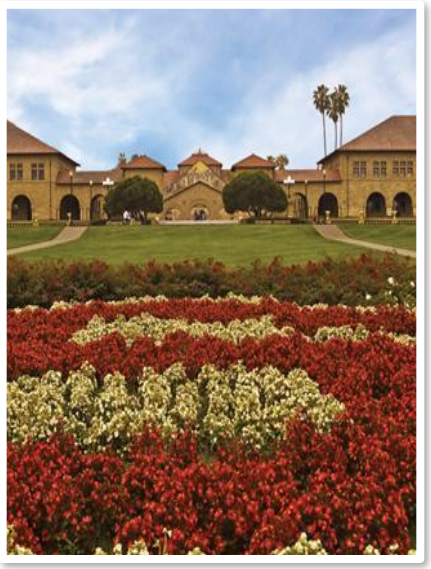
Schools & the Genetics of Educational Attainment: Evidence from Add Health

BEN DOMINGUE



What do we mean by “genetics”?

- Genome-wide data

	SNP 1	SNP 2	$\cdots$	SNP 1,000,000
P1	0	1	$\cdots$	2
P2	1	0	$\cdots$	0
P3	1	2	$\cdots$	1
$\vdots$	$\vdots$	$\vdots$	$\ddots$	$\vdots$
P1000	2	1	$\cdots$	2

$1,000 \times 1,000,000$ matrix; each cell $\in \{0, 1, 2\}$.

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$1,000 \times 1,000,000$ matrix; each cell $\in \{0, 1, 2\}$.

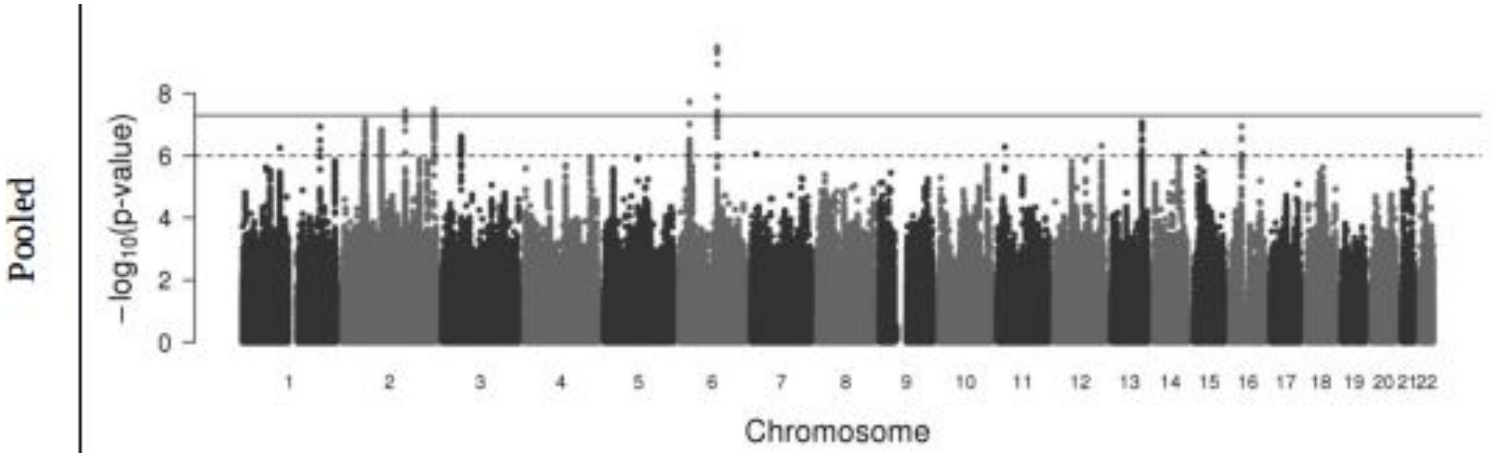
- How do we tie this large set of genetic variants to specific traits?

Sciencexpress

GWAS of 126,559 Individuals Identifies Genetic Variants Associated with Educational Attainment

Social Science Genetic Association Consortium

All authors with their affiliations appear at the end of this paper.



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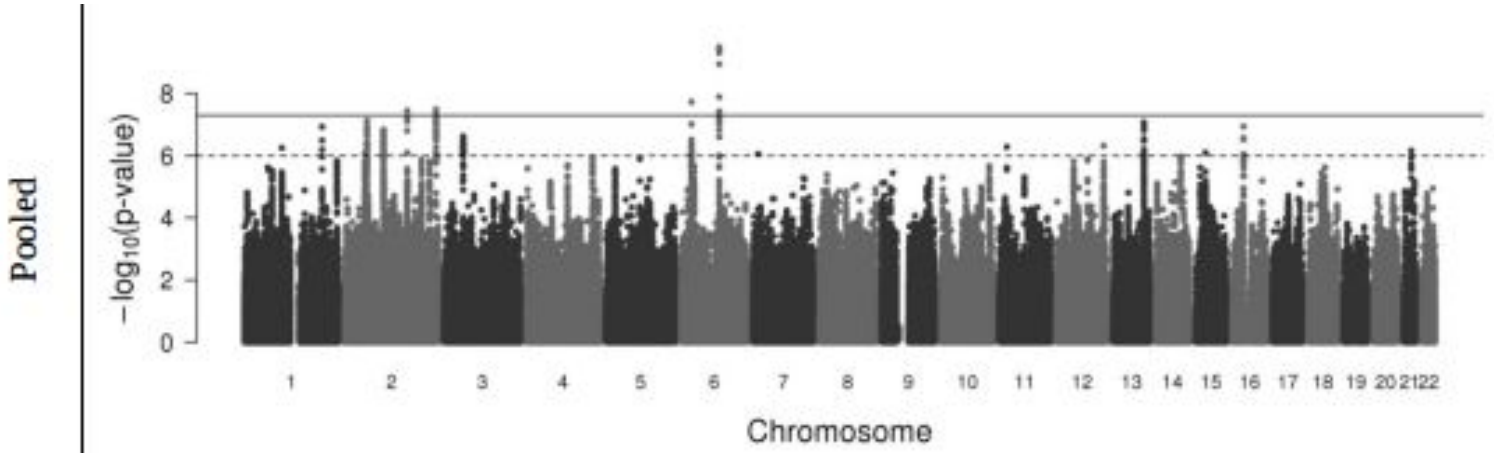

