

Our Fortunetelling Genes

Presentation by Lee Macklin



Adapted from Robert Plomin's book
“Blueprint: How DNA Makes Us Who We Are”

- “A mountain of evidence from twin and adoption studies has convinced most scientists that disorders like schizophrenia and traits like cognitive ability run in families for reasons of nature (genetics) not nurture (environment).”

- “What is new is the DNA revolution. Our ability to read the genetic blueprint of individuals and to predict, from birth, their psychological dispositions is growing by the day.”
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- “It promises to transform not just how we understand ourselves, but how we deal with a range of personal and social problems.”
- Robert Plomin

- About 99% of the 6 billion steps in the spiral staircase of DNA are the same for all of us. That is what makes us human.
 - Behavioral geneticists are interested in the 1% that makes us individuals. These inherited differences account for about 90% of the differences in people's physical traits, such as height and eye color.
- DNA also accounts, on average, for about 50% of our differences in psychological traits and personality, mental health and illness, and cognitive ability and disability.

- DNA is the major influence making us who we are as individuals. Environmental influences are important too, but what look like effects of the environmental are often genetic effects in disguise.
- Parents respond to their children's genetically driven traits, and children seek, modify and even create experiences correlated with their genetic propensities.
- Knowing that traits are inheritable is different from showing which actual differences in DNA are responsible for them. We have found a tool (SNP chips), which make it possible to map out hundreds of thousands of DNA differences across an individual's genome quickly and cheaply.

