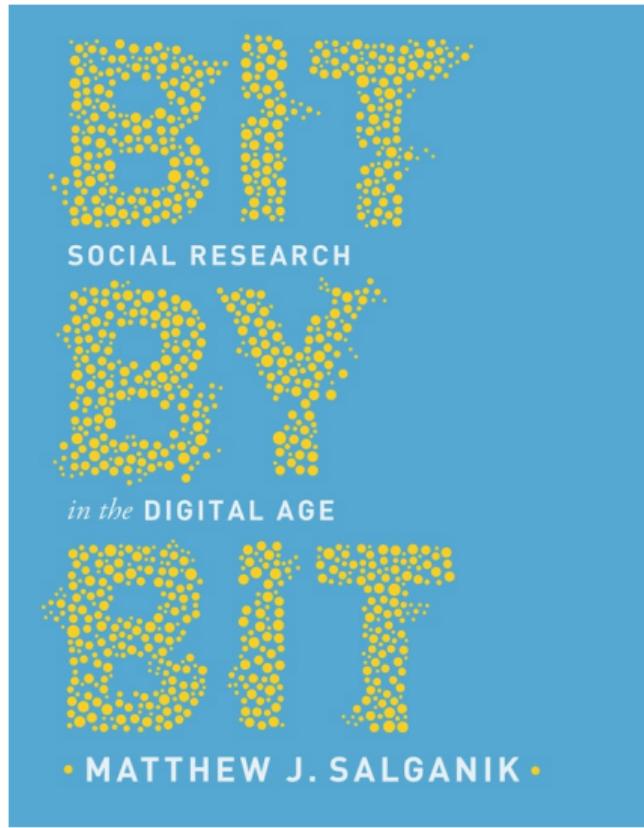


[Introduction to mass collaboration], [Human computation],
[Open call], [Distributed data collection],
[Fragile Families Challenge]

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- 1) Introduction
- 2) Observing behavior
- 3) Asking questions
- 4) Running experiments
- 5) Mass collaboration
- 6) Ethics
- 7) The future

mass collaboration

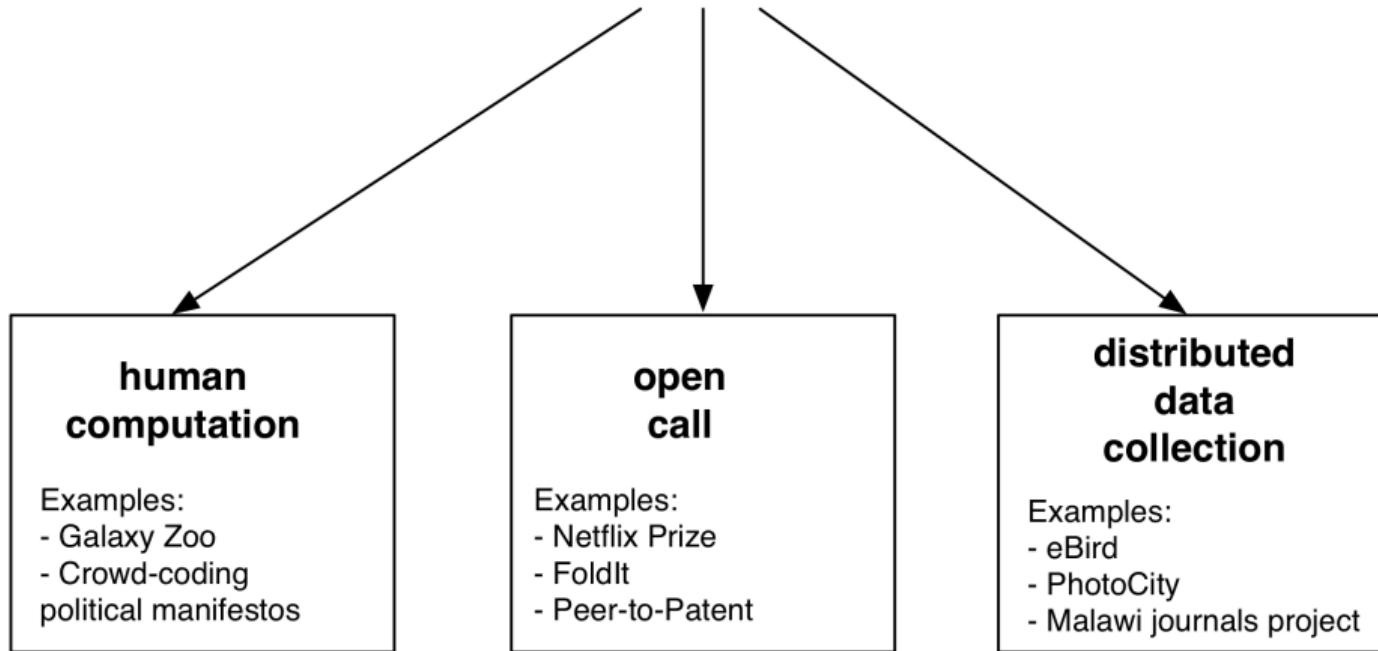


Fig 5.4 ([Salganik 2018](#))

mass collaboration

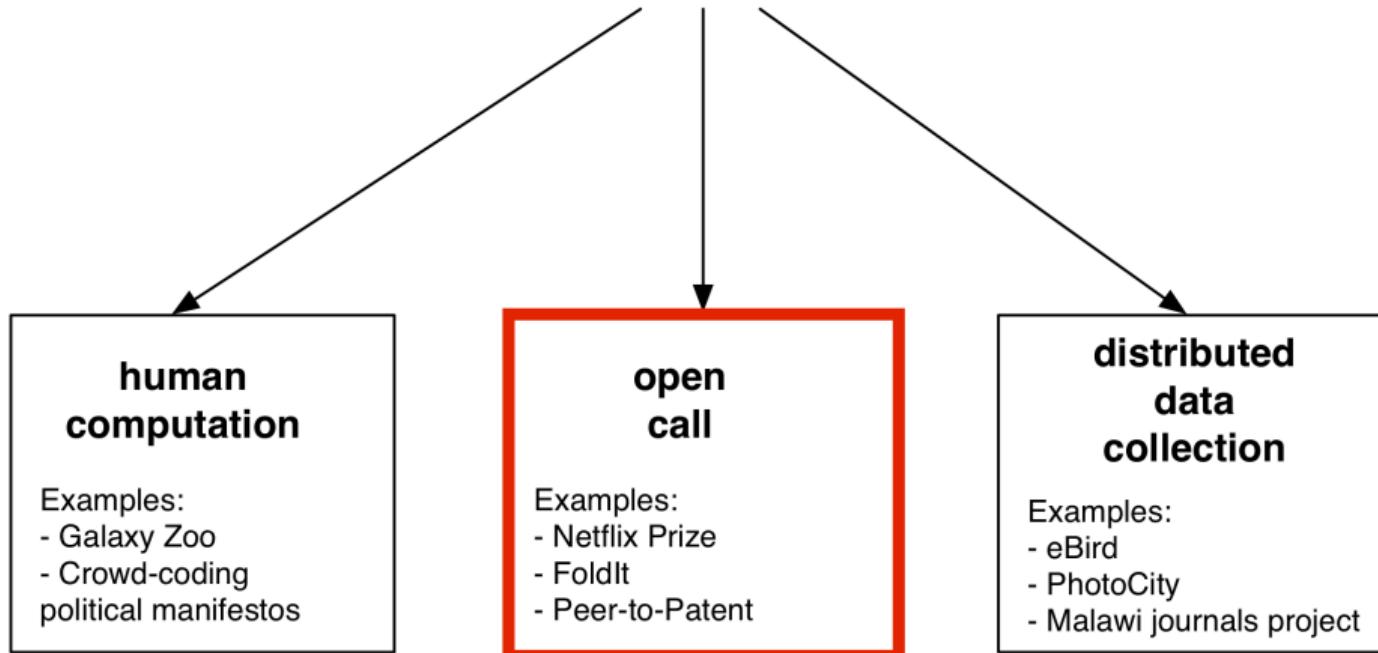
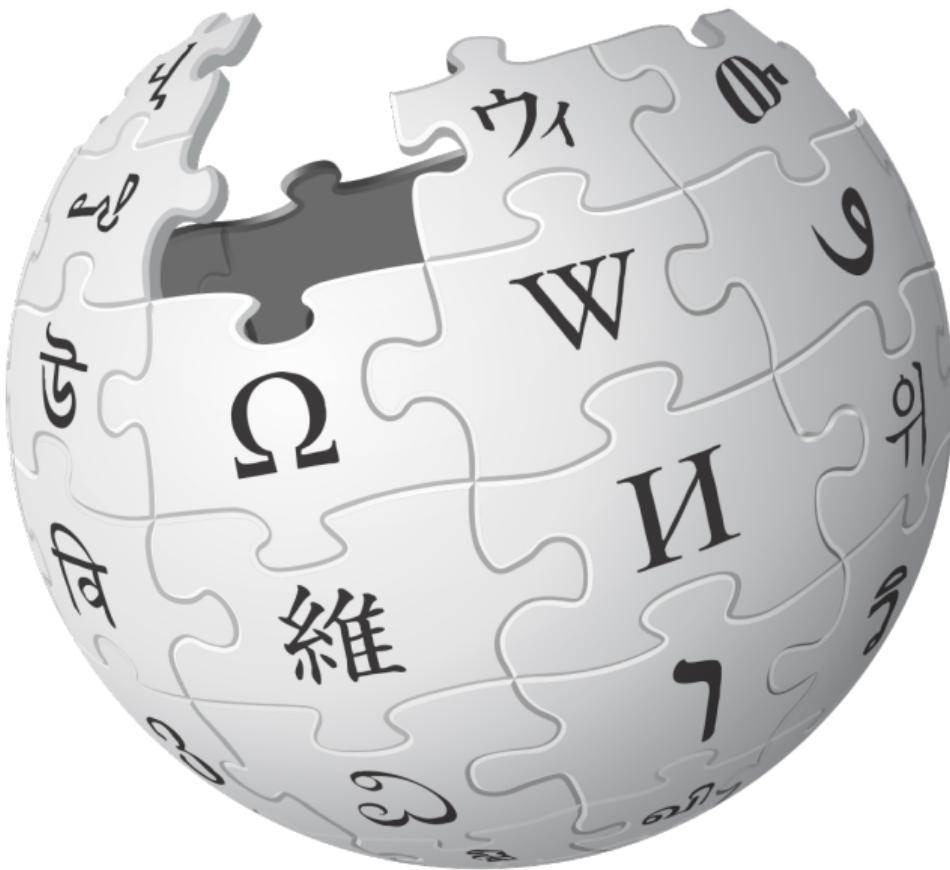