- Second generation educational attainment GWAS now available.
- Genome-wide association studies produce information about small associations between millions of variants and outcomes of interest.
  - Can we simplify?

Genome-wide association study identifies 74 loci associated with educational attainment

Aysu Okbay, Jonathan P. Beauchamp, Mark Alan Fontana, James J. Lee, Tune H. Pers, Cornelius A. Rietveld, Patrick Turley, Guo-Bo Chen, Valur Emilsson, S. Fleur W. Meddens, Sven Oskarsson, Joseph K. Pickrell, Kevin Thom, Pascal Timshel, Ronald de Vlaming, Abdel Abdellaoui, Tarunveer S. Ahluwalia, Jonas Bacelis, Clemens Baumbach, Gyda Bjornsdottir, Johannes H. Brandsma, Maria Pina Concas, Jaime Derringer, Nicholas A. Furlotte, Tessel E. Galesloot + *et al.*

Affiliations | Contributions | Corresponding authors

Nature **533**, 539–542 (26 May 2016) | doi:10.1038/nature17671
Received 24 June 2015 | Accepted 16 March 2016 | Published online 11 May 2016

Polygenic Score (PGS)

	SNP 1	SNP 2	⋯	SNP 1,000,000
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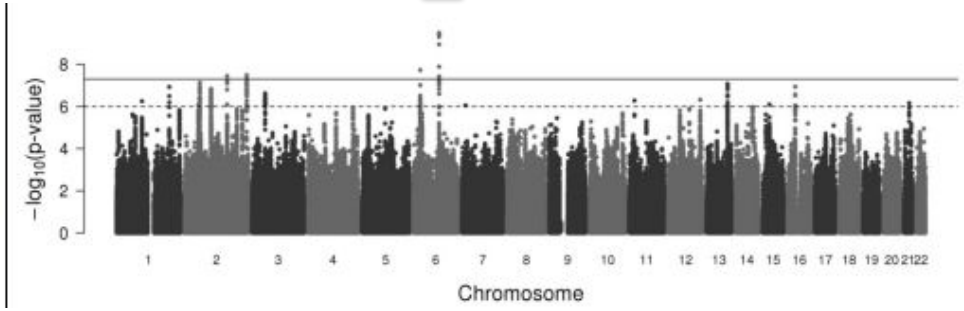