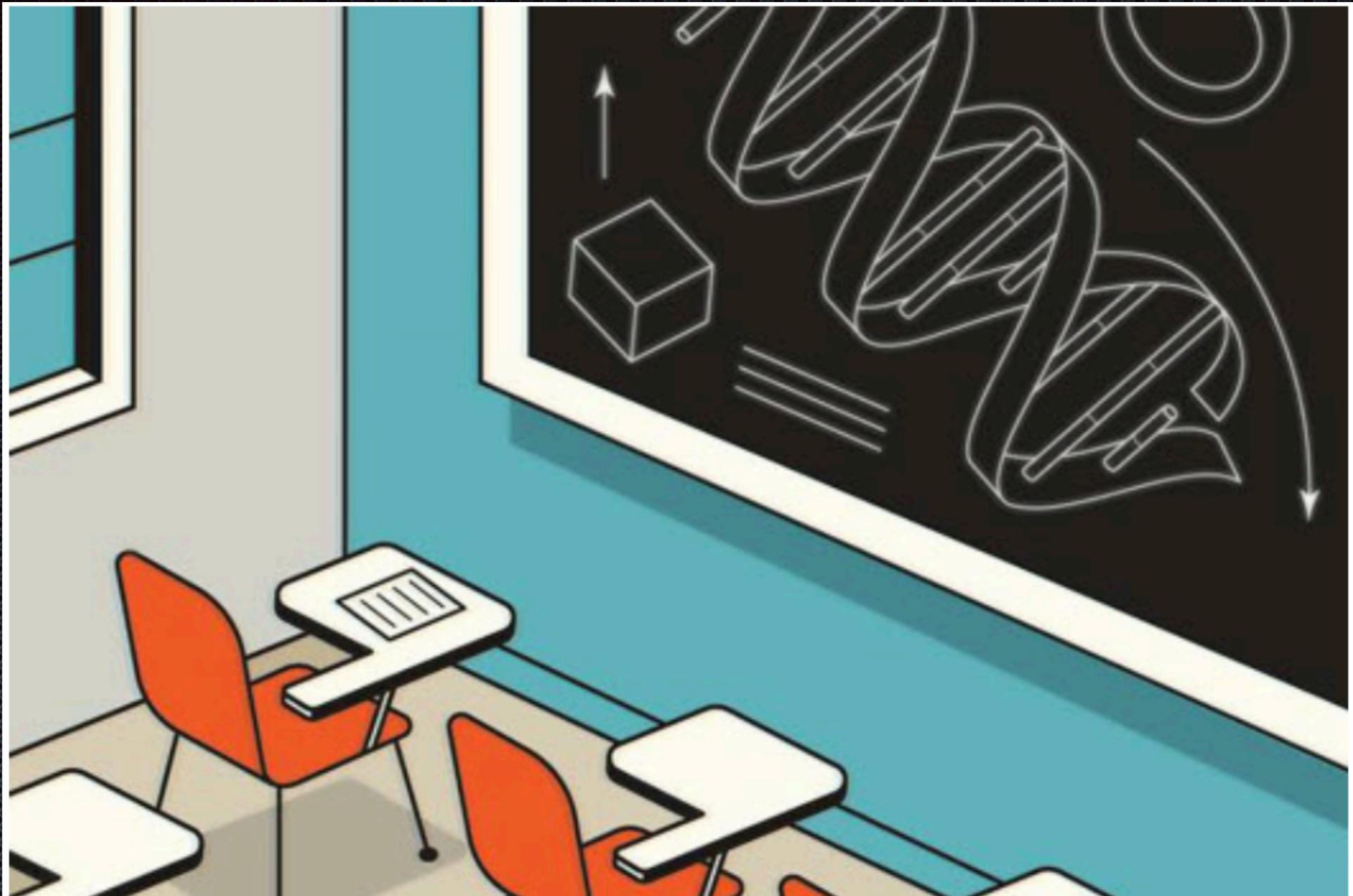


ILLUSTRATION: HARRY CAMPBELL

Polygenic scoring can predict significant differences across individuals in education aptitude

- By 2017, more than 10,000 significant SNP associations had been reported across individuals across many hundreds of traits, as summarized in a 2017 article in The American Journal of Human Genetics by Peter M. Visscher of the University of Queensland. But most of these traits were physical or physiological.
- In psychology, a remarkable collaboration emerged, called the Psychiatric Genomics Consortium, which now includes over 800 research scientists from 38 countries. The consortium's work was summarized in a 2018 paper in The American Journal of Psychiatry by Dr. Patrick Sullivan.

- Focusing on major psychological disorders, the consortium researched 60,000 cases of schizophrenia and found 155 associated SNPs. For bipolar disorders, they researched 20,000 cases and found 30 SNPs.

- So, studying the effects of specific SNPs can create powerful DNA fortunetelling. These are called polygenic (“many genes”) scores and they are the stuff of the coming DNA revolution in psychology.

- With polygenic scores, we can predict psychological traits from inherited differences in DNA without knowing anything about developmental pathways between genes and behavior.
- Unlike other predictors, this DNA fortuneteller can predict from birth because inherited DNA differences do not change from cradle to grave, from the single cell with which we begin life to the trillions of cells in our adult bodies.

- A Genetic Risk Mitigation Example



A clear genetic risk of alcoholism can act as an alert to anticipate the problem

- The biggest revelations so far from polygenic scoring have come in the field of education.
- Almost all of the genetic heritability studies done to date have asked their participants how much education they've had.
- Researchers realized that by pooling all of these samples they could conduct an analysis of educational attainment that reached the daunting sample sizes needed to detect SNP associations.

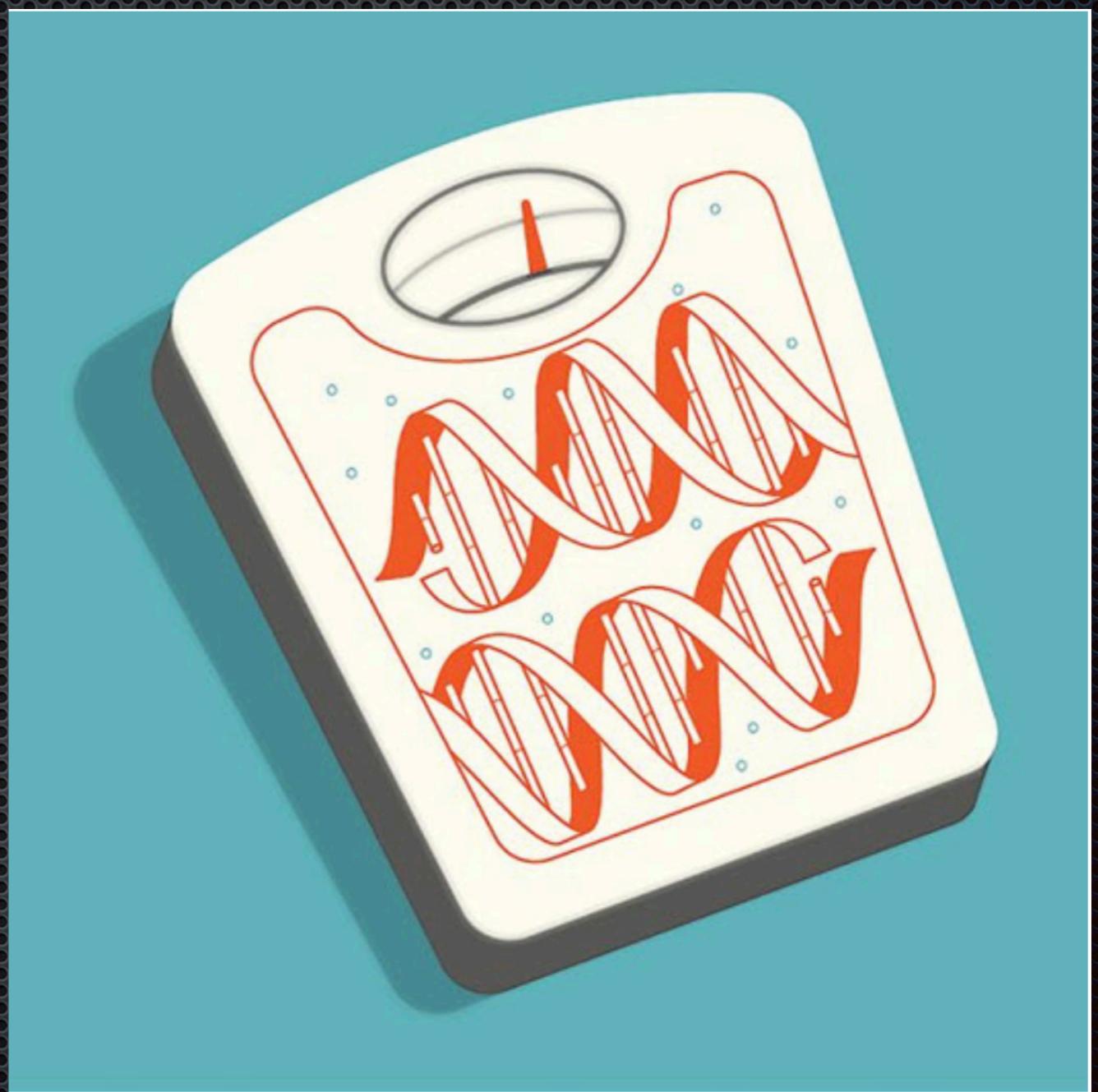
- Years of education is an interesting variable because it captures what it takes to visit a university.
- The consortium found that the polygenic score from their largest sample predicts up to 10% of the variance in general cognitive ability (intelligence or IQ).
- Another study showed that this score predicts 15% of the variance in nationwide tests of school performance in the compulsory subjects of English, mathematics, and science given to all U.K. students aged 16.