Fig 5.4 (Salganik 2018)

Measuring the Predictability of Life Outcomes with a Scientific Mass Collaboration

Matthew Salganik, Ian Lundberg, Alex Kindel, Sara McLanahan,
and the participants in the Fragile Families Challenge

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Initial sequencing and analysis of the human genome

International Human Genome Sequencing Consortium*

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Combined Measurement of the Higgs Boson Mass in pp Collisions at $\sqrt{s} = 7$ and 8 TeV with the ATLAS and CMS Experiments

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- Conference for Computing in High-Energy and Nuclear Physics (CHEP03), 2003, CHEP-2003-MOLT007, arXiv: physics/0306116.
- [28] L. Moneta, K. Belasco, S. Crammer, A. Lazzaro, D. Piparo, G. Schott, W. Verkerke, and M. Wolf, The ROOTS Project, in Proceedings of the 13th International Workshop on Advanced Computing and Analysis Techniques in Physics Research (ACAT2010) (SISSA, 2010), Proc. Sci., ACAT2010 (2010) 010 [arXiv:1009.1003].
- [29] K. Crammer, G. Lewis, L. Moneta, A. Shibata, and W. Verkerke (ROOT), "ROOTFACTORY: A tool for creating statistical models for use with ROOFIT and ROOSTATS," Tech. Rep. CERN-OPEN-2012-016, 2012 (<http://cds.cern.ch/record/1456844>).
- [30] ATLAS Collaboration, Electron and photon energy calibration with the ATLAS detector using LHC Run 1 data, *Eur. Phys. J. C* **74**, 3071 (2014).
- [31] ATLAS Collaboration, Measurement of the muon reconstruction performance of the ATLAS detector using 2011 and 2012 LHC proton-proton collision data, *Eur. Phys. J. C* **74**, 3130 (2014).
- [32] CMS Collaboration, Performance of CMS muon reconstruction in $p\bar{p}$ collision events at $\sqrt{s} = 7$ TeV, *J. Instrum.* **7**, P10002 (2012).
- [33] CMS Collaboration, Performance of electron reconstruction and selection with the CMS detector in proton-proton collisions at $\sqrt{s} = 8$ TeV, arXiv:1502.02701 [J. Instrum. to be published].
- [34] CMS Collaboration, Performance of photon reconstruction and identification with the CMS detector in proton-proton collisions at $\sqrt{s} = 8$ TeV, arXiv:1502.02702.
- [35] P. D. Dauncey, M. McKenzie, N. Wardle, and G. J. Davies, Handling uncertainties in background shapes: The discrete profiling method, *J. Instrum.* **10**, P04015 (2015).
- [36] ALEPH, DELPHI, L3, OPAL, SLD Collaborations, LEP Electroweak Working Group, and SLD Electroweak and Heavy Flavour Groups, Precision electroweak measurements on the Z resonance, *Phys. Rep.* **427**, 257 (2006).
- [37] ATLAS Collaboration, Observation and measurement of Higgs boson decays to WW^* with the ATLAS detector, arXiv:1412.2641 [Phys. Rev. D (to be published)].
- [38] ATLAS Collaboration, Evidence for the Higgs-boson Yukawa coupling to tau leptons with the ATLAS detector, *J. High Energy Phys.* **04** (2015) 117.
- [39] CMS Collaboration, Measurement of Higgs boson production and properties in the WW decay channel with leptonic final states, *J. High Energy Phys.* **01** (2014) 096.
- [40] CMS Collaboration, Evidence for the 125 GeV Higgs boson decaying to a pair of τ leptons, *J. High Energy Phys.* **05** (2014) 104.

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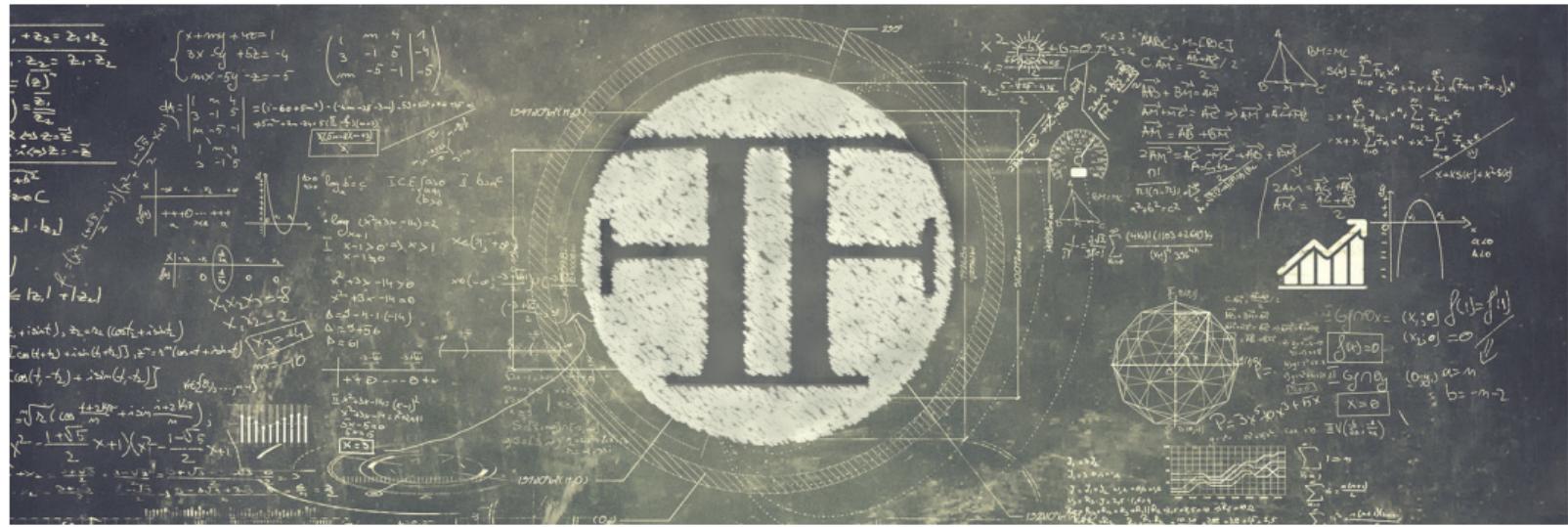
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Fragile Families Challenge

An overly simple view of stratification research.

$$Y = E(Y | \vec{X}) + \epsilon$$

An overly simple view of stratification research.

$$Y = E(Y | \vec{X}) + \epsilon$$

Attainment



An overly simple view of stratification research.

$$Y = E(Y | \vec{X}) + \epsilon$$

Attainment

- Academic achievement
- Occupation
- Income

An overly simple view of stratification research.

$$Y = E(Y | \vec{X}) + \epsilon$$

Attainment

- Academic achievement
- Occupation
- Income

Predictable component

An overly simple view of stratification research.

$$Y = E(Y | \vec{X}) + \epsilon$$

Attainment

- Academic achievement
- Occupation
- Income

Predictable component

An overly simple view of stratification research.

$$Y = \underbrace{\beta_1 X_1 + \beta_2 X_2}_{\text{Predictable component}} + \epsilon$$

Attainment

- Academic achievement
- Occupation
- Income

Predictable component

An overly simple view of stratification research.

$$Y = E(Y | \vec{X}) + \epsilon$$

Attainment

- Academic achievement
- Occupation
- Income

Predictable component

An overly simple view of stratification research.