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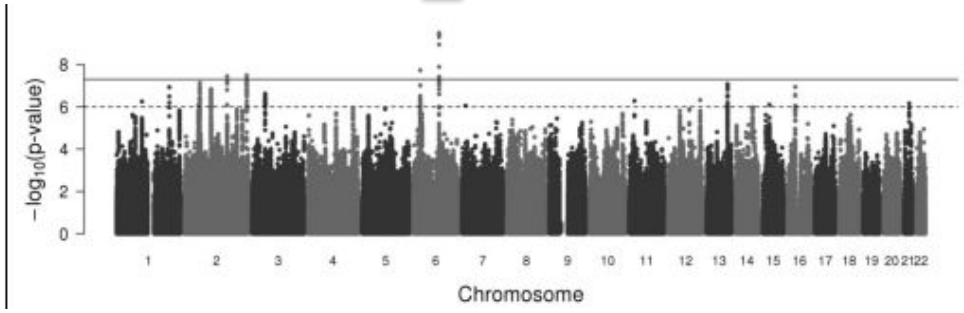
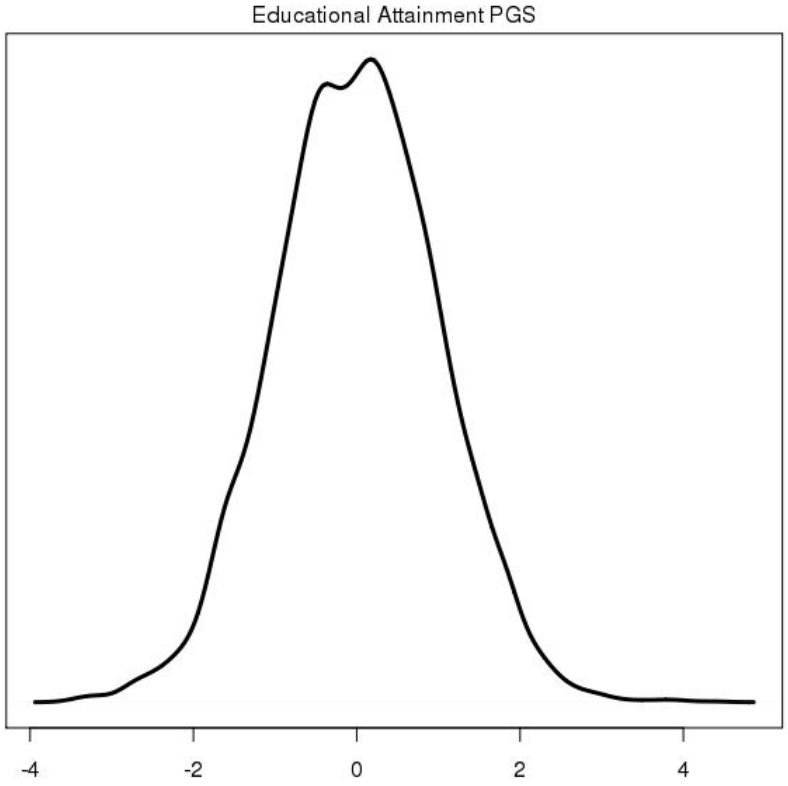
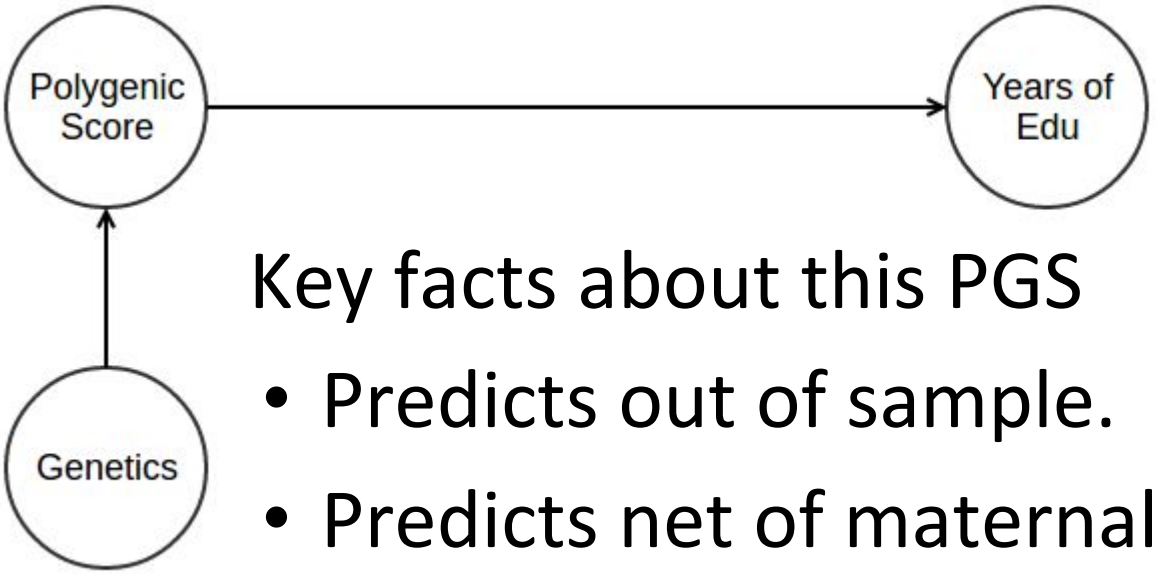




For technical reasons, we focus on non-Hispanic white respondents.


Polygenic Score
Years of Edu
Genetics



Key facts about this PGS

- Predicts out of sample.
- Predicts net of maternal education & maternal genetics.
- Predicts amongst siblings.

Replicability and Robustness of Genome-Wide-Association Studies for Behavioral Traits

Cornelius A. Rietveld[1,2], Dalton Conley[3], Nicholas Eriksson[4], Tõnu Esko[5], Sarah E. Medland[6], Anna A. E. Vinkhuyzen[7], Jian Yang[7], Jason D. Boardman[8,9], Christopher F. Chabris[10], Christopher T. Dawes[11], Benjamin W. Domingue[8], David A. Hinds[4], Magnus Johannesson[12], Amy K. Kiefer[4], David Laibson[13], Patrik K. E. Magnusson[14], Joanna L. Mountain[4], Sven Oskarsson[15], Olga Rostapshova[13], Alexander Teumer[16], Joyce Y. Tung[4], Peter M. Visscher[7,17], Daniel J. Benjamin[18], David Cesarini[19,20], Philipp D. Koellinger[1,2,21], and the Social Science Genetics Association Consortium

Is the Effect of Parental Education on Offspring Biased or Moderated by Genotype?

Dalton Conley, Benjamin W. Domingue, David Cesarini, Christopher Dawes, Cornelius A. Rietveld, Jason D. Boardman

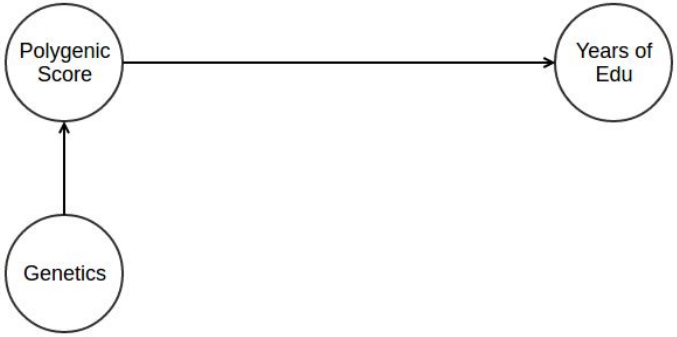
Sociological Science, February 25, 2015
DOI 10.15195/v2.a6

