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The Genetics of Staying in School

A huge study found 74 gene variants that are associated with years of formal schooling—but that doesn't mean there are "education genes."

Sheng Li / Reuters

ED YONG

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Why do some people sail through college while others drop out during high school? There are many obvious reasons, ranging from intelligence to motivation, social privilege to caring parents, great teachers to disruptive classmates. But one neglected factor—our genes—plays a small but significant role.

We know that because identical twins, who share all their DNA, peak at closer levels of education than non-identical twins, who share just half their genes. And now, in a study of almost 294,000 people, an international team led by Daniel Benjamin, David Cesarini, and Philipp Koellinger has identified variants in 74 genes that are associated with educational attainment. In other words, those who carry more of these variants, on average, complete more years of formal schooling.

You can almost hear the tsunami of misinterpreted takes cresting the horizon.

Anticipating the deluge, the team have released a long FAQ explaining what they did *not* find. First and foremost, "there are no 'genes for education'," says Benjamin. Genes don't affect education directly. Instead, many of these 74 seemed to be switched on in the brains of fetuses and are involved in creating neurons, guiding their movements, and wiring them together. Those biological influences could then affect psychological traits, which then influence social ones.

But "these genes are not deterministic," adds Benjamin. There's a common myth that our traits can be divided into a fixed portion that's "in our genes" and pre-destined from conception, and a flexible portion that depends on the environment and is under our control. That's wrong. Nature and nurture are not opposed; they go hand in hand. The environment sets the stage upon which genes act out their roles.

For example, the team found that their 74 variants has a much stronger effect on educational attainment among Swedes born in the 1930s than those born in the late 1950s. Between those years, Sweden introduced reforms that extended mandatory schooling by two years, and improved access to schools and universities. The weakening influence of genetic factors over the same timeframe "is consistent with the possibility that the reforms equalized

educational outcomes," says Benjamin.

So, educational success is not "in the genes", nor can you "blame your genes" if you flunk out. That's especially true because each of the team's 74 variants had a tiny effect, equivalent to just 3 to 9 weeks of extra schooling. And collectively, they explained just 3 percent of the differences in education levels across the whole population. "For comparison, professional weather forecasts correctly predict about 95 percent of the variation in day-to-day temperatures," the team writes in their FAQ. "Weather forecasters are vastly more accurate forecasters than social science geneticists will ever be."

For that reason, you can't reliably use these 74 variants to predict how long a child will stay in education, or to stratify children according to how much support they'll need. "It's not a smart way to use the score," says Benjamin. The same applies to any unwarranted talk of eugenics—of selecting for embryos with particular genes, or even using gene-editing technologies to alter said genes. These would be dumb ways of ensuring smarts; if you're really that concerned, you're better off just dating someone clever.

But if it took so much effort to find genes that have such small effects, and that can't usefully predict anything, what was the point of even looking? Why did the team bother?

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Partly, Benjamin says, to draw a line in the sand. Many earlier studies had searched for genetic variants linked to intelligence or academic performance, but their results were often misleading and irreproducible. That's because they were absurdly small. With anywhere from 50 to 2,000 volunteers, they

had nowhere near the statistical oomph they needed to reliably detect the variants they were looking for.

Medical geneticists had confronted the same problems of weak methods and phantasmal results. Their solution was to join forces and pool the data from many smaller studies—which is exactly what Benjamin, Cesarini, and Koellinger did. In 2011, they founded the Social Science Genetic Association Consortium (SSGAC). For their first study, published in 2013, they looked at 101,000 people and found three genetic variants linked to educational level. Now, with almost three times as many volunteers from 64 separate samples, they have found another 71 variants. They even cross-checked their list using a set of 113, 000 more recruits from a separate UK-based study.

Despite their gargantuan effort, the team can still explain just 3 percent of the variation in educational attainment, out of an estimated 20 percent that's influenced by genetic factors. This suggests that there may be thousands more unidentified variants that are individually negligible but collectively powerful. Alternatively, geneticist Kevin Mitchell from Trinity College Dublin suggests that the missing variants may be individually powerful but very rare. Either way, finding them would very difficult, and would require studies that are even larger than the latest one.

So, again: why bother?

We might learn something about the underlying biology behind intelligence. As I noted, many of the identified variants are involved in brain development. It makes perfect sense that genes of this kind should ultimately influence our academic lives. But how, and through what means?

One way to answer that is to create a "polygenic score" that reflects how many of these variants an individual carries, and then see how that relates to specific personality traits or mental abilities. Terrie Moffit from Duke

University has done just that. Her team used the SSGAC's earlier study to create a polygenic score, which they applied to a group of New Zealanders whose lives have been tracked since the 1970s. Their scores predicted when they began to talk, how rapidly they learned to read, how upwardly mobile they were, and even the socioeconomic class of the partners they ended up with, all independently of how much education they actually completed. This suggests that the education-associated variants are really tracking other underlying qualities, like intelligence, self-control, or interpersonal skills.

"When results of huge studies like this one appear, some people head straight for Tigger's camp and others for Eeyore's," says Kathryn Asbury from the University of York, who studies education and genetics. "I find myself somewhere in between. The progress here is impressive but I think we are struggling to match that with our understanding of what we would, or could, actually do with a polygenic risk predictor of an educational trait. Will such a thing be practically useful to teachers, parents or pupils, and can we ensure that it does more good than harm?"

Benjamin thinks that educators may not benefit directly, but social scientists certainly will. Imagine that authorities are planning to provide free pre-schooling to kids from disadvantaged backgrounds. To see if such a policy actually helps kids to stay in school for longer, scientists randomly assign the free classes to some kids but not others. Then, they look at how the two groups fare. (This actually happened.)

Here's the problem: we know that genes affect educational outcomes, but no one is currently taking them into account. That's like trying to see if being overweight leads to heart disease without adjusting for diet, or checking if urban life affects lung cancer risk without controlling for smoking rates. If you don't account for these other variables, you end up with a fuzzy picture. Likewise, when it comes to social science, "if we can take out genetic effects,

it's like sharpening the image down the microscope," says Benjamin. "We can better see what the effects of environmental interventions are."

"It's unsexy," he admits, "and it has nothing to do with genetics."

ABOUT THE AUTHOR

ED YONG is a staff writer at *The Atlantic*, where he covers science.