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8 Surprising Facts About Parenting, Genes and What *Really* Makes Us Who We Are

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In 1990, Thomas J. Bouchard, Jr. and his colleagues at the University of Minnesota published a striking finding: About 70 percent of the variance in IQ found in their particular sample of identical twins was found to be associated with genetic variation. Furthermore, identical twins reared apart were eerily similar to identical twins reared together on various measures of personality, occupational and leisure-time interests, and social attitudes.

Bouchard's study, along with many others, has painted a consistent picture: Genes matter. The studies say nothing about how they matter, or which genes matter, but they show quite convincingly that they indeed do matter. Genes vary within any group of people (even among the inhabitants of middle-class in Western society), and this variation contributes to variations in these people's behaviors.

Let's be clear: Twin studies have received much criticism. Even though the proliferation of advanced statistical techniques (such as structural equation modeling) and the implementation of additional controls have allayed some of the concerns, they haven't allayed all of the them.

Even so, the findings from twin studies should not be understated; it counters many a prevailing belief that we are born into this world as blank slates, completely at the mercy of the external environment. Because our psychological characteristics reflect the physical structures of our brains and because our genes contribute to those physical structures, there are unlikely to be any psychological characteristics that are completely unaffected by our DNA.

The fact that both our genes and our environment contribute to who we are and *depend* on each other is actually quite a good thing! Give too much control to our environment or our genes, and we lose free will. The way we work gives us choice.

Unfortunately, findings from twin studies are often misunderstood, misinterpreted and blown out of proportion -- not just by the media, but even by serious scientists who get their work published. To put things in perspective, I teamed up with the well-known developmental psychologist at Pitzer College, David S. Moore, to list eight facts about genes, twin studies, and the heritability statistic that may come as a surprise to many people -- even biologists!

1. Genes, By Themselves, Can't Determine Anything

Twin studies partition the variance in nature and the variance in nurture. This allows researchers to determine whether differences in genes or differences in the environment in a particular population are associated with more of the differences in observed behavior.

In reality, all biological and psychological characteristics are constructed during development, when genes interact with local environmental factors that can be influenced by the broader environment. Therefore, gene-environment interactions are understood to drive the development of all of our characteristics. Naked DNA (or RNA) is simply not sufficient to produce psychological or biological traits.

Therefore, when it comes to understanding the development of a trait in a particular person, nature can never be separated from nurture. Science writer Matt Ridley has put it this way:

[Genes] are devices for extracting information from the environment. Every minute, every second, the pattern of genes being expressed in your brain changes, often in direct or indirect response to events outside the body. Genes are the mechanisms of experience.

2. **Parents Matter, And Will Always Matter**

The authors of many twin studies have claimed that the environments experienced by twins (or any two siblings) do little to create differences in intelligence and personality as adults. Somehow, this finding translates to the media as "parenting doesn't matter." This couldn't be farther from the truth.

Take the most essential element: a child needs to be raised in a family, almost any kind of family, to develop the ability to speak a language. Since every single person in twin studies checks that box -- that is, they are raised in a family of some sort -- this factor never varies and thus does not predict differences in ability to speak a language. But does this mean that the variable "has a family" doesn't matter in determining whether or not a person develops the ability to speak a language? Of course not! That's like saying that water has no influence on a fish's development because all fish live in water. Just because a variable doesn't vary doesn't mean it has no causal impact on a particular outcome.

The parenting factors that are statistically associated with differences between individuals should never be confused with the parenting factors that cause the development of a trait within an individual. Genes could "account for" 100 percent of the variability in a trait in a particular twin study, but this does not mean that environmental factors are therefore unimportant in the development of the trait; parents still matter and will always matter.

It turns out that parenting matters, just in a way different than originally assumed. Genes matter to the extent that they support parenting, because like any other behavior, parenting behaviors are influenced by the genes. Parents matter to the extent that they support the expression of genes.