Attainment

- Academic achievement
- Occupation
- Income

$$Y = E(Y | \vec{X}) + \epsilon$$

Predictable component

Unpredictable component

An overly simple view of stratification research.

Attainment

- Academic achievement
- Occupation
- Income

$$Y = E(Y | \vec{X}) + \epsilon$$

Predictable component

Unpredictable component

An overly simple view of stratification research.

$$Y = E(Y | \vec{X}) + \epsilon$$

Attainment 

Predictable component 

Unpredictable component

Theories focus on the predictable component, but empirically the unpredictable component dominates

$$\hat{y} \quad \& \quad \hat{\beta}$$

Mullainathan and Spiess (2017): <http://dx.doi.org/10.1257/jep.31.2.87>

We should care about the predictability of social outcomes

We should care about the predictability of social outcomes

- ▶ Scientific reasons

We should care about the predictability of social outcomes

- ▶ Scientific reasons

- ▶ Basic social fact
- ▶ Discovery

We should care about the predictability of social outcomes

- ▶ Scientific reasons

- ▶ Basic social fact
- ▶ Discovery

- ▶ Policy reasons



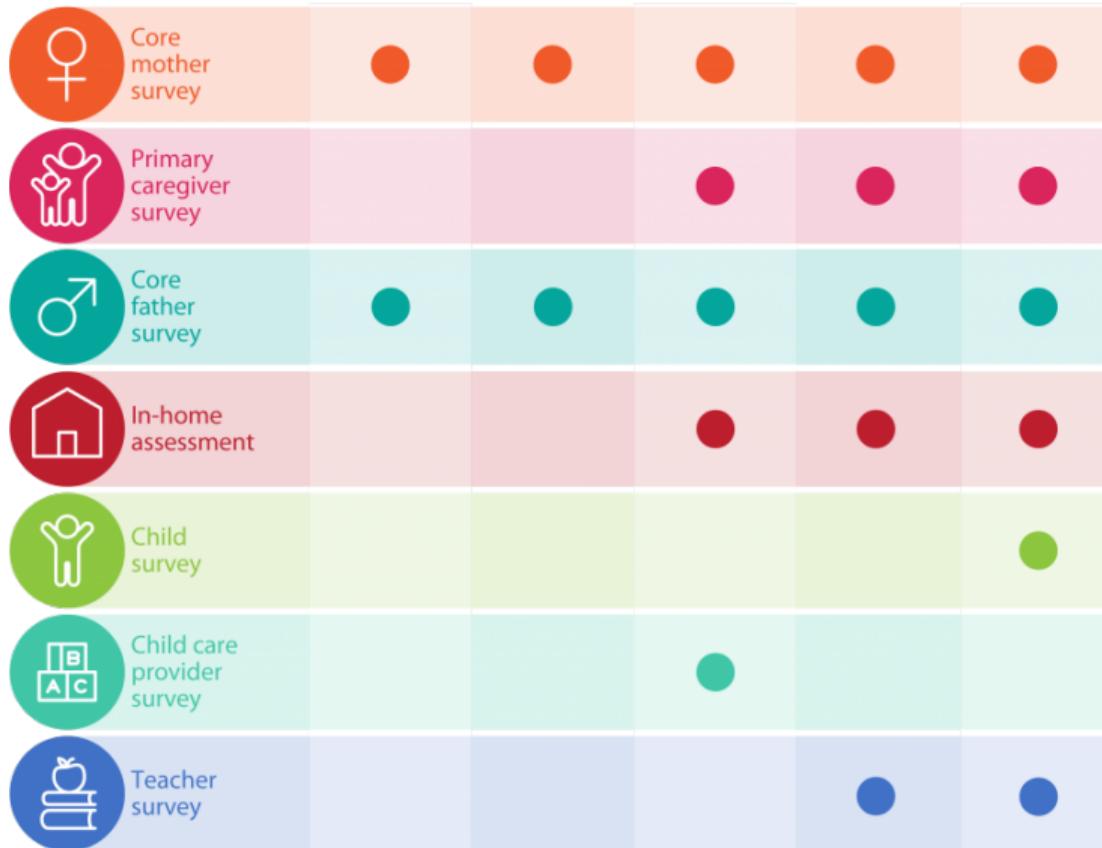
FF Fragile Families

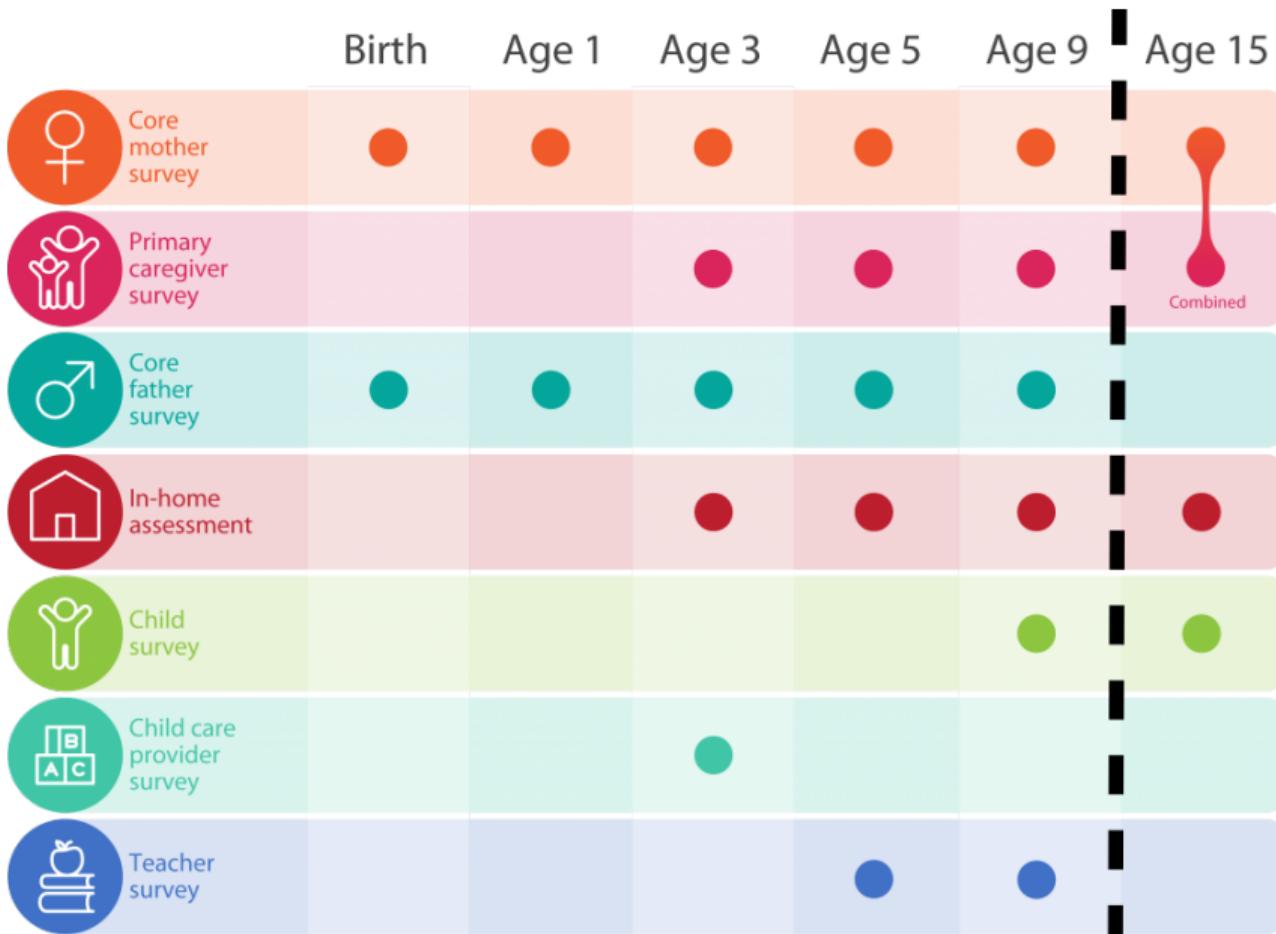
& Child Wellbeing Study
PRINCETON | COLUMBIA



