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COMMENT

Genetics and Human Agency: Comment on Dar-Nimrod and Heine (2011)

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Dar-Nimrod and Heine (2011) decried genetic essentialism without denying the importance of genetics in the genesis of human behavior, and although I agree on both counts, a deeper issue remains unaddressed: how should we adjust our cognitions about our own behavior in light of genetic influence, or is it perhaps not necessary to take genetics into account at all? I suggest that the genetics of behavior does have important implications for how we understand ourselves, the differences among us, and the ethical implications of our actions, but that the usual metric for these considerations, the heritability coefficient, is not the correct one. I propose an alternative.

Keywords: genetic essentialism

Dar-Nimrod and Heine (2011) identified but did not answer the most important question posed by the genomics of human behavior: once we accept that variation in genotype is associated with variation in behavior, how should this knowledge inform our understanding of ourselves and others? The authors made the case that we should not allow the heritability of behavior to rush us into genetic essentialism, but how *should* we respond? On this crucial question, the authors had little to say. It is a serious omission, especially because genetic essentialism has a mirror image that has produced just as much shoddy thinking about genes, environment, and behavior: naïve environmentalism, which describes a point of view in which the basic mode of responding to the theoretical and philosophical challenges of behavior genetics is to ignore them.

Naïve environmentalism and genetic essentialism are perennially attractive because they simplify difficult questions. Psychoanalysts, for example, were wrong to think that overbearing mothers made their children gay, and genetic essentialists were wrong about gay genes and similar nonsense (*Nature*, which should know better, once ran the headline, "Is homosexuality hard-wired?"; Maddox, 1991), but what is the right way to think about genetic influences on sexual orientation? Dar-Nimrod and Heine (2011), somewhat blithely, proceeded as though an unbiased view was lurking right below the surface, waiting only for the genetic essentialist brush to be cleared away, but the confusion runs deeper than that for laypeople and scientists alike. Who has not wondered whether those last few pounds around the middle persist because they have a genetic tendency to remain or wished that it were easier to be more extraverted or musical? What scientist has never gotten stuck trying to express exactly what a heritability of .50 implies and—perhaps to disguise his own confusion—lapsed into overconfident talk about a trait having a genetic basis or a casual dismissal of twin studies on methodological grounds?

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Consider Dar-Nimrod and Heine's section on obesity. (I note in passing that a less pejorative way of framing this question is in terms of weight or body mass index; for the same reason, the term "genetics of sexual orientation" is to be preferred over the term "genetics of homosexuality." Another aspect of genetic essentialist bias is to pathologize the traits to which genetic analysis is applied.) Readers of Dar-Nimrod and Heine's article learn that people adopt more anti-fat attitudes when presented with environmental explanations of obesity, view it as a less controllable and less blameworthy condition when presented with genetic explanations, are prone to eating more cookies when primed with genetic explanations, and discard the "default explanation" that obesity is under their control in favor of deterministic perceptions of weight. The unaddressed philosophical questions underlying these empirical results are profound and difficult, ranging from free will (What exactly do we mean when we say that a particular trait is or is not under our control?) to ethics (Under what conditions are our behaviors blameworthy?). It is left unclear whether genetic influences on obesity have anything to do with answers to these questions. Presumably, empirical science constrains our preferences for theorizing about the environmental and genetic determinants of weight: we cannot simply pick one or the other because we prefer the cognitive consequences. I think behavior genetics does have implications for our moral self-perception, but not in the obvious way that is usually presumed.

The obvious way to think about these issues is to presume that the higher the heritability of a trait, the more "determined" it is, the less we can control it, and the less we should be blamed for it. This presumption underlies the thinking of both genetic essentialists and naïve environmentalists, but it is incorrect. The reasons that it is incorrect are related to a simple principle: traits do not have heritabilities. That heritability depends on the population in which it is measured is one of the most frequently repeated caveats in the social sciences, but it is nevertheless often forgotten in the breach. (For example, it is nearly meaningless for Dar-Nimrod and Heine to note that "heritability [of intelligence is] typically estimated to range from .50 to .85" [p. 805]. The heritability of intelligence

isn't anything, and even placing it in a range is misleading. Making a numerical point estimate of the heritability of intelligence is akin to saying, "Social psychologists usually estimate the *F* ratio for the fundamental attribution error to be between 2.0 and 4.0.") The observation that genotypic variation accounts for 90% of the variation in height in the modern world depends on the variability of genotype and environment relevant to height. Among cloned animals with widely varying diets, body size is perfectly environmental with heritability of 0; in genetically variable animals raised in identical environments heritability is 1.0. This is no mere statistical fine point: it means that the entire project of assessing how essentially genetic traits are in terms of measured heritability coefficients is a fool's errand.