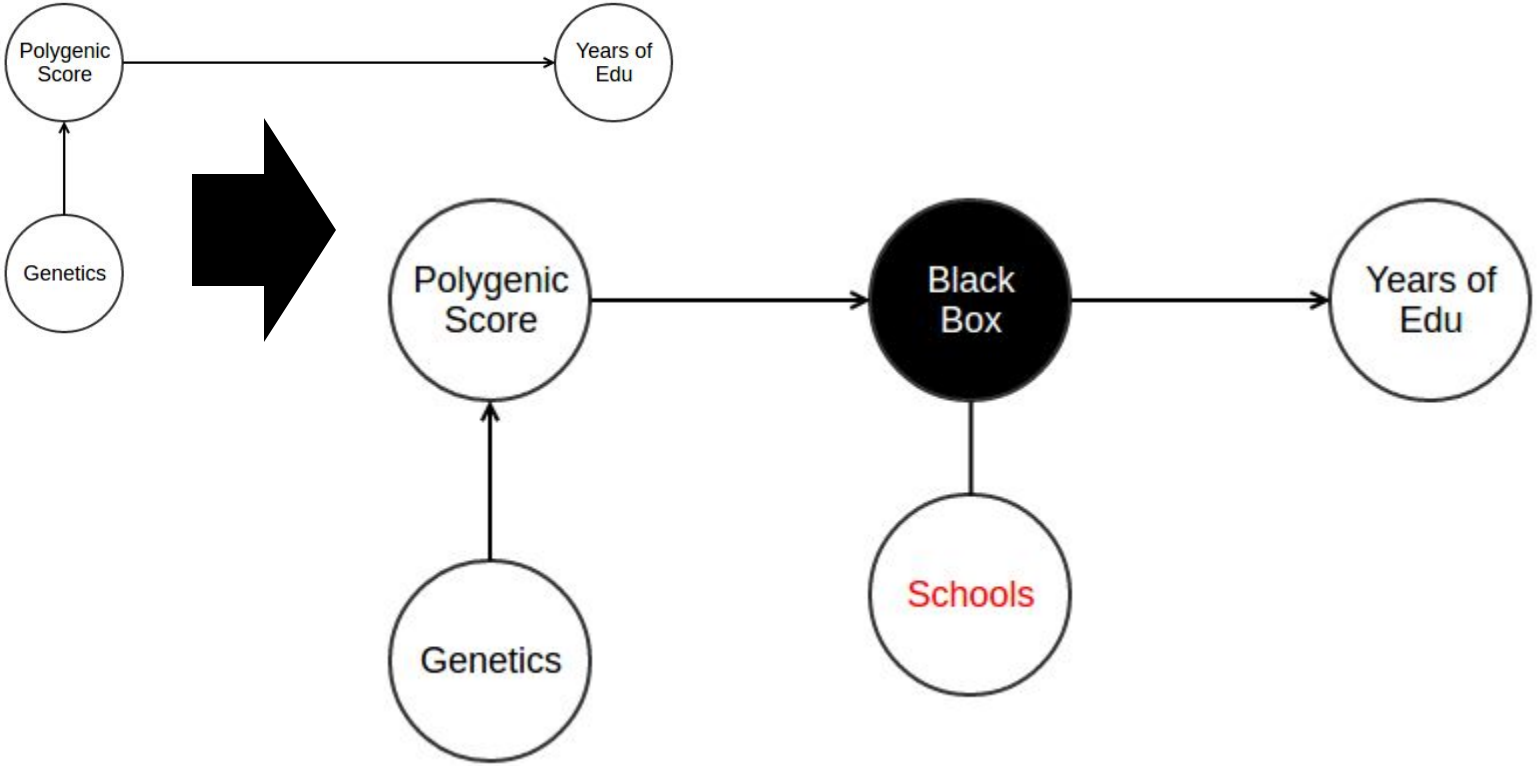
Polygenic Influence on Educational Attainment