- ▶ Birth cohort panel study
- ▶ ≈ 5,000 children born in 20 U.S. cities with an over-sample of non-marital births
- ▶ Followed from birth through age 15
- ▶ Already used in hundreds of papers and dozens of dissertations

Birth Age 1 Age 3 Age 5 Age 9

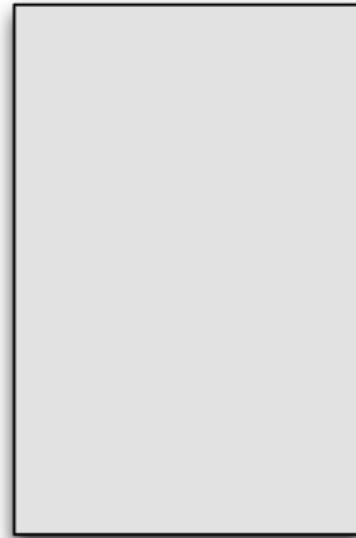
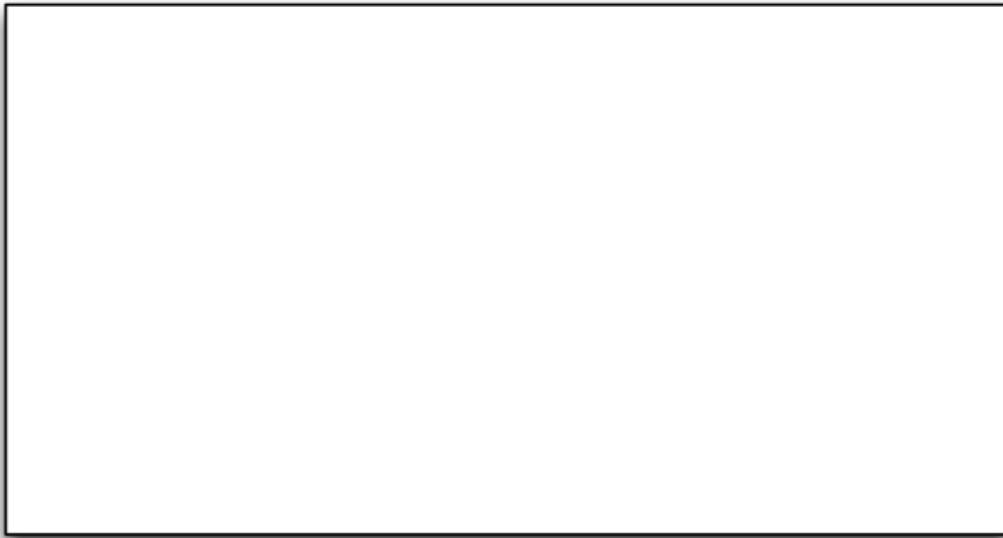




5,000 families

Birth to age 9
12,000 features

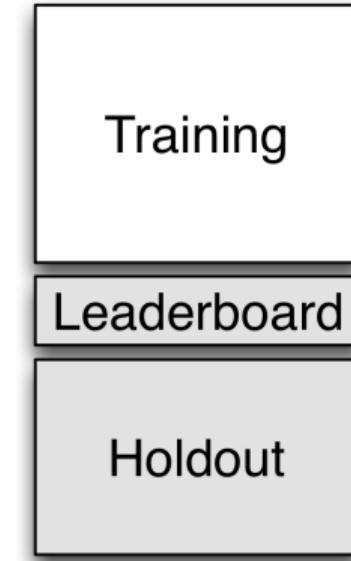
Age 15
1,500 features



4,242 families

12,942 features
birth to age 9

6 outcomes
age 15



Outcomes

- ▶ Child: GPA (continuous), Grit (continuous)
- ▶ Household: Eviction (binary), Material hardship (continuous)
- ▶ Primary care giver: Job training (binary), Job loss (binary)

457 researchers applied to participate. Many worked in interdisciplinary teams. Goal:
Make a prediction that minimizes mean square error on the hold-out set

$$MSE_{\text{holdout}} = \frac{\sum_{i \in \text{holdout}} (\hat{y}_i - y_i)^2}{n_{\text{holdout}}}$$

More on privacy and ethics audit: [Lundberg et al. \(2019\)](#)

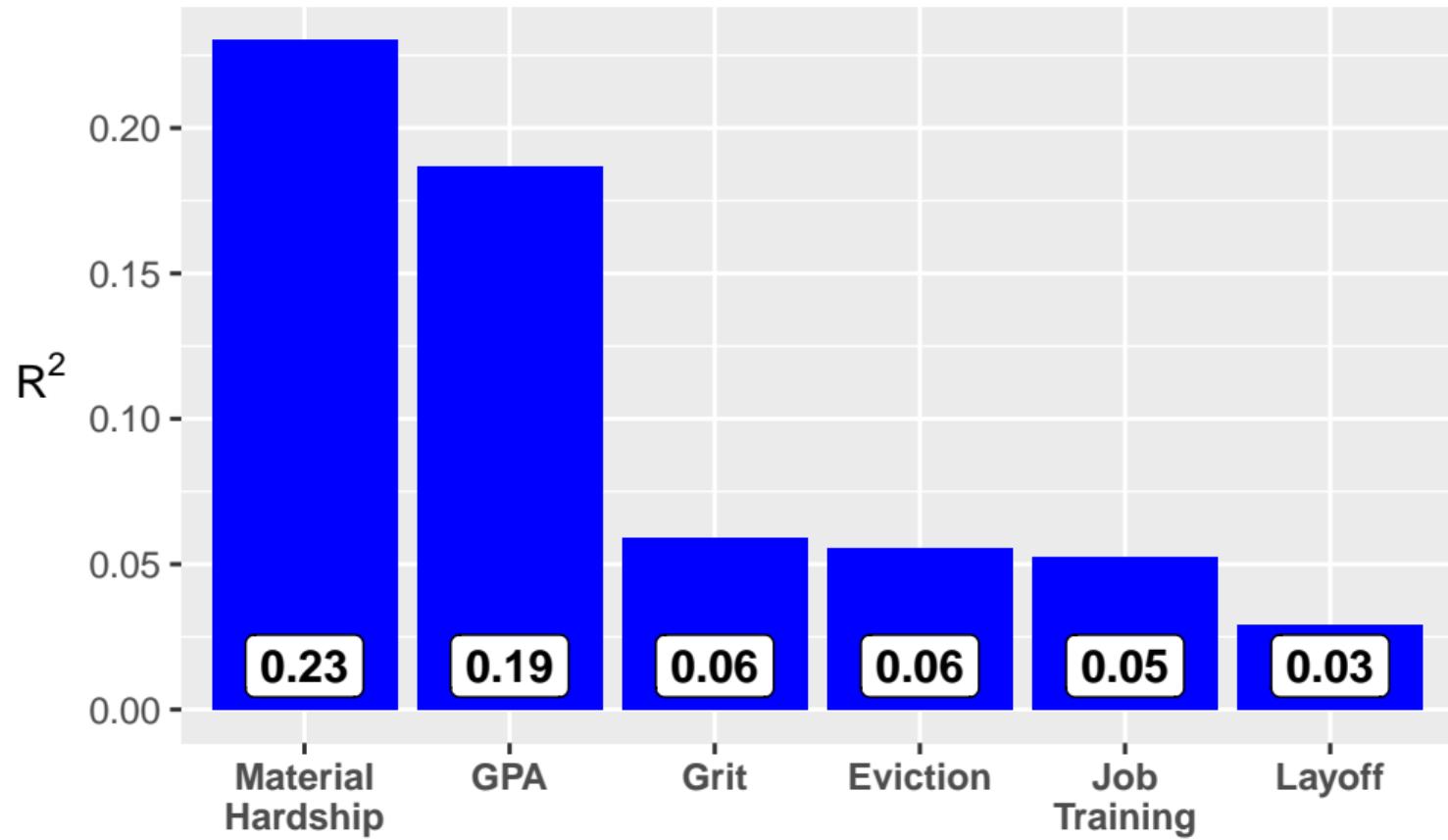
Using a large, high-quality social science dataset collected since birth and modern machine learning methods, how accurately can we predict outcomes from children, parents, and families?