3. **Heritability Depends Entirely On Context**

None of the twins in Bouchard's study were reared in real poverty, were raised by illiterate parents, or were mentally retarded. There is reason to believe that under more dire circumstances, the heritability of IQ would be significantly lower than that reported by Bouchard. After all, if everyone were raised in an identical environment, variations in their psychological characteristics couldn't possibly be accounted for by anything other than variations in their genes (since there would be no variations in their developmental environments); the more variation in environments that twins in twin studies are exposed to, the lower the heritabilities we should expect to find.

In one study, Eric Turkheimer and colleagues studied 320 pairs of 7-year-old twins who were raised in extreme poverty. Among the poorest, the shared environment accounted for most of the differences in IQ (60 percent), and the genes accounted for very little. Consequently, in this study, the heritability of IQ was reported to be close to zero! Among the richest, however, the heritability of IQ approached what Bouchard found: Variations in the genes accounted for most of the differences in IQ scores, and the shared environment accounted for very little of the variance. This study points to the fact that estimates of heritability depend on the sample that is studied, and the environment of that sample.

Turkheimer's study should also be a reminder that just because something is heritable doesn't mean it's immutable. The Flynn effect -- the dramatic rise in IQ witnessed in the 20th century -- is a good example of that. The Flynn effect should be a reminder of just how much the environment matters, even after completely controlling for genes (by looking at IQ changes across generations).

This raises a deeper point: Depending on what you hold constant, you can either show a genetic contribution or an environmental contribution. The point is that both are always contributing to the development of any trait, and context matters in which accounts for more of the differences in a trait.

4. **The Actual Heritability Value Simply Does Not Matter**

The heritability of a trait can vary from 0.00 to 1.00, depending on the environments from which research participants are sampled. Because we know that genes play some role in the development of any trait, the precise heritability estimate doesn't matter in a practical sense.

Heritability depends on the amount of variability in the environmental factors that contribute to a trait. The problem is that our understanding of the factors that contribute to the development of human traits in

general -- and to IQ in particular -- is currently so deficient that we typically do not know if the environmental factors important in the development of a particular trait are stable across testing situations, vary somewhat across those situations, or vary wildly across those situations.

Even if a population of individuals were to develop in a range of environments believed to be the same as that in which a particular study was conducted, the results of that study would not allow us to predict developmental outcomes in the new range of environments because the environmental factors that the researchers originally focused on -- and controlled for -- might not be the relevant environmental factors at all.

Instead, the crucial environmental factors might remain unmeasured, and consequently, variability of those factors across the new range of environments could easily be very different than the variability of those factors across the environments sampled in the original study.

Of course, we could just aim to measure all of the environmental factors that might affect the development of a trait. But it is not at all obvious prior to developmental analysis which environmental factors might make important contributions to the development of specific traits, so that approach would leave us measuring a seriously unwieldy number of variables.

Because the development of behavioral and psychological characteristics can be influenced by experiential factors in ways that are unpredictable from casual observation, we cannot hope to happen to measure -- through sheer lucky guesswork -- which environmental factors contribute importantly to the development of those characteristics; we first need to understand the mechanisms by which those traits develop.

5. **Heritability Doesn't Necessarily Have To Do With Biology**

Environmental factors influence the development of highly heritable traits just as much as they influence the development of non-heritable traits (i.e. a trait like height, which is highly heritable in most developed nations, is very affected by environmental factors, like diet). Likewise, as can be seen from the example below, genetic factors influence the development of non-heritable traits just as much as they influence the development of highly heritable traits.

In fact, the least heritable features of human nature may be those that appear to be the most genetically determined! Consider the fact that having 5 fingers on each of our hands is not a particularly heritable characteristic (because most finger number variations in humans are attributable not to genetic variation, but to variations in experiences, such as accidents). Nonetheless, it is quite obvious that genetic factors play a role in determining the number of fingers we have on each of our hands!

