

A series of Earth-like planets are shown in a row, receding into space. The planets are depicted with various surface features like clouds, land, and water. In the background, a ringed planet is visible. The overall scene is set against a dark, starry space background.

Multiverse Analysis:

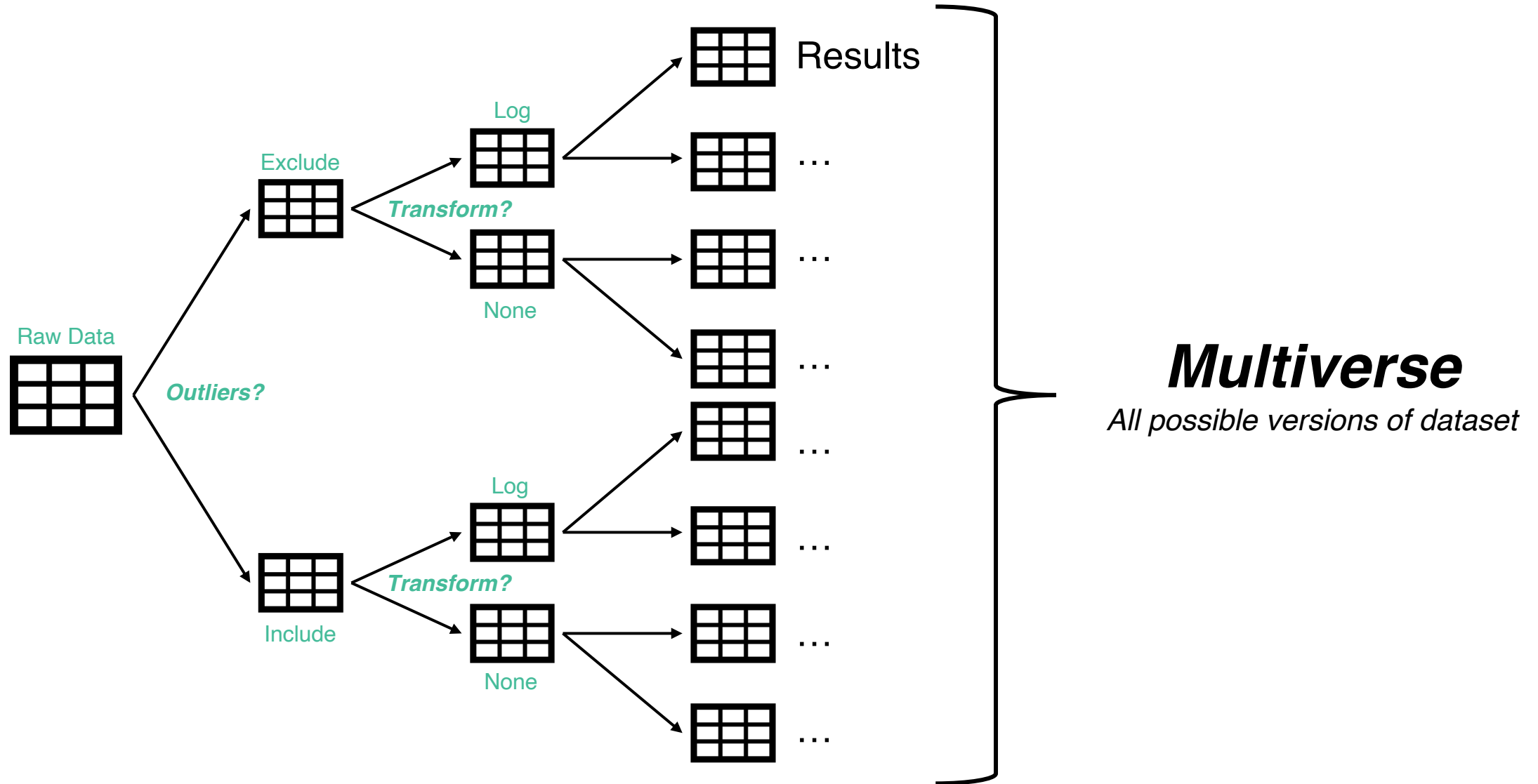
Being transparent about subjective decisions
in data analysis

