caspi, Sugden, Moffitt, Taylor, Craig, Harrington, McClay, Mill, Martin, Braiwaite, & Poulton, 2014). Are there gene-environment correlations? That is, do individuals with certain genetic constitutions seek out specific environment? People who score high on measures of sensation seeking certainly, on average, tend to find themselves in more dangerous environments than people who score low for this trait (Bouchard & McGue, 2012).

Genetic disorders can be inherited in much the same way a person can inherit other characteristics from the parents such as eye and hair color, height and intelligence (Kim & Yong-Kyu, 2009). Children inherit genetic or hereditary information by obtaining genes from each parent.
There are three types in modes of inheritance namely:

1. Dominant
2. Recessive
3. Sex-linked or x-linked

Dominant Inheritance: occurs when one parent has a dominant, disease causing gene which cause abnormalities even if coupled with healthy gene from the other parent. Dominant inheritance means that each child has a 50% chance of inheriting the disease causing gene. An example of dominant inheritance associated with mental retardation is Tuberous sclerosis.

Recessive Inheritance: occurs when both parents carry a disease-causing gene but outwardly show no signs of disease. Parents of children with recessive conditions are called carriers since each parent carries one copy of a disease gene. They show no symptoms of having a disease gene and remain unaware of having the gene until having an affected child. When parents who are carriers give birth, each child has a 25% chance of inheriting both disease genes and being affected. Each child also has a 25% chance of inheriting two healthy genes and not being affected, and a 50% chance of being a carrier of the disorders like their parents. Examples of disorders which are inherited recessively and are also associated with mental retardation include Phenylketonuria (PKU) and Galactosemia.

Sex-linked or x-linked Inheritance: this affects those genes located in the X chromosome and can be either X-linked dominant. The X-linked recessive disorder, which is much more common compared to X-linked dominant inheritance, is referred to as a sex-linked disorder since it involves genes located in the X-chromosome. It occurs when an unaffected mother carries a disease-causing gene on at least one of her X chromosomes. Since females have two X chromosomes, they are usually unaffected carriers because

the X chromosome that does not have the disease-causing gene compensates for the X chromosome that does. Therefore, they are less likely than males to show any symptoms of the disorder unless both X chromosome have the disease-causing gene. To understand heredity, you have to know a little about human chromosomes and how they work.

Chromosomes come in Pairs in the Cell's Nucleus. Humans have 46 chromosomes in each cell nucleus, which are actually 23 pairs of chromosomes. For 22 of these pairs, numbered chromosome 1 through chromosome 22, the chromosomes are the same; that is, they carry genes for the same traits. One chromosome comes from a person's mother, the other from his father.

The 23rd Pair is an Exception and Determines Gender. The 23rd chromosomal pair differs according to whether you are a male or a female. Males have an X and a Y chromosome, while females have two Xs for this 23rd pair of chromosomes. Every female gets one X chromosome from her mother and one X from her father. Every male gets an X chromosome from his mother and a Y from his father.

Estimates of the Magnitude of Genetic Influence on Psychological Traits

Below are typical behaviour genetic findings drawn from studies of broad and relatively representative samples from Enugu State University of Science and Technology?

Personality

Psychologists have developed two major schemes for organizing specific personality traits into a higher-order structure, the Big Five and the Big Three. As Table 1 shows, the findings using the two schemes are much the same. Genetic influence is in the range of 40 to 50%, and heritability is approximately the same for different traits. There is evidence of nonadditive genetic variance. That is, genes for personality, in addition to simply adding or subtracting from the expression of a trait, work in a more complex manner, the expression of a relevant gene depending to some extent on the gene with which it is paired on a chromosome or on gene located on other chromosomes. Research has yielded little evidence for significant shared environmental influence, that is, similarity due to having trait-relevant environmental influences in common. Some large studies have investigated whether the genes that influence personality traits differ in the two sexes (sex limitation). The answer is no. However, sometimes these are sex differences in heritability.

Mental Ability

Early in life, shared environmental factors are the dominant influence on IQ but gradually genetic influence increases, with the effects of shared environment dropping to near zero (see the twin studies in table 1). Although not reported here, adoption studies of (a) unrelated individuals reared together and (b) adoptive parents and their adopted offspring have reported similar results-increasing genetic influence on IQ with age and decreasing shared environmental influence. Results from two twin studies of OQ in old age (over75) are reported in Table1. Both studies found a substantial level of genetic influence and little shared environmental influence. The results do, however, suggest some decline in heritability when compared with results for earlier ages. There is no evidence for sex in heritability for IQ at any age.