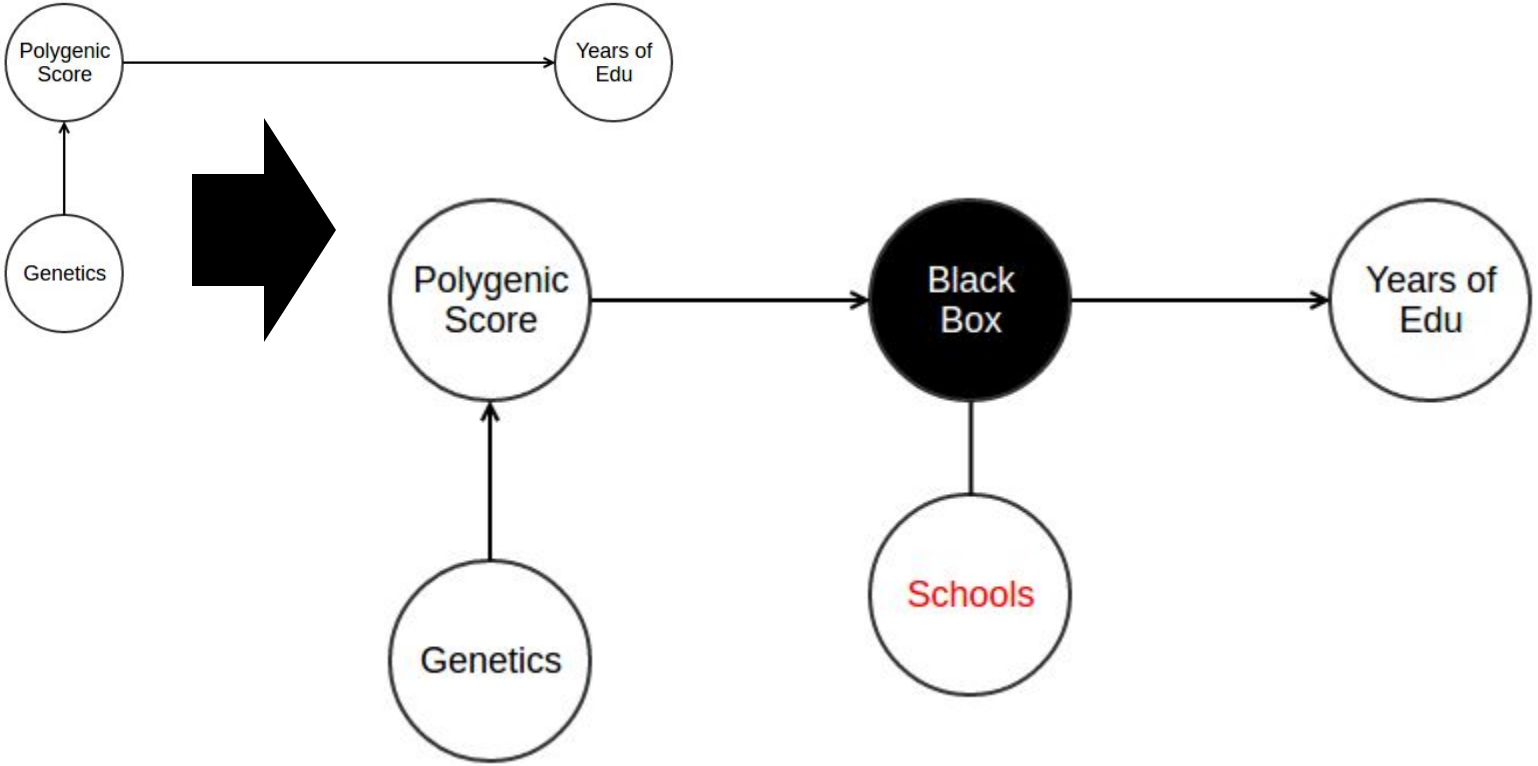
New Evidence From the National Longitudinal Study of Adolescent to Adult Health

Benjamin W. Domingue, Daniel W. Belsky, Dalton Conley, Kathleen Mullan Harris, Jason D. Boardman

DOI: 10.1177/2332858415599972, Aug 2015


Polygenic Score
Years of Edu
Genetics

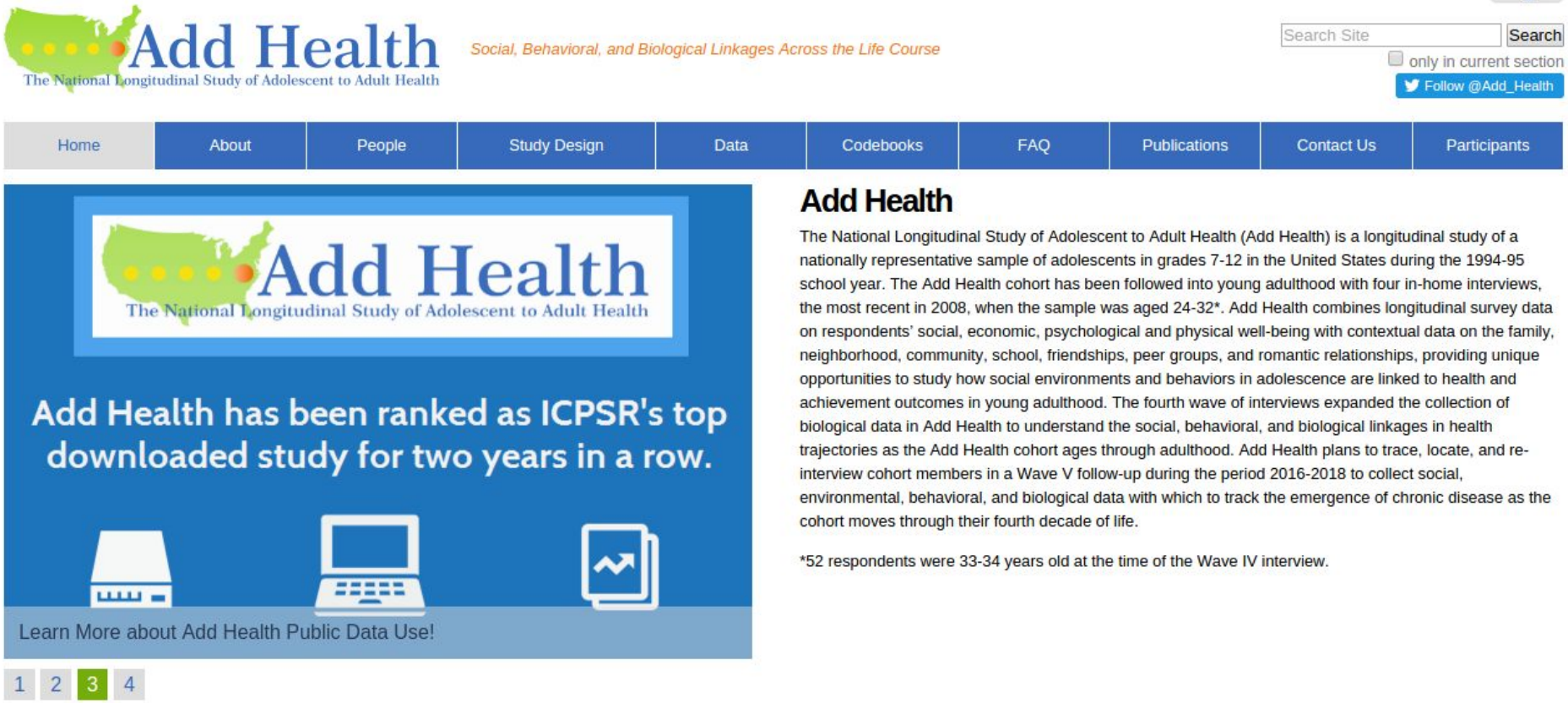

Polygenic Score
Years of Edu
Genetics
Polygenic Score
Black Box
Years of Edu
Schools
Genetics



What is role of schools?

