Beware the phony horserace between genes and environments

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Abstract: Although Burt (2022) provides a valuable critique of the scientific value of integrating genetic data into social science research, she reinforces rather than disrupts the age-old horserace between genetic effects and environmental effects. We must move past this false dichotomy to create a new ontology that recognizes the ways in which genetic and environmental processes are inextricably intertwined.

Main Text:

Burt (2022) thoughtfully challenges the practical value of integrating molecular genetic data into social science research. In doing so, she provides a vital form of dissent that is uncommon to social and behavioral genomics – the field's critics (DOM included) more often demur the ethical and societal implications of the work. Her critique highlights the statistical and scientific limitations of current polygenic scores. She correctly emphasizes the scores' contextual and confounded nature, undermining their use as clean measures of genetic propensity (Meyer et al., 2020; Murray, 2020) and complicating efforts to identify gene-environment interactions (Domingue et al., 2020). Nonetheless, Burt makes a conceptual error when defining a genetic effect, conflating environmental mediation with environmental confounding, which ultimately leads her to an unproductive and age-old horserace between genes and the environment.

Specifically, Burt decomposes the effect of genes, as defined under the potential outcomes (or counterfactual) framework (Holland, 1986), into "upward" and "downward" sources of causation. She defines upward genetic causation as when genetic differences shape trait differences via biological pathways. For instance, she argues that the DNA related to Huntington's disease has an (upward) genetic effect on a person via their biology. In contrast, she defines downward genetic causation as when sociocultural forces act upon genetically influenced individual differences. For example, Burt argues that the areas of our genome related to skin color have only "artificial" (downward) effects on a one's life that operate through the sociocultural environment: consider a dark-skinned girl who experiences more racial animus than her lighter complected sister and, in turn, experiences increased depressive symptoms (Laidley et al., 2019).

Burt is correct to point out that counterfactual thinking, the key conceptual toolkit for establishing causation (rather than mere correlation) in the social and biomedical sciences, does not distinguish between the effects of genes that do and do not operate through sociocultural pathways. However, Burt's desire to separate out genuine genetic effects from so-called artificial ones is itself built on: (i) the flawed and historically burdened idea that true effects of genes are straightforward, homogenous, and strictly biological; and (ii) the misguided belief that it is possible to meaningfully distinguish between causal pathways that are, *in general*, proximal versus distal, or direct versus deeply mediated.

Burt's division of upward and downward genetic causation is well-intentioned and may be aimed at combating poor genomics communication that reinforces oversimplified and deterministic conceptions of genetic effects (Heine, 2017). For instance, consider a recent study that used a sibling design to estimate "direct individual genetic effects" on a range of traits, including depression, education, and body mass index (Howe et al., 2021). Because the effects of genes on social and behavioral traits often operate through complex causal chains that include group-level sociocultural processes, like discrimination, referring to them as "direct" or "individual" is misleading. The term 'genetic effect', at present, refers to *any* causal pathway that begins with a genetic difference, allowing genes to linguistically trump any number of environmental mediators. We need new language to replace the entrenched gene-environment binary, as genetic determinist ideologies have helped establish and legitimize a wide range of social inequalities (Martschenko et al., 2019).

However, in labeling the way genetic influences on skin color ultimately impact mental well-being as merely "artificial genetic associations," Burt makes the opposite mistake. She

argues that colorism – the way in which our society discriminates based on a person's skin tone – is actually "the difference that makes a difference." Yet, both colorism and genes related to skin color make a difference! In a world without colorism, inheriting different genes that influence skin tone wouldn't in turn affect a person's mental health. However, in a world with no variation in skin tone across individuals, eliminating the explicit and implicit biases that produce colorism wouldn't change depression rates.

Under the potential outcomes framework, the effects of a genetic variant and sociocultural processes are not mutually exclusive – each effect is defined by its own unique thought experiment which compares exactly two counterfactuals. One aspect of the world, the 'treatment', is changed, and everything else is held the same. To say that there is a causal effect of a *genetic variant* on depression is to say that, in a world where a person was to inherit different alleles but everything else is held constant (including the way society 'does' race), a person's likelihood of developing depression would change. Similarly, to say that there is a causal effect of *colorism* on depression is to say that, in a hypothetical world without the acute racism in our current world but identical in every other way (including the genetic characteristics of everyone within it), we would expect a change in the population prevalence of depression. The effects of one's genes and one's sociocultural environment are hopelessly intertwined – indeed, each effect is defined *only* for particular states of the other. Even for Huntington's disease, how a persons' DNA ultimately affects their life is a function of environmental features, like access to long-term care and medications that help manage the symptoms. For this reason, Burt is wrong to claim that genetic sibling designs are confounded (i.e., lacking internal validity) by sociocultural influences like colorism; instead, the example of skin tone and colorism highlights that such research designs identify contextual causal processes which often operate through the sociocultural features of our world (and therefore may have low external validity). We agree with her point that GWAS "cannot disentangle genetic from environmental," but the limitations are not only practical – they are conceptual. Burt's distinction between upward and downward genetic causation privileges sociocultural processes as somehow ontologically and causally prior to genetic factors, which is equally mistaken as viewing genetic factors as ontologically and causally prior to environments. Ironically, in attempting to wrest some of the counterfactual effects of genes back into the environmental fold, Burt thrusts the conversation again into a phony horserace between genes and environments, wherein opposing sides engage in a bean-counting exercise over how much outcome variation counts as genetic. We've been there before; it's an intellectual dead end.

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