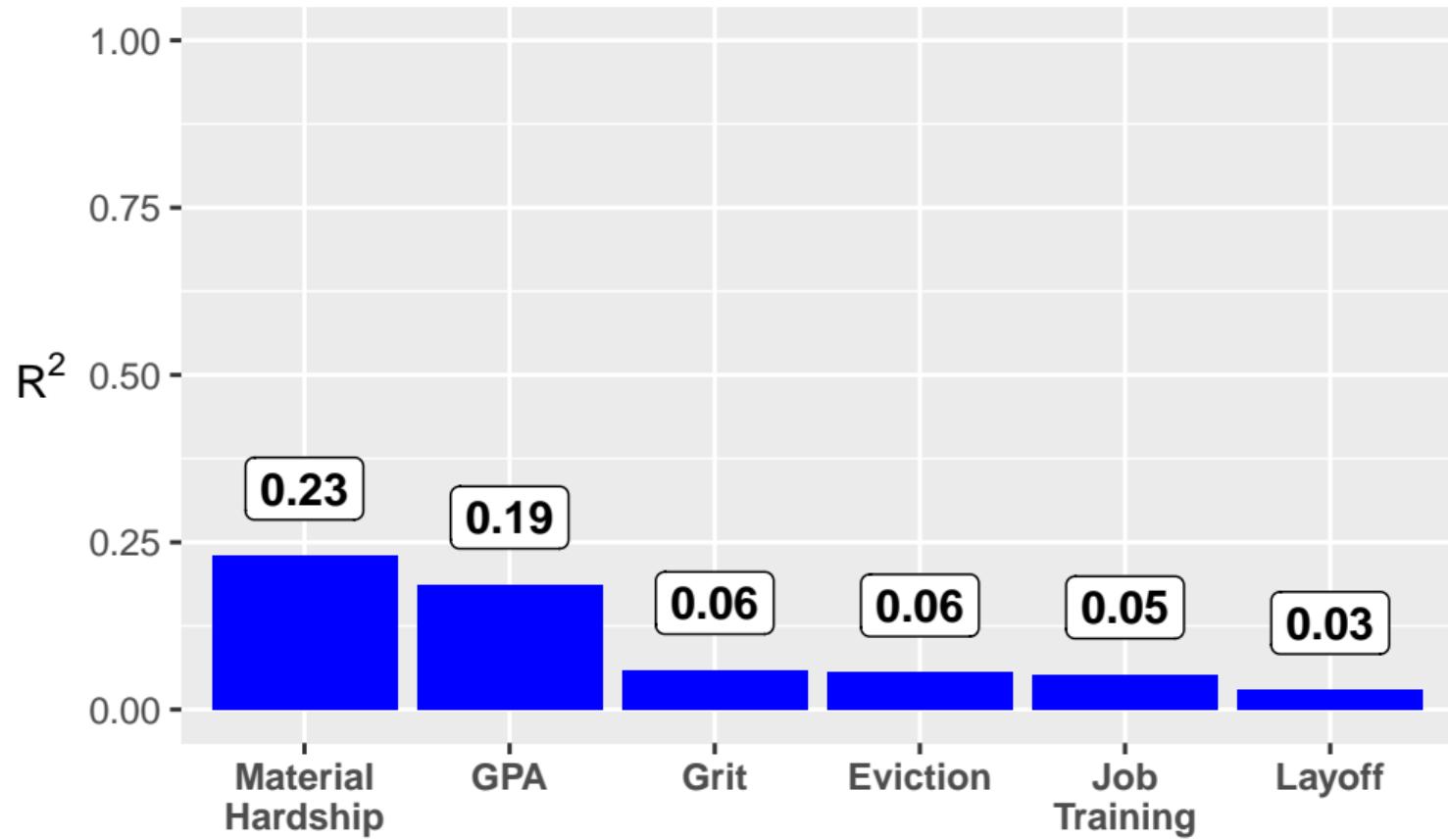
$$R_{holdout}^2 = 1 - \frac{\sum_{i \in holdout} (\hat{y}_i - y_i)^2}{\sum_{i \in holdout} (\bar{y}_{train} - y_i)^2}$$

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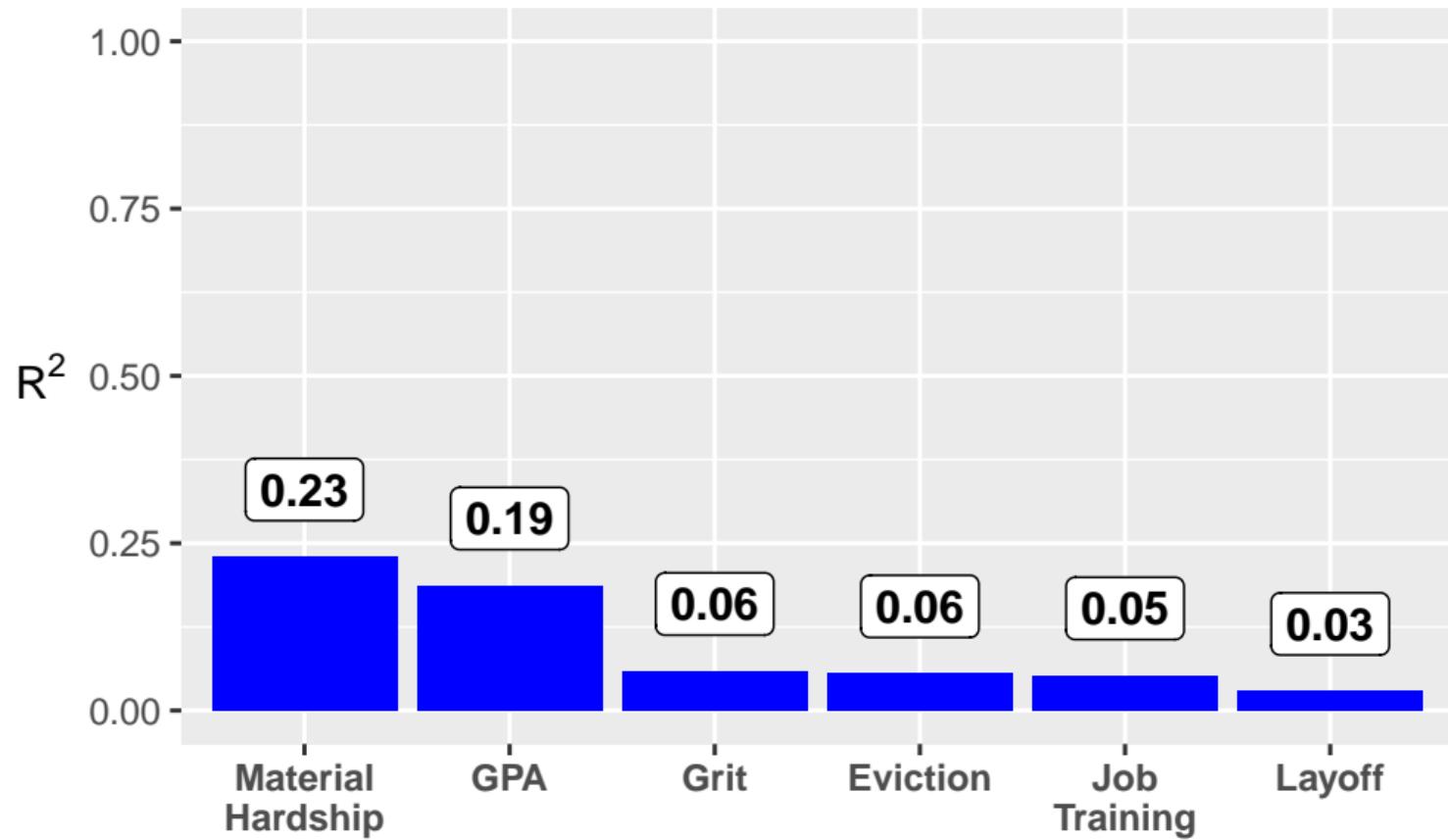
$$R^2_{holdout} = 1 - \frac{\sum_{i \in holdout} (\hat{y}_i - y_i)^2}{\sum_{i \in holdout} (\bar{y}_{train} - y_i)^2}$$