6. **Heritability Says Nothing About Whether Intelligence Is More Determined By Genes Or The Environment**

Because heritability is a population statistic, it has nothing to say about the individual. It makes no sense to ask whether a particular individual's intelligence has been more determined by nature or by nurture. As already stated, every trait develops through the interplay of genes and the environment. Nature and nurture are complementary, not at odds.

7. **Twin Studies Do Not Reveal The Causes Of Intellectual Development**

Because adoption and twin studies that seek to account for trait variation in terms of genetic and environmental variation are always correlational, they reveal nothing about the *causes* of the appearance of the traits.

Adoption studies and twin studies do not entail the purposeful manipulation of either specific genes or specific environmental factors. Hence, such studies are unable to generate satisfying understandings of the factors and processes that contribute to the development of intelligence.

It's important to keep in mind that the route from genotype (genetic makeup) to phenotype (observed behavior) is hardly ever clear-cut. It's possible for many traits to involve gene-environment *correlations*. The idea here is that environments set off an appetite in the genes that nudges individuals to engage in certain

experiences, and the environment then responds in a reciprocal fashion that reinforces an individual's nature. The genes and environment eventually become correlated.

It's very easy to imagine how slight genetic predispositions can get magnified through the course of development by the environment. Imagine if you were born slightly taller than others (maybe you don't have to imagine this!). You get picked first for the basketball team, whereas your smaller friends may not get picked at all. This would give you more experience in basketball, which increase the chances you'd get picked first for another team. Those who repeatedly don't get picked for the basketball team may invest in other skills, such as physics or art. This cycle continues to magnify observed ability differences in basketball between those who keep getting opportunities to increase their skills and those who didn't get picked that first time. The rich tend to get rich, and the poorer tend to get poorer. The causal route from genes to behavior is often very complex!

8. Heritability Is Not The Same As Heredity

Heritability does not tell us how likely it is that people's characteristics will be inherited by their children. Because traits that are 100 percent heritable can nonetheless be strongly influenced by environmental factors, it is not the case that a trait found to be heritable in a particular twin study will be passed from a given pair of parents to their children. Let's imagine that a study of alcoholism in the United States finds that the vast majority of the variation in people's tendencies to drink to excess can be accounted for by variation in their genes. If we then take a baby, newly born to a pair of alcoholic American parents, and raise it in a small village in southern India where it never encounters alcohol across its lifespan, it will not develop alcoholism. We often talk as if we "inherit" full-blown traits from our parents, like eye colors, nose shapes and shyness. But all that we actually inherit from our parents are our genes and our genes' (and our) environments, factors that then construct full-blown traits during development. Consequently, it doesn't matter how heritable a trait is; if development of the offspring occurs in a different environment than the parent developed in, most bets are off.

Does Heritability Have Any Practicality?

We hope these eight facts have cleared up some misunderstandings. After reading these facts, it might be reasonable to ask, "Does the heritability coefficient have any practical value?"

At the very least, heritability tells us how much of the variation in IQ can be accounted for by variation in genetic factors when development occurs in an exquisitely specific range of environments. However, David S. Moore has argued that even this is not significant when we realize that the magnitude of any heritability statistic reflects the extent of variation in unidentified non-genetic factors that contribute to the development of the trait in question.

Because we cannot assess the variability (across our testing environments) of all the yet-to-be-identified non-genetic factors that influence IQ, Moore argues that estimates of the heritability of IQ are effectively uninterpretable and unable to be applied in any appropriate way. As Moore puts it in his journal article:

Many psychologists continue to compute heritability statistics without questioning what exactly it is that they reveal to us. Unfortunately, careful consideration of these statistics suggests that they might not be applicable in any meaningful way, and so, consequently, are uninteresting at best and misleading at worst.

Some of the most well-known behavioral geneticists, including Thomas Bouchard, Jr., recognize that it's time to move beyond heritability estimates. A currently active area of research is the study of epigenetics, and how the many interacting genes that make up any trait are differentially activated depending on the environment. Nature and nurture are inextricably intertwined, and it's time for science to figure out how.

Recommended Reading

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