Sociogenomics: The intricate science of how genetics influences sociology

June 29 2023, by Brittany Steff

Robbee Wedow is an expert in sociogenomics. His research works to integrate data science approaches with sociology research for deeper insights into how genetics helps shape human behavior. Credit: Purdue University /Kelsey Lefever

Humans contain multitudes. Each person on the planet contains enough

DNA to stretch to Pluto—several times.

Studying how all this genetic material works, and especially how genes influence human behavior, is an enormously complicated undertaking—one that's being made easier by the emergence of massive banks of genetic data and complex data science analysis techniques to parse that data.

Robbee Wedow, an assistant professor of sociology and data science in Purdue University's College of Liberal Arts, an adjunct assistant professor of medical and molecular genetics in the Indiana University School of Medicine, and Purdue's inaugural faculty-in-residence at AnalytiXIN/16 Tech in Indianapolis, maps those miles of genes for insights into how genetics interacts with social forces and environments.

He uses genetic databases to study how tiny bits of genes called single nucleotide polymorphisms, or SNPs, affect complex, overarching traits including sexual behavior, educational attainment, socioeconomic status, health behaviors and more.

"We know that social forces like socioeconomic status play a role in influencing a person's life and life outcomes," Wedow said. "But we also know there is a genetic component to every behavior. What we don't understand yet is how these biological forces interact with the environment and what these sorts of interactions might mean for social science—and what we think we know about social science research to date. We are using well-powered genetic data to do more accurate and replicable social science and to explore what might be possible at the intersection of genetic and behavioral science."

When scientists sequenced the first human genome in 2003, the true scale of genetics started to become apparent. Early geneticists thought that finding a gene for each trait was simply a matter of looking in the

right place.

However, DNA bases and genes are not simply keys on a massive piano upon which human lives are played like masterpieces. Instead, DNA operates more like a pipe organ, where stops, switches and pedals can change the way notes sound, mute them or increase their volume.

Environment, nutrition, pollution, life experiences and other circumstances can change when and how genes matter for certain outcomes, and even change which places in the genomes matter for those outcomes altogether. There isn't a single gene for a behavioral outcome. Biology isn't destiny. It may lay out the musical score, but musicians are free to improvise and interpret as they play.

The idea, Wedow stresses, is not that these genes control a person's life or destiny. Each SNP, in fact, has a very small effect on an overall outcome like educational attainment. No "Gattaca"-level reading of one's destiny from their genes—in the style of the dystopian 1990s movie—is on the horizon. Rather, being able to clarify the genetics of certain behaviors can help scientists understand the nuances of human behavior.

"People think that genetics is always about biology, but in the case of sociogenomics it's more about using the advantages of this new, well-powered data to better understand the outcomes themselves, or about allowing researchers to do more accurate social science and behavioral research," Wedow said. "The social sciences have recently struggled with replicating studies. Oftentimes the sample sizes are too small for rigorous estimates and certainty. That's where the potential of using these huge banks of genetic data for the social sciences comes in. They help us get a much clearer, more certain look at what's really going on."

Analyzing the genetics is only the first step. An American geneticist in the early 1800s could have correlated genetics with educational mastery

and concluded that anyone with two X chromosomes tended to have less education. That is not because the chromosomes had anything at all to do with education. Rather, the correlation reflected social and gender biases present in the culture at the time. Similar insights lurk in Wedow's research.

"Sociogenomics isn't necessarily about biology, like some might think," Wedow said. "When someone studies cancer genetics, they are studying it because they want to elucidate the biology of cancer; they want to figure out ways to better diagnose it, track it and treat it. But researchers in the field of sociogenomics want to study the genetics in order to do better social science. No one would ever study sociology without considering socioeconomic status and environment. We want to be able to take genetics into account in the same way."

In a study published in the journal *Nature Human Behaviour*, Wedow, his co-corresponding author Andrea Ganna from the University of Helsinki, and his other co-authors looked at 109 survey questions in over 300,000 individuals to examine the ways that people's genes correlated with whether they answered certain questions or left them blank in surveys answered in the UK Biobank. That may sound fairly abstruse, but it fills a gap that the field of sociology has struggled with for decades.

"How do you know what you don't know or how someone might have answered a question if they choose not to answer it?" Wedow said. "It turns out that the genetics of people who either answer the survey question, or do not, overlaps with the genetics of other outcomes like education, income or certain health behaviors."

That means that scientists can use this type of data to get a better understanding of how people who choose not to answer questionnaires might also share similar responses to questions about health or social

behaviors. Geneticists can also use the results of this study to correct for bias in genetic studies of any behavioral, psychiatric or medical outcomes.

"We can't parcel out the signal from the noise yet or causally tease apart the effects of environment from the effects of biology," Wedow said. "We know the genetics correlate with certain outcomes, but we are not at a point where we can say any specific gene causes any one outcome. The effect of each individual gene is small. It's only in large data sets that we start to get the statistical power to get meaningful, reproducible results. We are using these new exciting, emerging data and tools to revolutionize social science."

More information: Patterns of item nonresponse behaviour to survey questionnaires are systematic and associated with genetic loci, *Nature Human Behaviour* (2023). DOI: 10.1038/s41562-023-01632-7

Provided by Purdue University