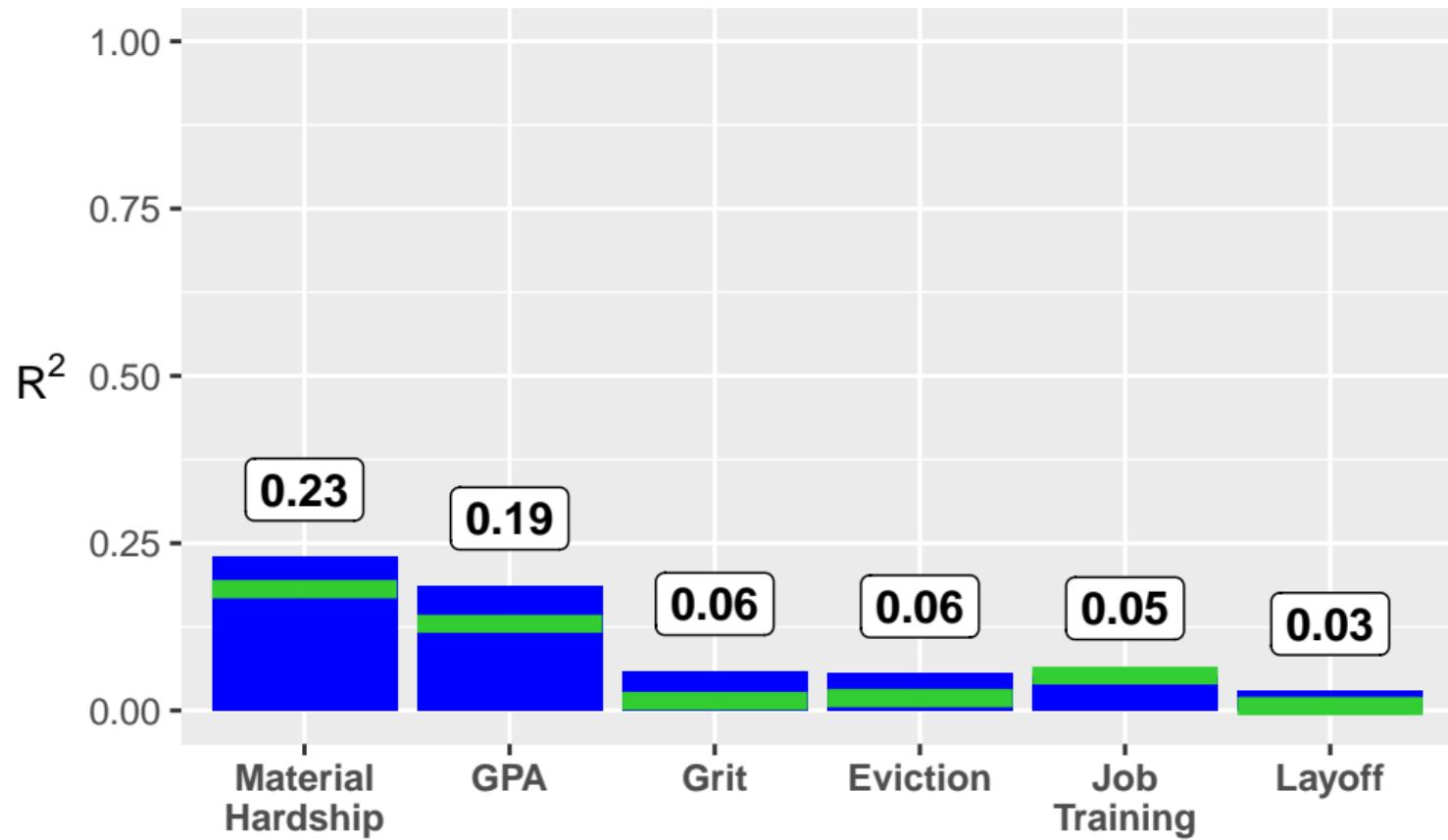
Before I show the results, let's vote . . .





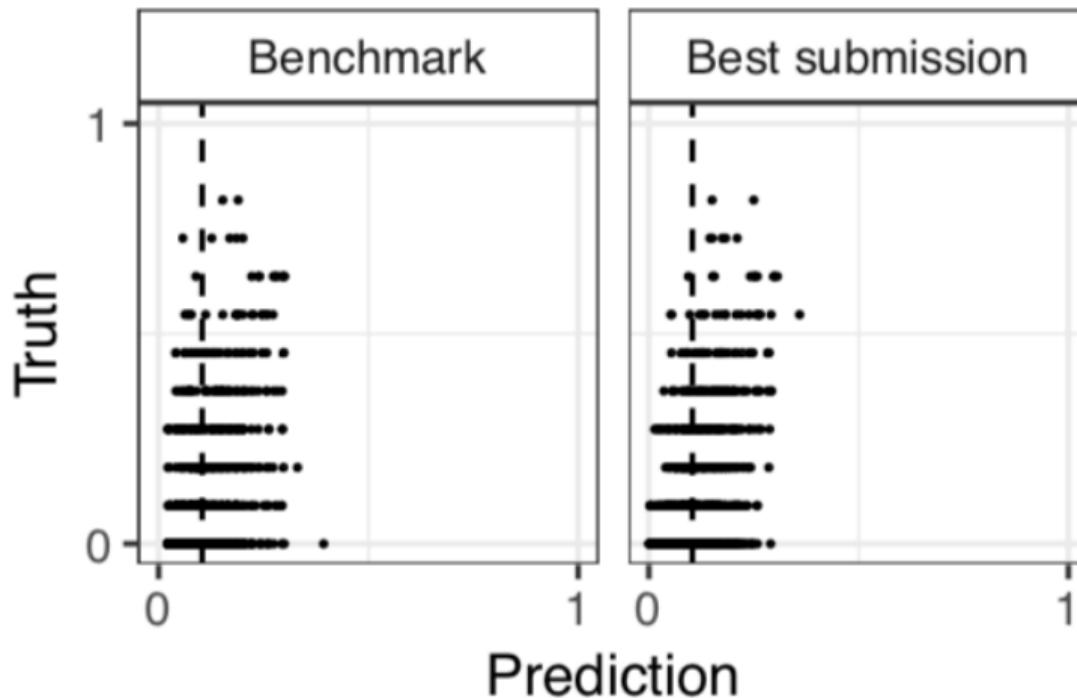
Is this even better than a benchmark model?