We are further reminded of this problem when we note that although height has a high heritability when measured cross sectionally in the modern world, the average height of many groups of people has increased substantially since the Second World War. How can this be? The answer is simple: generational change in height is a reflection of variation over time and along dimensions of the environment (like access to minimally adequate levels of nutrition and freedom from chronic disease) that no longer vary much today. Therefore—and I am agreeing with Dar-Nimrod and Heine in all of this—the heritability of height says nothing about the environmental malleability of height or our control over our own height or our blameworthiness for our height. If parents systematically undernourished their children in a way that stunted their growth, we would certainly blame them for it, and the population heritability of height would offer no defense.

The realization that heritability offers no direct moral insight can lead one's thinking in several directions. It can lead to naïve environmentalism, a possibility not worth considering here. Or, and I think this is the path the authors have implicitly followed, it can lead to a point of view called *developmentalism* or *interactionism*. This point of view, popular in philosophy and developmental biology, starts with the observation that no trait can develop in any organism without both genetic and environmental inputs. No matter how heritable height may be in some particular time and place, neither height in a single individual nor differences in height among individuals can develop without an environment. This is simply another way of saying that the contemporary high heritability of height does not mean that environment cannot affect height in principle; it only means that differences in the environment as they currently exist in our world are not causing differences in height. So it is not only misguided to use heritability as a means of quantifying the genetic and moral structure of a trait, but the whole project of differentiating traits into those that are more or less essentially genetic is hopeless from the start. In this, all traits are the same: they all require interaction of genes and environment to develop, and that's that. Growing to a particular height is no more genetic than robbing banks or learning to play the oboe, so moral analysis of these traits will have to be found elsewhere. The scientific task is to unravel the developmental processes through which traits develop, not to waste time quantifying intuitions that turn out to be unsound in the long run.

Developmentalism is a great argument, but surely height is more genetic than oboe playing and less blameworthy than bank robbery. Isn't there some way to rescue our common sense intuition that people are more responsible for their life of crime than for their short stature and deserve more credit for their musicality than for their physical beauty without drifting into hereditarianism or naïve environmentalism? I think there is, but heritability is not the answer.

A typical biometric analysis of a trait produces two environmental variance components along with heritability: shared and nonshared. The shared component consists of environmental forces that make children in the same family more alike, and as such it comprises most of the potential environmental effects I have discussed here. Most of the time, the deleterious effects of poor nutrition related to poverty or the monstrous parents who choose not to feed their children will be shared by siblings and will thus tend to make them more like each other and less like siblings in other families. People often think of the nature–nurture debate as a contest between genetic effects and the kind of cultural, socioeconomic, or familial environments that compose the shared environment, a characterization that is inadequate for a number of reasons I have discussed elsewhere (Turkheimer, 2000). Here I want to focus on one shortcoming in particular: that the other environmental term, the nonshared environment, is more important than either the genetic or shared environmental components for understanding the personal and ethical consequences of behavior genetics.

Exactly what the nonshared environment consists of has been a matter of mystery and controversy for some time. The nonshared environment comprises the nongenetic reasons that siblings raised in the same family are different; as such, it is the only reason that identical twins raised in the same family are different. The most literal account of what constitutes the nonshared environment—that it is the consequence of exogenous within-family environmental differences, for example, differential parenting practices applied within sibling sets—was proposed by Plomin and Daniels (1987), but it turns out not be the whole story and probably not much of the story at all. A meta-analysis of studies in which an aspect of the nonshared environment was measured and used to predict siblings in outcome showed than on average less than 3% of differences in outcome were explained by differences in environment, compared with upwards of 50% of the total variance in outcome attributed to the omnibus variance component called nonshared environment (Turkheimer & Waldron, 2000).

Why don't identical twins raised in the same family have identical outcomes? There are two important reasons. The first is measurement error. The second is the self-determinative ability of humans to chart a course for their own lives, constrained but not determined by the genes, family, and culture, and in response to the vagaries of environmental experience with which they are presented. The nonshared environment, in a phrase, is free will (Sarich, 1997). Not the kind of metaphysical free will that no one believes in anymore, according to which human souls float free above the mechanistic constraints of the physical world, but an embodied free will, tethered to biology, that encompasses our ability to respond to complex circumstances in complex and unpredictable ways and in the process to build a self.

The proportion of variance attributable to the nonshared environment is equal to the remainder after the systematic effects of genetic and family environmental influences have been accounted for. It is approximately equal to $1 - r_{MZ}$, that is, 1 minus the correlation between identical twins reared together, the proportion of variation in outcome that cannot be predicted from an identical twin with whom one was raised, or

the sum of the genetic and shared environmental variance. As the complement of the combined constraints of genetics, family, and culture, the nonshared environment is independent of what is usually thought of as the competition between nature and nurture because in an important sense it is orthogonal to both of them. So, for example, as the heritability of intelligence goes up and the shared environmental portion goes down as a function of increasing age (Haworth et al., 2010) or socioeconomic status (Turkheimer, Haley, Waldron, D'Onofrio, & Gottesman, 2003), the proportion attributable to the nonshared environment is relatively constant. From the point of view of the individual, this represents the degree to which intelligence is under that individual's control, as opposed to the degree to which it is limited by either genes or upbringing.