- The prediction of school performance is the most powerful polygenic score reported to date in the behavioral sciences.
- Predicting 15% of the differences in school performance might not seem like much, but it a better predictor than the education attainment of student's parents.
- Research has shown that children with the 10% highest polygenic scores are five times more likely to go to a university than children with the 10% percent lowest scores.

- In the behavioral sciences, we can rarely explain more than 5% of the variance of traits.
- Ratings of school quality, for example, explain less than 2% of the differences of children's school performance.
- Although polygenic scores only burst on the stage in the last few years, they are already the best predictors we have for certain traits.

- Polygenic scores make genetic findings more real and personal because they can predict problems and promises for individuals.
 - Polygenic scores for educational attainment not only predict performance in school but also in life, such as mate choice, occupational status, social mobility, and even financial planning for retirement. - “The Genetics of Success”, by Daniel W. Belsky, Duke University
- The reason for the wider affects of the polygenic score for education attainment is that it taps into other traits needed to succeed in higher education, not just intelligence but also qualities such as conscientiousness, grit, and mental health.

- Another Genetic Risk Mitigation Example



Knowing a gene-based to gain weight can spur preventative strategies

- This is the beginning of the era of polygenic scores. They are currently available for hundreds of physical and physiological traits and for dozens of psychological traits including personality (extroversion and neuroticism, for example), adult mental illness (schizophrenia and depression) and childhood behavioral problems (hyperactivity and anxiety).

- Polygenic scoring makes it possible to identify problems on the basis of underlying genetic causes rather than behavioral symptoms.

- We all have thousands of DNA differences that predispose us to schizophrenia; genetic risk depends on how many of these differences we have. It's all quantitative, a matter of more or less. Genetically speaking, there are no disorders, just dimensions.

- Another transformative impact of polygenic scoring on psychology is to shift the focus from treatment to prevention. Polygenic scores are the perfect early-warning system.
- The predictive power of polygenic scoring promotes interventions to prevent problems, in stark contrast to what we know, which is to wait until problems emerge and then try to fix them.

- Would you not want to know that you or your child is at genetic risk for alcohol problems? Knowing that you are at risk might make you more likely to heed the message for all of us to be mindful of our alcohol consumption, because you can't become an alcoholic unless you drink a lot of alcohol. Forewarned is forearmed.
- “A further benefit of polygenic scoring is self-understanding. For me I discovered that my polygenic risk for weight was at the 94th percentile. My DNA would have predicted this at birth which offers the possibility of early intervention, long before weight in childhood becomes an adult issue.” - Robert Plomin

- It would be paternalistic to prevent people from learning, if they so chose, how their genome shapes their lives and prospects. The DNA genie is out of the bottle and, even if we tried, we cannot stuff it back in.
- This presentation was adapted from Dr. Plomin's book "Blueprint: How DNA Makes Us Who We Are," published by the MIT Press.
- Dr. Plomin is a professor of behavioral genetics at the Institute of Psychiatry, Psychology, and Neuroscience at King's College London.

Questions?

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