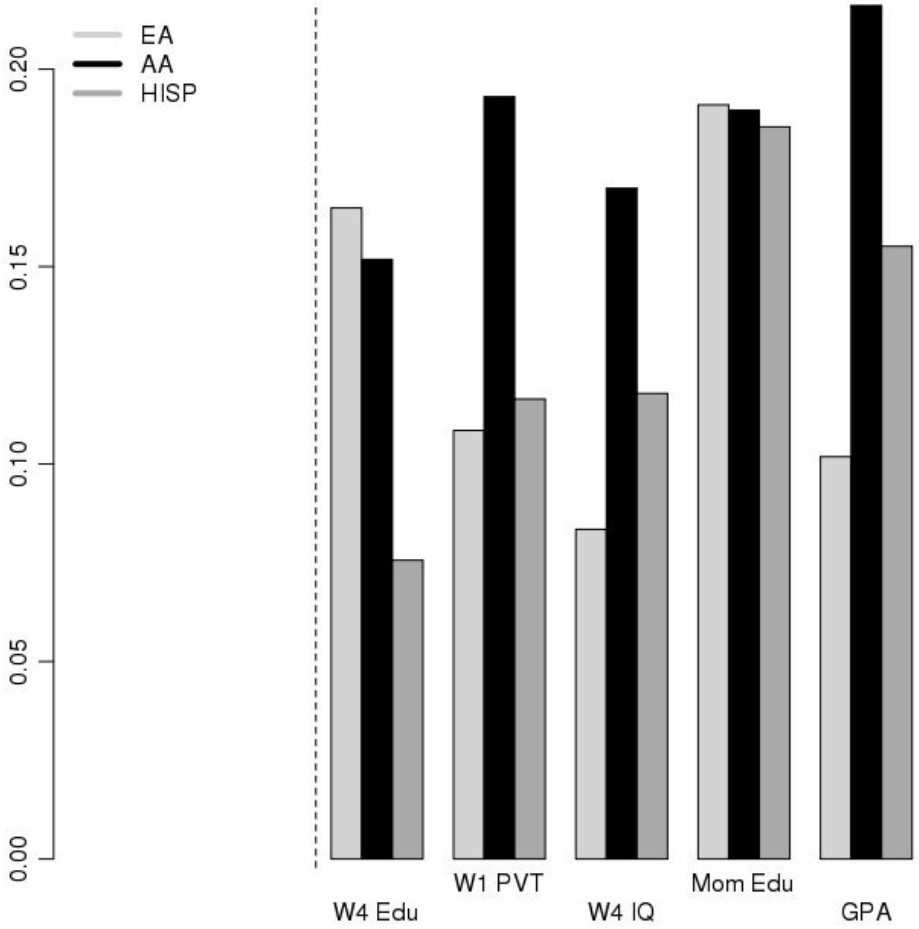
Questions

1. How are relevant genetics distributed across schools?
2. Any indication that schools are moderating genetic effects?



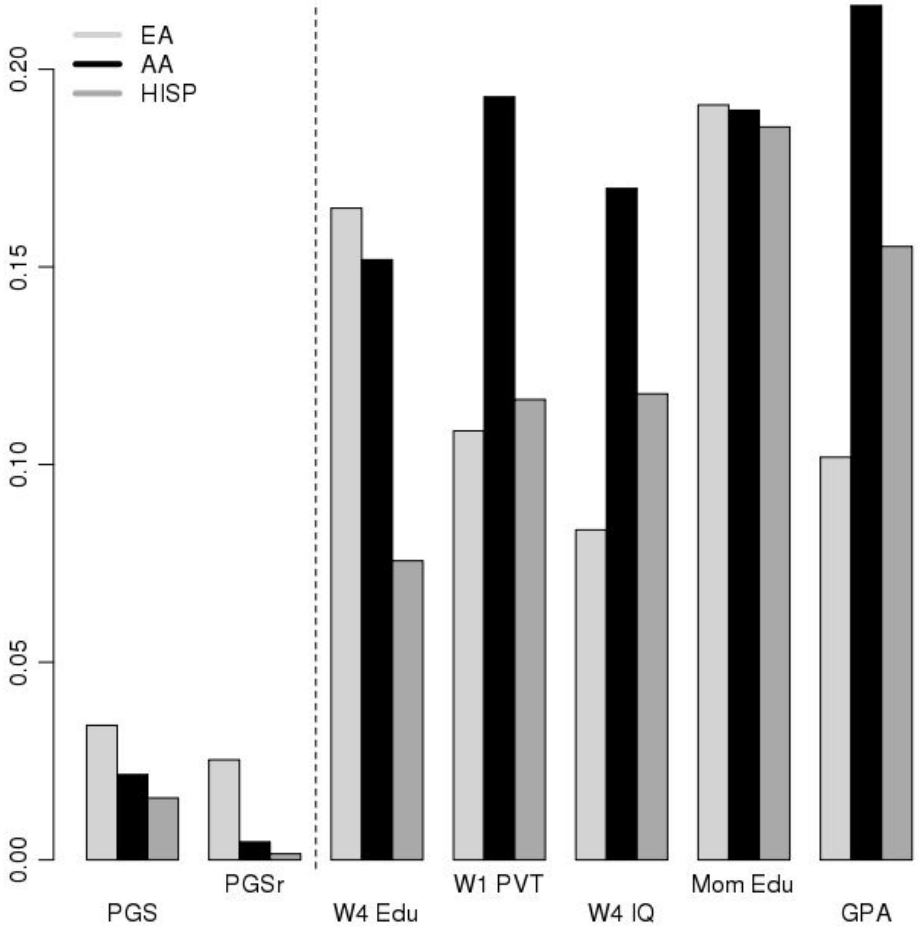
- Probability sample drawn from >100 schools.
- Subsample (siblings) first genotyped.
- Full cohort now genotyped.
  - 10,577 total
  - 6,524 non-Hispanic White