The essential unpredictability of human outcomes cuts deeper than anyone anticipated. At the forefront of modern genomics, researchers are grappling with what has come to be known as the missing heritability problem, referring to the surprising finding that genome-wide association studies that can quantify association between upwards of a million genetic markers and an outcome nevertheless fail to account for a substantial portion of even the most heritable outcomes, such as height (Visscher, 2008). This problem has deep analogies with the nonshared environment problem discussed earlier, posed by Turkheimer and Waldron (2000) in response to Plomin and Daniels (1987): a substantial variance component that refuses to be decomposed into the individual causal actions of its constituents (Turkheimer, in press).

In Table 1, I have assembled a quick collection of nonshared environmental proportions for the traits included by Dar-Nimrod and Heine (2011): sexual orientation, criminality, mental illness, and body mass index. I have added height, schizophrenia, and personality for some additional comparison. They should all be corrected for reliability, which is higher for height, weight, and intelligence than for the others, so the actual span in the values is actually somewhat less than it appears. Of course, one would not want to take such figures too literally. As proportions of variance, they are prone to the some of the same distortions as heritabilities, related to changes in the variability of the nonshared environment, but not to the same extent. In any world we can plausibly imagine, there will be significant limits on our ability to predict who will become depressed because the hypercomplex contingencies of a freely led life will always intercede between our knowledge of the family environment and the genome on the one hand and complex human outcomes on the other.

Table 1
Nonshared Environmental Proportions for Selected Traits

Trait	Reference	$1 - r_{MZ}$
Height	Silventoinen et al. (2003)	.1
Weight	Schousboe et al. (2003)	.3
Adult intelligence	Haworth et al. (2010)	.2
Personality	Jang, McCrae, Angleitner, Riemann, & Livesley (1998)	.6
Schizophrenia	McGue, Gottesman, & Rao (1983)	.15
Depression	Kendler & Prescott (1999)	.6
Criminality	Rhee & Waldman (2002)	.4
Sexual orientation	Bailey, Dunne, & Martin (2000)	.5

The nonshared environment captures what is at stake when we are concerned about whether people are able to control their own weight or choose their own sexual orientation or whether they should be held responsible for their criminal behavior. We neither hold people responsible for their height nor give them credit for it because given the influence of genes and upbringing, there is not much variability left for individuals to navigate on their own; people are considered somewhat more responsible for their weight and their intelligence, although both are still severely constrained. The traits in Table 1, I would suggest, are plausibly ordered in terms of their controllability and moral relevance: weight more than height, personality more than intelligence, and depression more than schizophrenia.

Ultimately, the differences among traits quantified in Table 1 explain why we have been wrestling with behavioral genetics for more than a century. Our behavior is neither perfectly free nor absolutely determined, notwithstanding the oversimplified bromides offered by genetic essentialists and naïve environmentalists. More challenging yet, our behaviors are not equally free or constrained, contradicting the slightly more sophisticated assumption offered by the developmentalists. The reason behavior genetics exists is not really that it is about behavior: from a biological point of view, there is little reason for the genetics of behavior to be different than the genetics of other complex human phenotypes. We have a special concern for the genetics of behavior because behavior genetics is *experienced* genetics, and the interaction of genetics with human agency. A fully realized genetics of behavior offers us a way to think about the unique human ability to be conscious of, and to some extent to control, our own genetic endowments and the differences among them.

None of the proportions attributable to the nonshared environment are 0 (complex human traits are never absolutely determined), but apart from physical characteristics like height, none of them are even close to 1.0. This is a reminder of the First Law of Behavior Genetics (Turkheimer, 2000) and of a simple fact of human—one might say biological—existence: we are not free to become whatever we want, unconstrained by genetic or other familial constraints. Or rather, we are free to become what we want, but doing so will take more effort for some traits than for others (Tesser, 1993) and an almost unimaginable amount of effort for the most ingrained. We could all be taller if we were willing to take growth hormones or put in enough time on the rack. We can leave it to the philosophers to work out all the details in a theory of what it means to have a choice about our behavior and therefore to be morally culpable for it, but quantifying human agency in these terms, as the variability that remains after genetic and environmental familial constraints have been taken into account, at least gives us an empirical place to start and protects us from coarse and absolute claims about people either "having a choice" or being "hard wired" for their traits. Genetic essentialism is a bias, and Dar-Nimrod and Heine (2011) are to be congratulated for having laid it bare; naïve environmentalism is also a bias; but genetic and environmental constraints on our freedom are inevitable, challenging, and sometimes restrictive aspects of the human condition. Our ability to overcome those restrictions is what we cherish about ourselves, and why the science of behavior genetics will always be relevant.

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