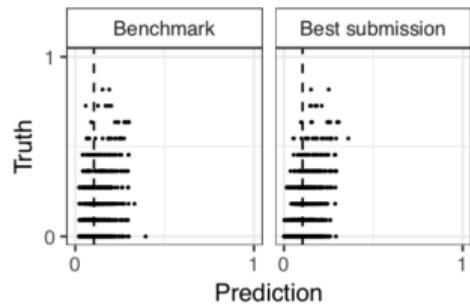


Green line: 4 variable linear regression model

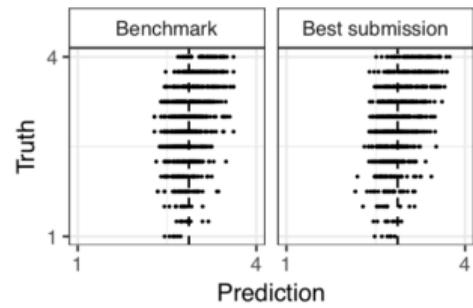
Material hardship



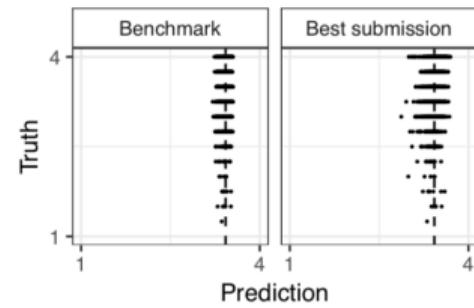
Material hardship



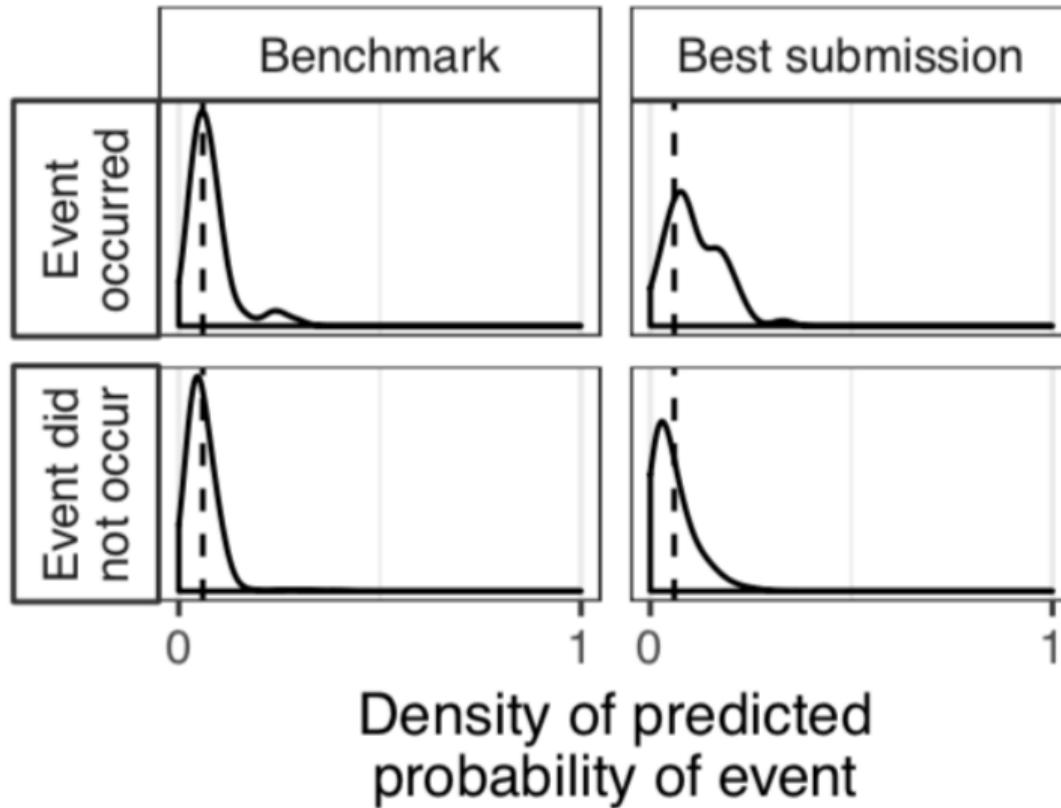
GPA



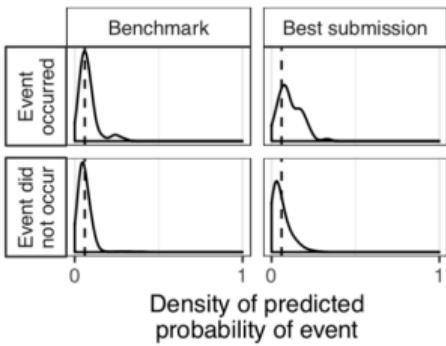
Grit



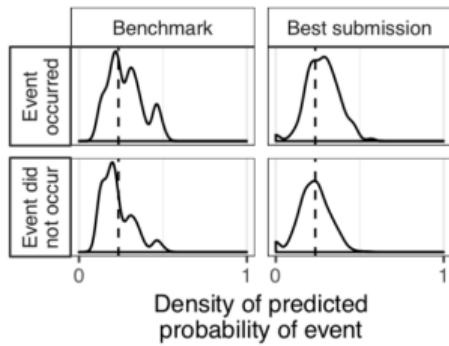
Eviction



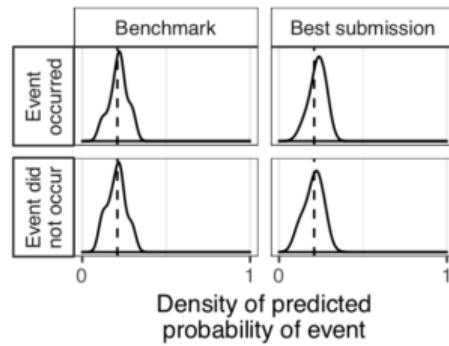
Eviction



Job training

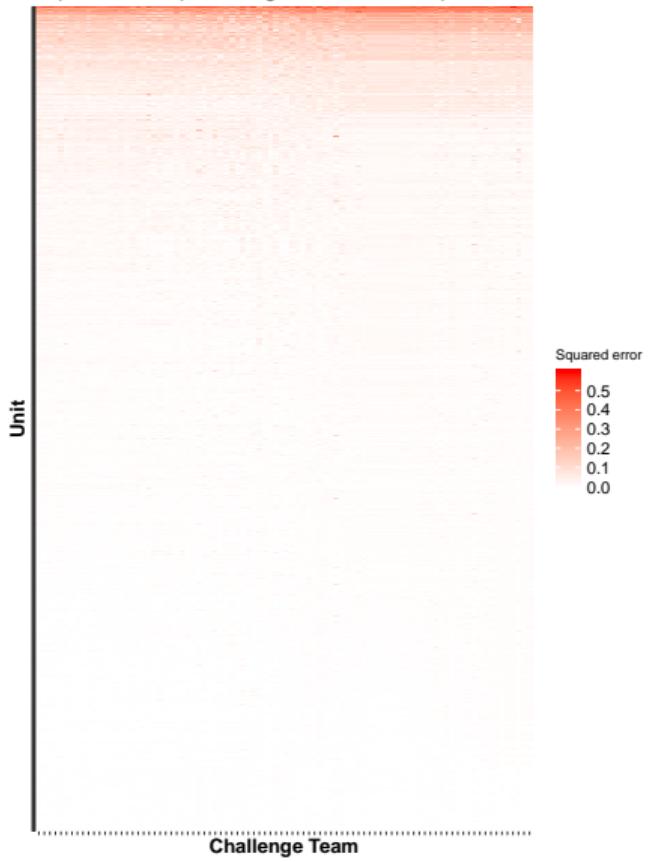


Layoff

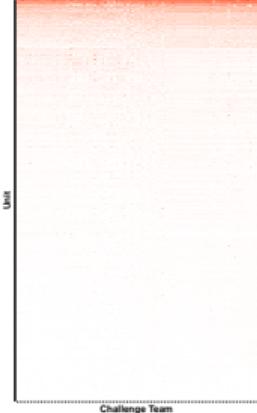


What can we learn looking at all the predictions?

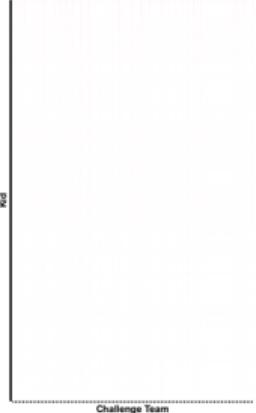
Squared error predicting materialHardship



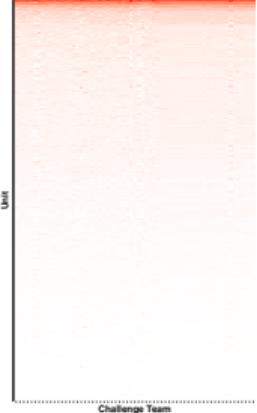
Squared error predicting materialHardship



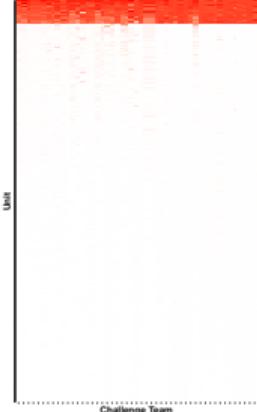
Squared error predicting gpa



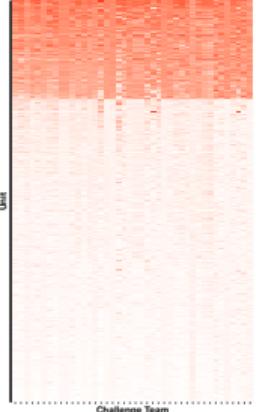
Squared error predicting grit



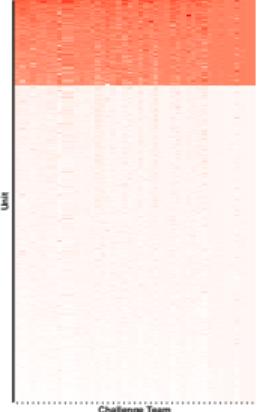
Squared error predicting eviction



Squared error predicting jobTraining



Squared error predicting layoff



What do these results mean for policy makers?

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- ▶ Complex models may not outperform simple models

What do these results mean for researchers?