Clustering of PGS into schools

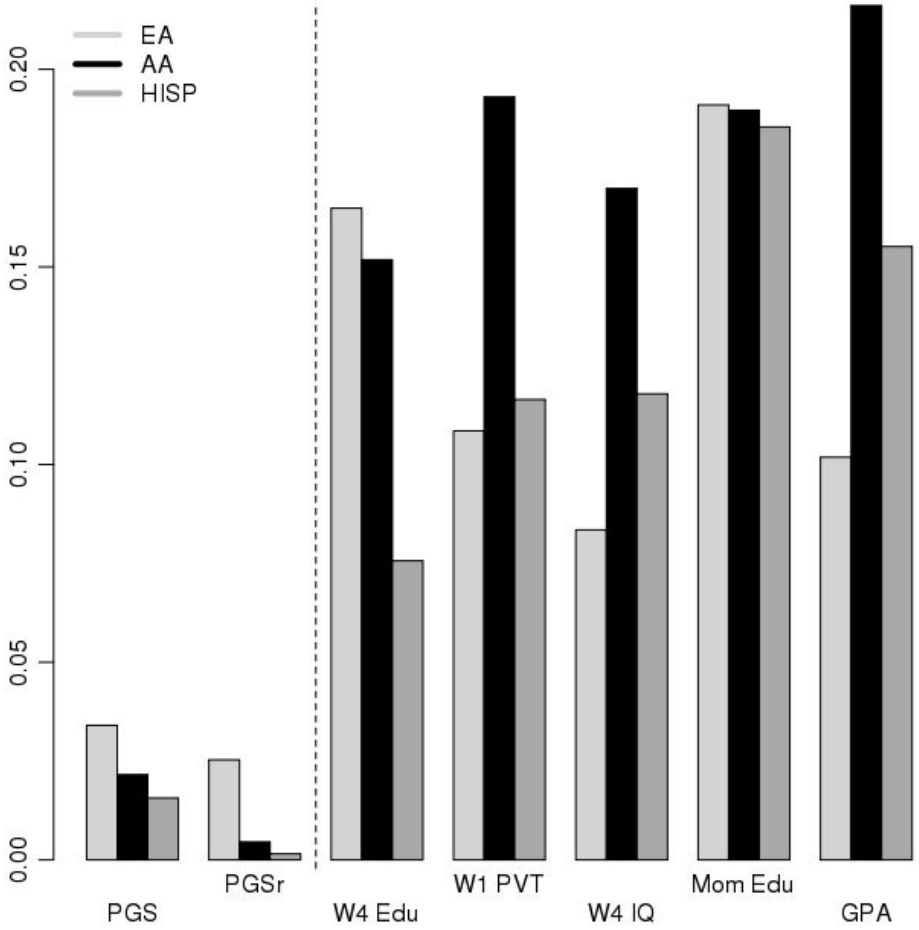


- ICC showing proportion of variation in outcomes that is between schools.
  - e.g., ~20% of the variation in maternal education is between schools.

Clustering of PGS into schools

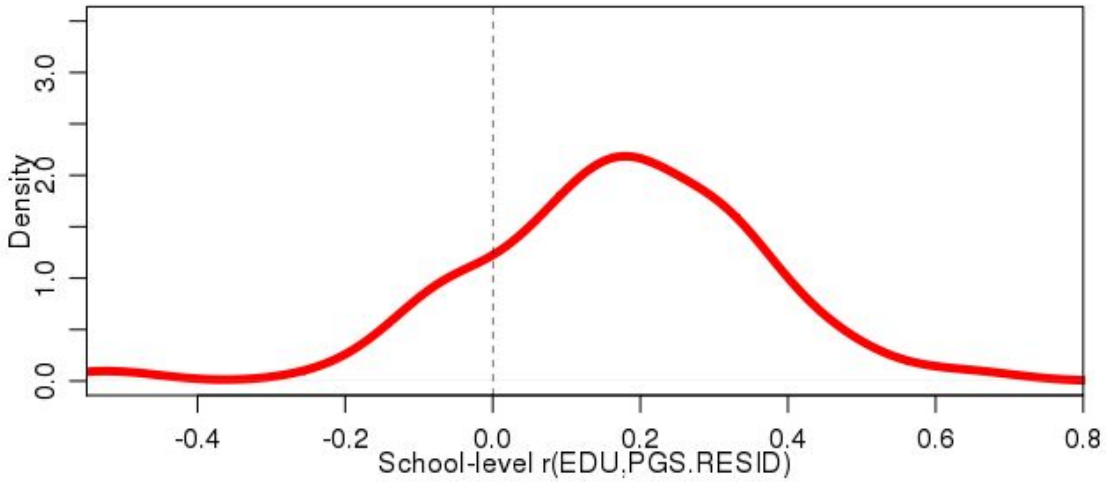


Clustering of PGS into schools



- What is effect of the clustering we do observe?
  - Genetics of EA student's peers are more predictive than their own.