Psychological Interests

Heritability's for psychological interests, also called vocational or occupational interests, are also reported in table 1. These heritability's were estimated using gathered in a single large study that made use of a variety of samples (twins, siblings, parents and their children, etc.) gathered over many years. All respondents completed one form or another of a standard vocational interest questionnaire. There is little variation in heritability for the six scales, with an average of 36. As with personality traits, there is evidence for non additive genetic influence. Unlike personality, psychological interests show evidence for shared environmental influence, although this influence is modest, about 10% for each trait.

Psychiatric Illnesses

Schizophrenia is the most extensively studied psychiatric illness, and the findings consistently suggest a very high degree of genetic influence (heritability of about 80), mostly additive genetic influence, with no shared environmental influence. There do not appear to be gender differences in the heritability of schizophrenia. Major depression is less heritable (about.40) than schizophrenia. Men and women share most, but not all, genetic influences for depression. Panic disorder, generalized anxiety disorder, and phobias are moderately heritable, and the effect is largely addictive, with few if any sex differences. The heritability of alcoholism is in the range of .50 to 60, mostly because of additive genetic effects. Findings regarding the possibility of sex differences in the heritability of alcoholism are mixed.

Antisocial behavior has long been thought to be more heritable in adulthood than childhood. The results of a recent analysis do not support the conclusion. The genetic influence is additive and in the range of .41 to 46. Shared environmental influences decrease from childhood to adulthood, but do not entirely disappear in adulthood. There are no sex differences in heritability.

Social Attitudes

Twin studies reveal only environmental influence on the conservatism up to age of 19; only after this age do genetic influences manifest themselves. A large study (300 adults, including twins and most of their first-degree relatives) yielded heritability of .65 for males and .45 for females. Some of the genetic influence on conservatism is non additive. Recent work with twins reared apart has independently replicated these heritability findings. Conservatism correlates highly, about .72, with right-wing authoritarianism, and that trait is also moderately heritable.

Religiousness is only slightly heritable in 16-year-olds (.11 for girls and .22 for boys) and strongly influenced by shared environment (.60 in girls and .45 in boys). Religiousness is moderately heritable in adults (.30 to .45) and also shows some shared environmental influence. Good data on sex differences in heritability.

Table 1

Estimates of Broad Heritability and Shared Environmental Influence and Indications of Non additive Genetic Effects and Sex Differences in Heritability for Representative Psychological Traits of religiousness in adults are not available.

Trait	Heritability	Non additive genetic effect	Shared environmental effect	sex differences in heritability
Personality (adult samples)				
Big Five				
Extraversion	.54	Yes	No	perhaps
Agreeableness (aggression)	.42	Yes	No	probably
Conscientiousness	.49	Yes	No not	probably
Neuroticism	.48	Yes	No	No
Openness	.57	Yes	No	probably not
Big Three				
Positive Emotionality	.50	Yes	No	No
Negative emotionality	.44	Yes	No	No
Constraint	.52	Yes	No	No
Intelligence				
By age in ESUT cross-sectional twin data	.22	No	.54	No
Age 5	.40	No	.29	No
Age 7	.54	No	.26	No
Age 10	***.85***	No	No	No
Age 12	***.62***	No	No	No
Age 16	***.82***	No	No	No
Age 18	***.88***	No	No	No
Age 26	***.85***	No	No	No
Age 50	***.54--.62***	Not tested	No	No
In old age (> 75 years old)				
Psychological interests				
Realistic	.36	Yes	.12	NA
Investigative	.36	Yes	.10	NA
Artistic	.39	Yes	.12	NA
Social	.37	Yes	.08	NA
Enterprising	.31	Yes	.11	NA
Conventional	.38	Yes	.11	NA
	.80			
Psychiatric illnesses (liability estimates)	.37	No	No	No
Schizophrenia	.30-.40	No	No	Mixed
Major depression	.30	No	Findings	
Panic disorder	.20-.40	No	No	No
Generalized anxiety disorder	.50-.60	No	Small female only	No
Phobias		No	No	No
Alcoholism	.46		Yes	Mixed
Antisocial behavior	.43	No	Findings	
Children	.41	No		
Adolescents		No	.20	No
Adults			.16	No
	.00		.09	No
Social attitudes	.45-.65	NR		
Conservatism	.50-.64	Yes	Yes	NR
Under age 20 years		No	Yes in females	Yes
Over age 20 years			.00-.16	NA
Right-wing authoritarianism (adults)				
Religiousness				

16-year-olds	.11-.22	No	.45-.60	Yes
Adults	.30-.45	No	.20-.40	Not clear
Specific religion	Near zero	NR	NA	NR

Note: NA 5 not available; NR 5 not relevant.

