The New York Review of Books recently published a grossly unfair review. I wrote a letter in response that will not be published. Here is the letter, followed by further comments

To the editors
In NYRB (April 21) M.W.Feldman and Jessica Riskin publish a hostile review of Kathryn Paige Harden's recent book *The Genetic Lottery, why DNA matters for social equality*. The review makes some arguments that make no sense to me and deserve rebuttal.

Let us discuss the genetics of Educational Attainment (EA) defined as the number of years of schooling and measured in adults over 30 years old. EA takes up a good part both of the book and the review. Using genetic data from more than 300,000 individuals of European ancestry, it was possible to develop a 'score' using the genomes of the people in the study (Okbay et al. *Genome-wide association study identifies 74 loci associated with educational attainment*, Nature, 2016). The details of the score are of lesser importance, but it's important to realize that the score is a single number calculated from a genomic sample, by a fixed recipe. The score is correlated with EA at an enormously significant statistical level. This result was then replicated in an Icelandic study, using entirely different individuals from the first study. (Kong et al. *Selection against variants in the genome associated with educational attainment*, PNAS, 2017). Again enormously significant results were obtained.

How do Feldman and Riskin explain these results? After a somewhat rambling diatribe complaining that choices were made in the details of the score, and how exactly the EA phenotype was chosen to study, they conclude that 'researchers are [not] counting anything but their own projections'. How is this reasonable? A recipe is given, checked in a different study and the results replicated. (Incidentally a much larger study with more than 3,000,000 (!) individuals was completed just this month and the results again replicated). Are we somehow to believe that experimental error in Iceland is correlated with EA of a sample? This is truly absurd.

The score has other interesting features. The average has been decreasing in Iceland since at least 1910, and the score strongly correlates between mating couples, an effect much stronger than correlation of EA. This argues that the score is meaningful without making the meaning clear. The work on EA is technically little different from studies of the genetics of height, and if we took the criticisms of Feldman and Riskin seriously that would invalidate an enormous amount of modern genetics, in which it is routine to find that complex traits are associated weakly with multiple genetic loci.

Feldman and Riskin also attack Harden for stating that the score will be normally distributed. Claiming that a trait follows a bell-shaped curve is 'a found-

ing axiom of eugenics'. This is an argument of guilt by association. The score is a sum of small values mostly independent and any geneticist, or statistician, will expect the distribution to be approximately normal. In a given study it is trivial to check normality of the computed scores.

This review is baffling. Feldman is a leading mathematical biologist at Stanford who I would have assumed understands statistical genetics, yet if I didn't know who the reviewers were I would have thought that they were incompetent or ignorant.

Perhaps Feldman and Riskin think that any argument is acceptable if it goes against results that they dislike?

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Addendum
Since the review was written a new paper on the genetics of Educational Attainment has appeared. (Okbay et al. *Polygenic Prediction of Educational Attainment ...* Nature Genetics, 2022) This looked at 3 million individuals. All previous results are confirmed, and the 'score' improves as would be expected on statistical grounds. There is much of interest here and I highlight the phenomenon of assortative mating. Humans tend to partner with those similar to themselves. For instance tall people tend to marry tall people. Highly educated people tend to marry highly educated people. However the genetic score for Educational Attainment is *more* predictive of who you will partner than actual education. What can this mean? What is likely to be happening here is that people are consciously or unconsciously evaluating potential mates and are aware of more features than are available to a social scientist. Gregory Clark has made a similar point. This result is in contrast to height, which is highly heritable. For height one can construct a genetic predictor but this score adds nothing to predicting a partner over and above actual height.

There is a big contrast with the Feldman/Riskin review and another also quite negative review of Paige Harden's book by Graham Coop and Molly Przeworski. (Coop and Przeworski *Lottery, luck or legacy ...* Evolution, 2022). This review challenges some interpretations by Paige Harden of the genetic results, for example whether it is appropriate to describe the different genetics of unrelated individuals as a 'lottery' but does not challenge the science. Thus early in their review we find:

... the fact that educational attainment is heritable was documented before GWAS and is in some sense trivial. In humans as in any other species, almost all traits

that vary within a group are heritable (Barton & Keightley, 2002; Turkheimer, 2000). We thus fully grant the book's starting point. ,

This is the right approach for scientists. The GWAS results are in my view essentially unimpeachable. But the implications and especially whether they are relevant for social policy are very much open to debate. Contrast this with Jessica Riskin in an interview associated with her review:

DNA is an essential part of all living things including humans. But that doesn't mean that DNA causes or explains all aspects of human life, society, and culture.
This is a classic straw man argument. Nobody, and I really mean nobody, thinks that DNA explains all aspects of human life, but I do believe that DNA induces some predispositions to behaviors some of which have important lifetime consequences. The evidence for this is overwhelming.

There are some very important caveats about this work. The individuals studied are all of European descent living in Western culture. It seems probable that similar results will be found in some other cultures with different genetic background, but I expect the predictor for Educational Attainment will differ. There are likely to be complicated interactions with environment and societal expectations. In fact in a culture with no variation in the length of training for children it will be impossible to even define Educational Attainment. Furthermore, these results shed no light on reasons that education levels differ on average between different human groups.

Summarizing, the main point here is that genetics does influence behavior. This is unsurprising but now science has provided overwhelming evidence. Academics should be searching for truth and not deny the obvious. Ostriches burying their heads in the sand neither make good scientists nor make wise recommendations for social policy.