

Looking at the *Nature* paper in the rearview mirror

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Thirty years have passed since the publication of the paper “Education policy and the heritability of educational attainment” in *Nature*. This paper probably deserves a place among the classics. It has been cited around 150 times, most recently in 2015 (1). Using data from a comparatively large sample of Norwegian MZ and DZ twins and their parents, it was one of the earliest papers documenting the contribution of both genetic and environmental factors to the variance in educational attainment. Arguably, the most important result was that the impact of genes and environments varies across birth cohorts. In the cohorts before the last world war (1915-1939) genetic factors explained about 41% of the variance in educational attainment. If we use data only for the twins (the classic twin design), the (broad) heritability estimate will be even lower (mean heritability across sexes was 0.23). In one of the models tested, gene-environment correlation accounted for 19%, and common environments accounted for 28% of the total variance. In another model, there was no gene-environment correlation, and the effect of common environments accounted for 47% of the variance (64% using twin data only).

The impact of genes and common environments changed dramatically in the cohorts after the war, especially for males. Collapsing the two postwar cohorts (1940-1949 and 1950-1960) into one and calculating means, the impact of genetic factors among males (excluding parental data gave similar results) increased to 72% of the variance, whereas the effects of common environment decreased substantially (11%). The heritability for females hardly changed at all and remained around 0.40, and common environment accounted for 45% of the variance.

Two studies of Norwegian twins (born in 1967 or later) concerning the heritability of educational attainment have been done since the publication of the *Nature* paper. Tambs et al. (2) did not report female and male data separately, and found that genes accounted for 59% of the variance in educational attainment. This is quite close to the postwar mean of the heritabilities of males and females found in the *Nature* study. The other study (3) found that the heritability was *lower* for males than for females (0.40 and 0.55, respectively).

A recent meta-analysis (4) has essentially confirmed and elaborated that the results shown in the *Nature* paper also may apply to other nations. Thus, similar sex and cohort effects were reported. Also, the heritability of educational attainment seems to be contingent on nation. The results of a recent study (1) indicate that the heritability of educational attainment is *decreasing* in the USA.

Of course, there are no major genes coding for educational attainment, so the heritability must be due to other factors. Education is correlated with IQ scores ($r \approx 0.50$), and IQ scores are heritable (around 0.65 in Norway). Personality factors may also be involved.

At the time when the *Nature* paper was published, there was a lack of studies investigating factors that may moderate the heritability of behavioural characteristics. Although many researchers acknowledged the possibility that heritability estimates may be moderated by environmental factors, it seems to have been a quite common belief that the heritability of a trait would remain approximately the same across social conditions. Now we know that this is not the case. Thus, the heritability of IQ in young children seems to be contingent on social class (5), and may also vary across cohorts (6).

So why does the heritability of educational attainment change across generations? In the *Nature* paper we proposed that profound changes in the Norwegian society were responsible for the heritability changes. I still think that our reasoning is essentially correct. In short: Before the war, there were substantial differences between social classes in Norway. Only people with sufficient economic means could afford to pay for education beyond elementary school. Hence the comparatively large impact of common environments. After the war, the government offered cheap loans to youngsters who wanted more education, and educational attainment thus became more independent of the economic resources of their parents. The genetic potentials of youngsters from comparatively poor homes more often became realized in higher educational attainment, resulting in higher heritability of this phenotype. Cultural factors have also been involved. Parents generally became more conscious that education was important for their children’s possibilities to attain well-paid and secure jobs.

The difference between males and females is probably due to gender roles. A common argument at that time was that female education was “wasted”; they usually ended up in the “Kinder und Küche” position anyway. The results found in a recent Norwegian study (3) may indicate that the opportunities for females have improved substantially. In the USA, decreasing heritability across cohorts (1) may be due to increasing inequality between social classes, including high tuition costs at many of the best universities.

The *Nature* paper has influenced two quite different research traditions. Social scientists were reminded of the possible role of genetic differences for educational attainment and possibly other complex social phenotypes. All too often, it has been assumed (and still is)

that individual differences in such variables are mainly due to environmental factors. The *Nature* paper and later findings show that educational attainment may be influenced by genetic factors.

Behaviour genetic researchers have learned that

simple models comprising only main effects may miss factors that can moderate the relative importance of genetic and environmental factors. Studies of moderating factors may deepen our understanding of the complex interplay between genes and environmental factors in the development of the phenotypical structure.

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