Researchers must reconcile an “understanding/prediction” paradox

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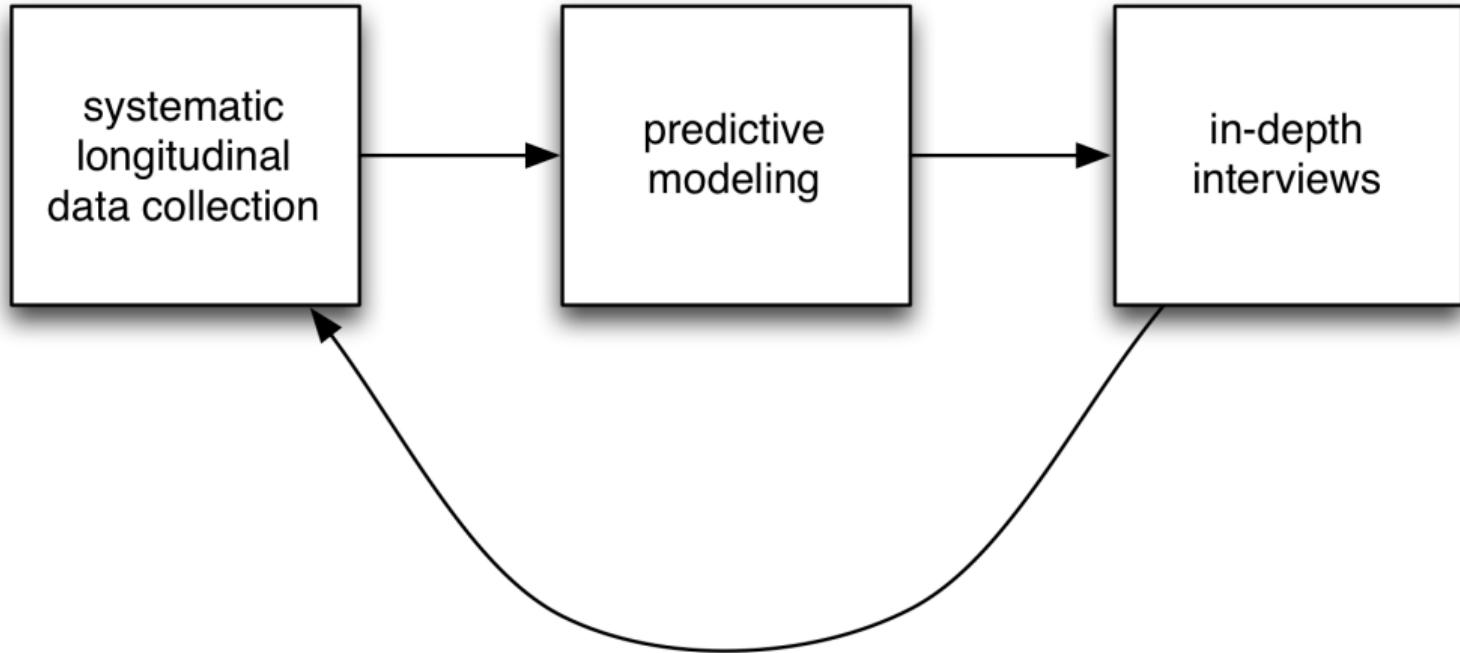
- ▶ We don't understand much
- ▶ Prediction is not a good measure of understanding
- ▶ Our current understanding is correct but incomplete

How can we expand our understanding?

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In-depth, semi-structured interviews

Dark matter interview team: Rachel M. Brown-Weinstock, Bobbi Brashear, Kristin Catena, Susan Clampet-Lundquist, Sophie Damas, Katie Donnalley, Kaitlin Edin-Nelson, Kathryn Edin, Alexus Fraser, Sarah Gold, Ashley Hyman, Daniel Kim, Ian Lundberg, Abigail MacLean, Collin “Ren” MacLean, Stefanie Mavronis, Timothy Nelson, Matthew Salganik, Naomi Shifrin, and Vicki Yang.



Measuring the predictability of life outcomes with a scientific mass collaboration

Matthew J. Salganik^{a,1}, Ian Lundberg^a , Alexander T. Kindel^a, Caitlin E. Ahearn^b, Khaled Al-Ghoneim^c, Abdullah Almaatouq^{d,e} , Drew M. Altschul^f , Jennie E. Brand^{b,g}, Nicole Bohme Carnegie^h , Ryan James Comptonⁱ, Debanjan Datta^j, Thomas Davidson^k, Anna Filippova^l, Connor Gilroy^m, Brian J. Goodeⁿ, Eaman Jahani^o, Ridhi Kashyap^{p,q,r} , Antje Kirchner^s, Stephen McKay^t , Allison C. Morgan^u , Alex Pentland^e, Kivan Polimis^v, Louis Raes^w , Daniel E. Rigobon^x, Claudia V. Roberts^y, Diana M. Stanescu^z, Yoshihiko Suhara^e, Adaner Usmani^{aa}, Erik H. Wang^z, Muna Adem^{bb}, Abdulla Alhajri^{cc}, Bedoor AlShebli^{dd}, Redwane Amin^{ee}, Ryan B. Amos^y, Lisa P. Argyle^{ff} , Livia Baer-Bositis^{gg}, Moritz Büchi^{hh} , Bo-Ryehn Chungⁱⁱ, William Eggert^{jj}, Gregory Faletto^{kk}, Zhilin Fan^{ll}, Jeremy Freese^{gg}, Tejomay Gadgil^{mm}, Josh Gagné^{gg}, Yue Gaoⁿⁿ, Andrew Halpern-Manners^{bb}, Sonia P. Hashim^y, Sonia Hausen^{gg}, Guanhua He^{oo}, Kimberly Higuera^{gg}, Bernie Hogan^{pp}, Ilana M. Horwitz^{qq}, Lisa M. Hummel^{gg}, Naman Jain^x, Kun Jin^{tt} , David Jurgens^{ss}, Patrick Kaminski^{bb,tt}, Areg Karapetyan^{uu,vv}, E. H. Kim^{gg}, Ben Leizman^y, Naijia Liu^z, Malte Möser^y, Andrew E. Mack^z, Mayank Mahajan^y, Noah Mandell^{ww}, Helge Marahrens^{bb}, Diana Mercado-Garcia^{qq}, Viola Mocz^{xx}, Katriina Mueller-Gastell^{gg}, Ahmed Musse^{yy}, Qiankun Niu^{ee}, William Nowak^{zz}, Hamidreza Omidvar^{aaa}, Andrew Or^y, Karen Ouyang^y, Katy M. Pinto^{bbb}, Ethan Porter^{ccc}, Kristin E. Porter^{ddd}, Crystal Qian^y, Tamkinat Rauf^{gg}, Anahit Sargsyan^{eee}, Thomas Schaffner^y, Landon Schnabel^{gg}, Bryan Schonfeld^z, Ben Sender^{ff}, Jonathan D. Tang^y, Emma Tsurkov^{gg}, Austin van Loon^{gg}, Onur Varol^{ggg,hhh} , Xiafei Wangⁱⁱ, Zhi Wang^{hhh,jjj}, Julia Wang^y, Flora Wang^{fff}, Samantha Weissman^y, Kirstie Whitaker^{kkk,lli}, Maria K. Wolters^{mmm}, Wei Lee Woonⁿⁿⁿ, James Wu^{ooo}, Catherine Wu^y, Kengran Yang^{aaa}, Jingwen Yin^{ll}, Bingyu Zhao^{ppp}, Chenyun Zhu^{ll}, Jeanne Brooks-Gunn^{qqq,rrr}, Barbara E. Engelhardt^{y,ii}, Moritz Hardt, Dean Knox^z, Karen Levy^{ttt}, Arvind Narayanan^y, Brandon M. Stewart^a, Duncan J. Watts^{uuu,vvv,wwww} , and Sara McLanahan^{a,1}

<https://doi.org/10.1073/pnas.1915006117>

See also Garip (2020) "What failure to predict life outcomes can teach us"

<https://doi.org/10.1073/pnas.2003390117>

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 - ▶ “[Successes and struggles with computational reproducibility in the Fragile Families Challenge](#)” by Liu & Salganik

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A new class:

- ▶ COS 597E/SOC 555 Limits to Prediction (Fall 2020), Taught by Arvind Narayanan and Matthew Salganik

$$\hat{y} \quad \& \quad \hat{\beta}$$

Mullainathan and Spiess (2017): <http://dx.doi.org/10.1257/jep.31.2.87>