Membership in a specific religious denomination is largely due to environmental factors.

A Note on Multivariate Genetic Analysis

In this review, the researcher has addressed only the behaviour genetic analysis of traits taken one at a time (univariate analysis). It is important to recognize that it is possible to carry out complex genetic analyses of the correlations among traits and compute genetic correlations. These correlations tell us the degree to which genetic effects on one score (trait measure) are correlated with genetic effects on a second score, at one or at many points in time. The genetic correlation between two traits can be quite high regardless of whether the heritability of either trait is high or low, or whether the correlation between the traits high or low. Consider the well-known positive correlation between tests of mental ability, the evidentiary base for the general intelligence factor. This value is typically about .30. The genetic correlation between such tests is, however, much higher, typically closer to .80. Co-occurrence of two orders, a common finding in psychiatric research, is often due to common genes. The genetic correlation between anxiety and depression, for example, is estimated to be very high. Multivariate genetic analysis of behavioural traits is a very active domain of research.

Conclusions

One unspoken assumption among early behaviour geneticists, an assumption that was shared by most for many years, was that some psychological traits were likely to be significantly influenced by genetic factors, whereas others were likely to be primarily influenced by shared environmental influences. Most behaviour geneticists assumed that social attitudes, for example, were influenced entirely by shared environmental influences and so social attitudes remained largely unstudied until relatively recently. The evidence now shows how wrong these assumptions were. Nearly every reliably measured psychological phenotype (normal and abnormal) is significantly influenced by genetic factors. Heritability also differs far less from trait to trait than anyone initially imagined. Shared environmental influences are often, but not always, of less importance than genetic factors and often decrease to near zero after adolescence. Genetic influence on psychological traits is ubiquitous, and psychological researchers must incorporate this fact into their research programs else their theories will be “scientifically unimpressive and technologically worthless”, to quote Meehl again.

At a fundamental level, a scientifically impressive theory must describe the specific molecular mechanism that explicates how genes transact with the environment to produce behaviour. The rudiments of such theories are in place. Circadian behaviour in humans is under genetic influence (Hur, Bouchard, & Lykken, 1998), and some of the molecular mechanisms in mammals are now being revealed (Lowrey & Takashi, 2000). Ridley (2003) and Marcus (2004) have provided additional examples of molecular mechanisms that help shape behaviour. Nevertheless, the examples are few, the details are sparse, and major mysteries remain. For example, many behavioural traits are influenced by non additive genetic processes. These processes remain a puzzle for geneticists and evolutionists, as well as psychologists, because simple additive effects are thought to be the norm (Wolf, Brodie, & Wade, 2000). We also do not understand why most psychological traits are moderately heritable, rather than, as some psychologists expected, variable in heritability, with some traits being highly heritable and others are largely under the influence of the environment. It seems reasonable to suspect that moderate heritability may be a general biological phenomenon rather than one specific to human psychological traits, as the profile of genetic and environmental influences on psychological traits is not that different from the profile of these influences on similarly complex physical traits (Boomsma, Buhsjan, & Peltonen, 2002) and similar findings apply to most organisms.

Recommendations

The first recommendation to this research is a confirmation of something we all know intuitively--our genes influence our behavior, and in particular, the kinds of behaviors that are associated with longevity in school (e.g., perseverance, cognitive ability, work ethic) Turkheimer, Haley, Waldron, D'Onofrio, & Gottesman,(2015). The opined that if one is skeptical about the genetic influence on human psychological trait a visit to Neurotree would clear the doubt. Neurotree is a website where scientists trace their intellectual genealogy. How cognitive dissonance shifts attitudes (Festinger, 1987).

Secondly, In the early years examining the links between genes and personality, it was typical for a study to examine self-reports of personality and compare the self-reports between fraternal twins--who share roughly 50% of their genes--to those of identical twins--who share 100% of their genes (Segal & Nancy, 2005). In this study, very consistent effects emerged that suggested one thing: when it comes to personality, genes matter.

Lastly, this study was very clear in its suggestion that there are some genetic influences on personality considering that human behaviour is a product of both the situation and past experience. Given this theoretical perspective, the right question is not a question of genes v environment or nature v nurture, the right question is how do gene and environment interact to shape behaviour (Rutter & Michael, 2006).

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