Genes linked with education and fertility depend on when and where you live

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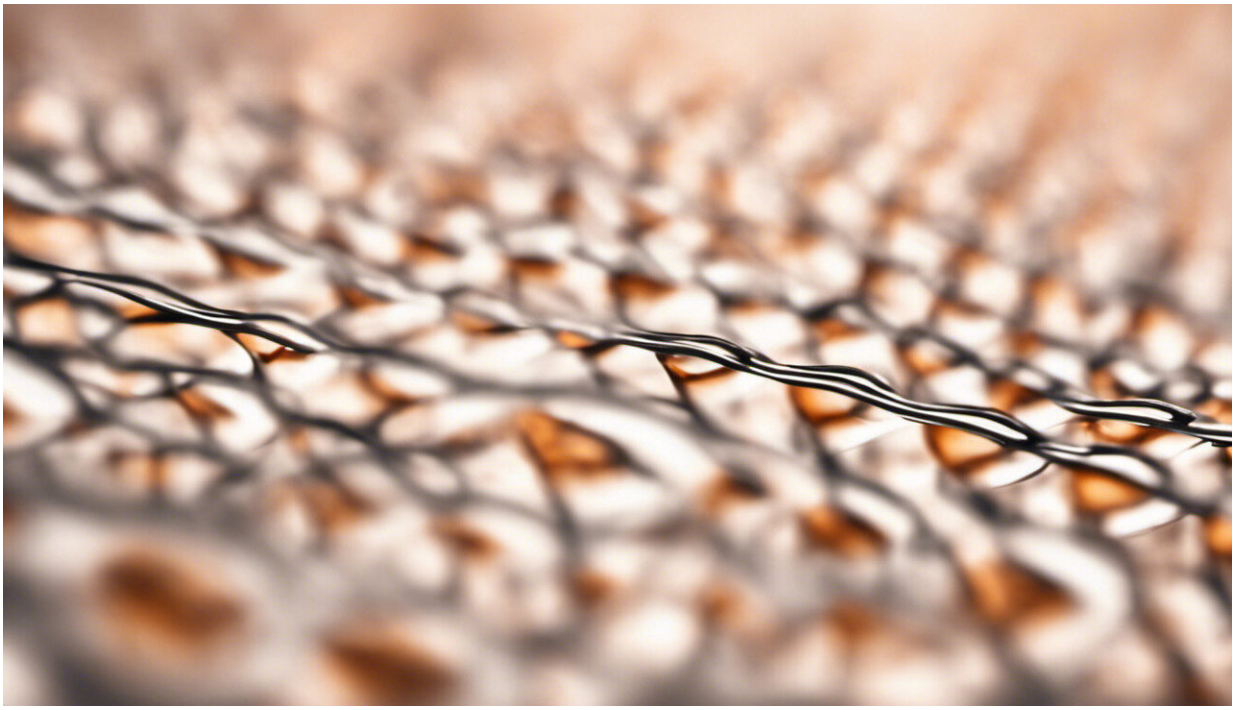

Credit: AI-generated image (disclaimer)

Different genes affect educational attainment and fertility in different times and places, according to new research from the University of Oxford. This means we could be missing important variations when we try to draw conclusions about the influence of genes on human behaviour, because combining data sets from vastly different countries

and historical periods could muddy the waters.

Scientists regularly make use of genome-wide association studies (GWAS), which isolate genes linked to certain outcomes. For physical traits such as height and BMI (body mass index), the connection is relatively straightforward. When it comes to human behaviour, such as having children or succeeding in education, it can be more difficult to determine the influence of genes compared to other external factors. The new research, published in the journal *Nature Human Behaviour*, has found that the genes associated with different outcomes, such as education and fertility, differ over time and from place to place—perhaps because the social context for education and childbearing can vary so much in different times and cultures.

GWAS studies often combine genetic data from individuals from different countries and historical time periods in order to gain a large enough sample size. By doing this they assume that the influence of genes on individuals is universal across time and place, but the new findings show that this is not the case.

Previous studies estimate that genetic differences should be able to explain around 15 percent of the differences in fertility between individuals in a population, and up to 25 percent of the differences in educational attainment. However, large GWAS studies which aimed to uncover the specific genes which are related to fertility and education, have produced much lower estimates, in the range of 1 to 4 percent. According to the new findings, this could be because GWAS methods rely on highly diverse sets of individuals, from different countries and historical periods. Combining these data sets could mask large differences. In other words, if the genes that are important for fertility or education differ across countries and historical period, it may be difficult to detect genetic variants when combining data from diverse populations.

To test this assumption, the researchers, from Oxford University's Department of Sociology and international partner institutions, combined large molecular genetic data sets from six countries (Australia, Estonia, Netherlands, Sweden, UK and the US; overall 35,062 men and women) and several historical periods.

They demonstrated that around 40 percent of genetic effects on education and timing of fertility, (i.e., age when someone has her or his first child), are being 'hidden' or 'watered down' when data across populations in different countries and time periods are combined. For the number of children, this value increases up to 75 percent. In contrast, they found that physical traits such as height are not impacted. The genes connected with height seem to be the same across populations. The researchers concluded that, in the case of behavioural traits such as fertility, it's essential to take country and historical period into account.

Lead author Dr Felix Tropf, from the Department of Sociology, University of Oxford and Nuffield College, said: "Our research is of great importance for the future of genetic discovery of behavioural outcomes. It suggests that the release of large samples such as the UK Biobank, which provides information on more than 500,000 genotyped individuals in a single dataset, will be a great milestone."

Professor Melinda Mills, senior author and principal investigator of the project, added: "This study demonstrates the value of interdisciplinary work and how as social scientists our focus on the social environmental context allows us to ask fundamentally new questions. This study shows that particularly for behaviour and complex traits, genetic influences can be strongly dependent on the social environment."

More information: Felix C. Tropf et al. Hidden heritability due to heterogeneity across seven populations, *Nature Human Behaviour* (2017). DOI: 10.1038/s41562-017-0195-1