How much variation is there in the PGS effect between schools?



- First computed correlations between educational attainment and PGS for each school.
- Then considered the distribution.

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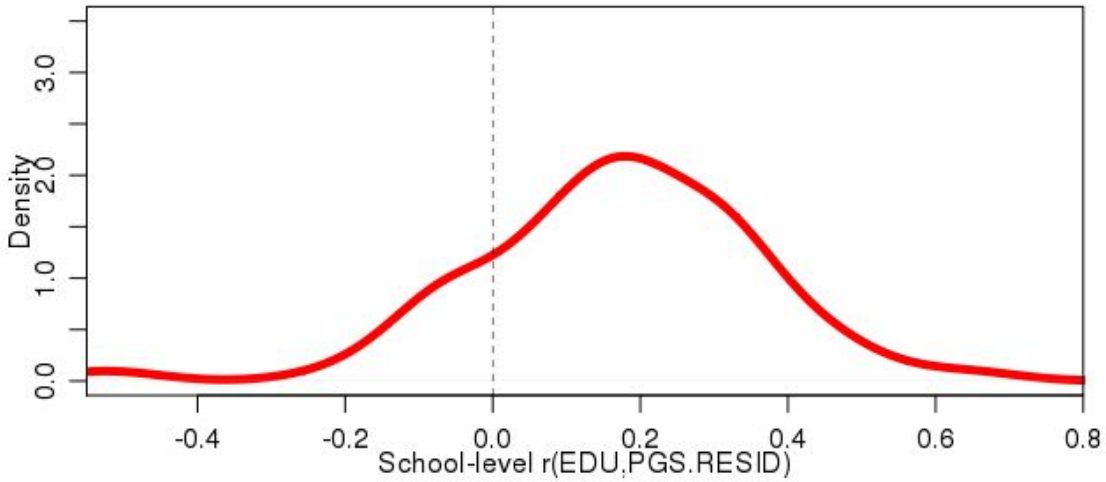

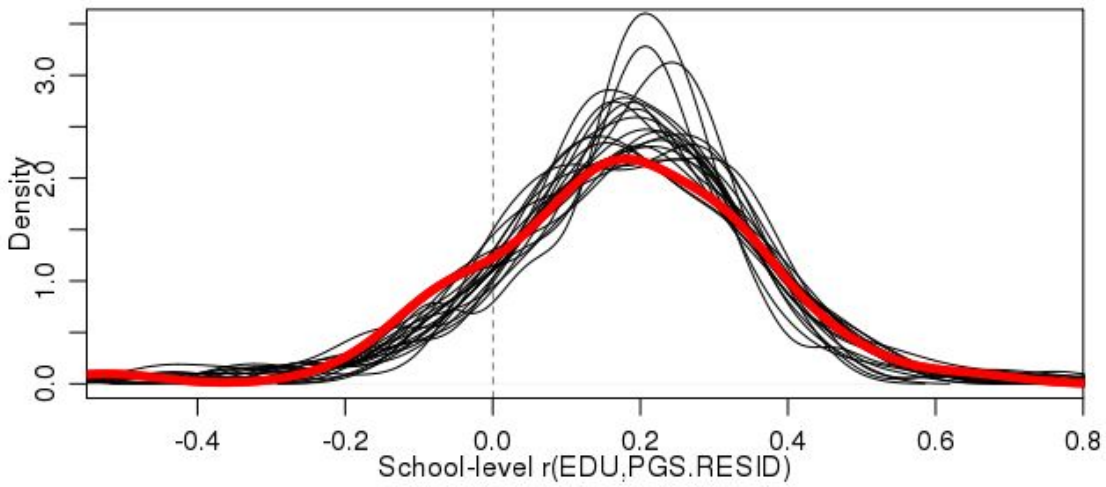

In closing

- Preliminary Findings:
  - It seems clear that there is interesting genetic clustering into schools.
  - Little evidence for school-level moderation of genetic effect.

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- Preliminary Findings:
  - It seems clear that there is interesting genetic clustering into schools.
  - Little evidence for school-level moderation of genetic effect.
- Consistent with a model in which genetic risks are not evenly distributed but where there is little gene-environment interaction (GxE).
  - Key role for gene-environment correlation (rGE).
- Also of interest: upstream (developmental pathways) and downstream (later-life outcomes) associations with PGS.

Thanks!

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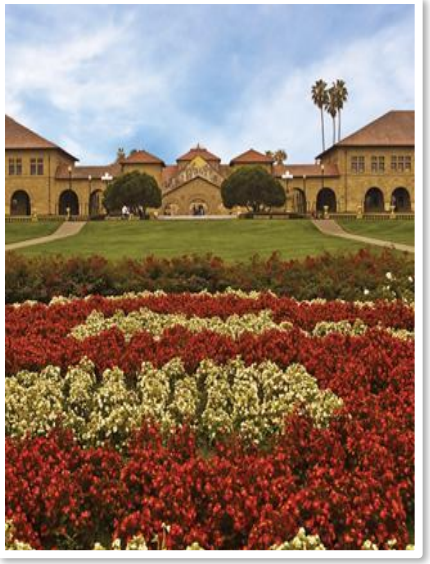

Collaborators: Dan Belsky, Kathleen Mullan Harris, Jason Boardman