Ethan Young

Garden of Forking Paths



Garden of Forking ~~Paths~~ Datasets



Cherry Picking

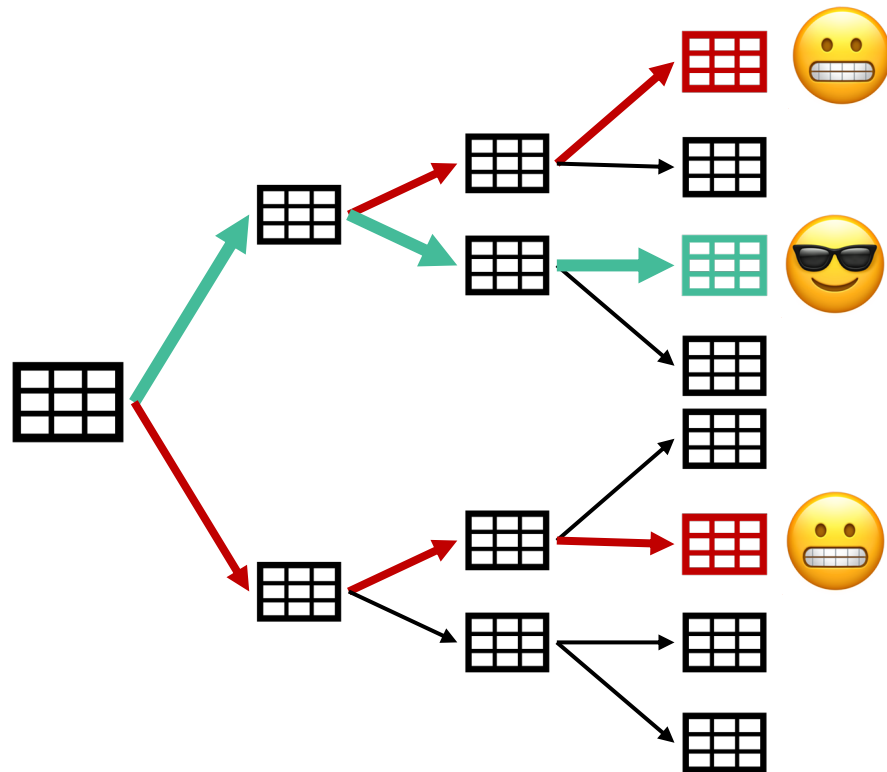


Pigeonholes



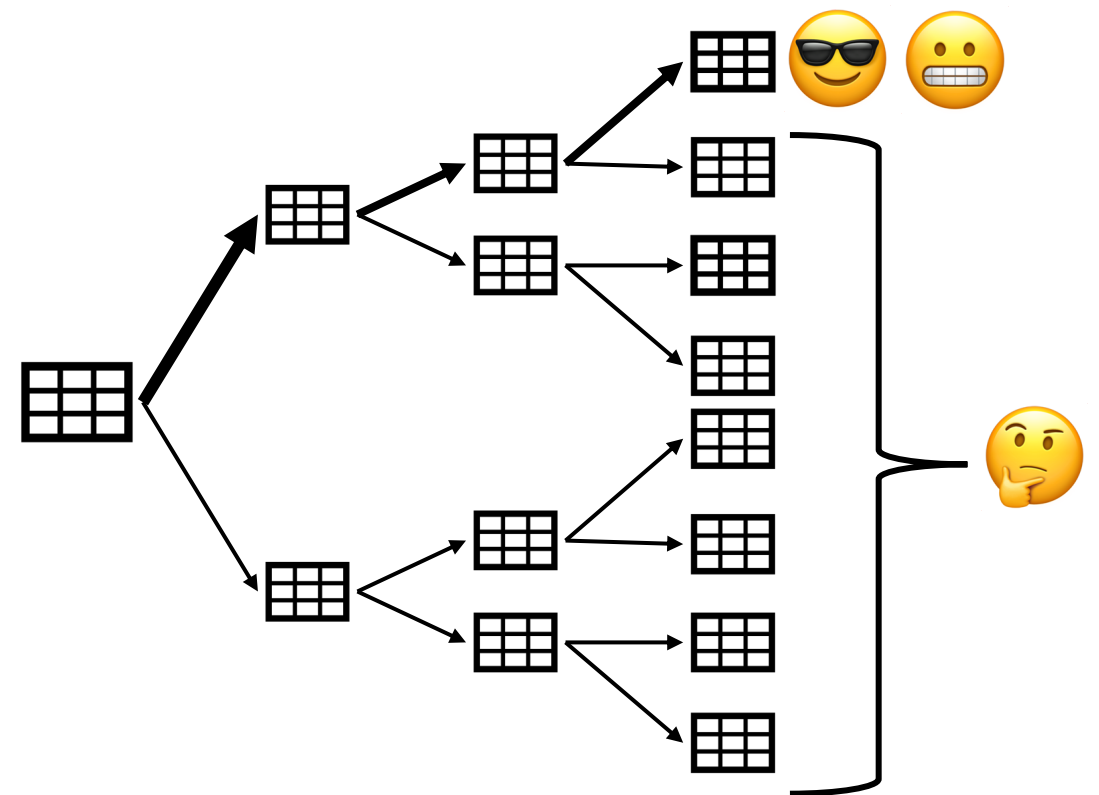
Cherry Picking

Selectively reporting the analysis that shows your preferred result



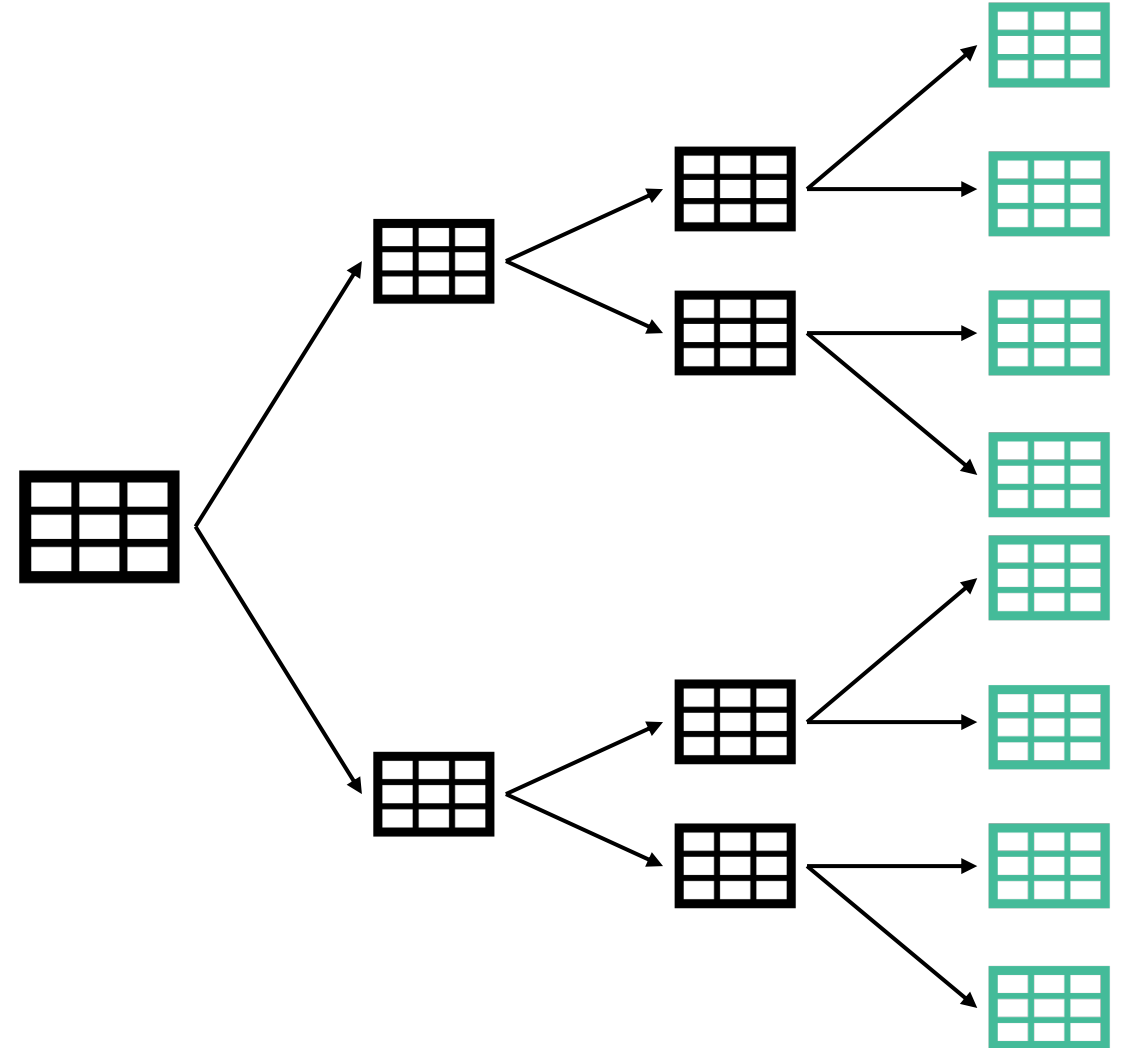
Pigeonholes

Becoming constrained by overly rigid analysis criteria



Multiverse Analysis

- ***Transparently*** and ***systematically*** analyze the whole multiverse
- Transparency reduces cherry-picking
- Systematically handling decisions reduces pigeonholing



Multiverse Analysis



Non-Arbitrary

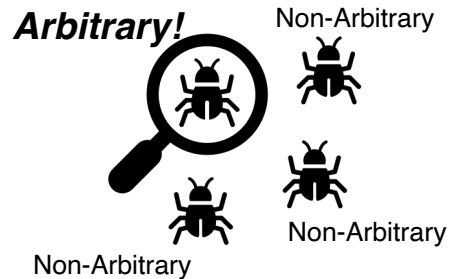
Some alternatives better than others

Arbitrary

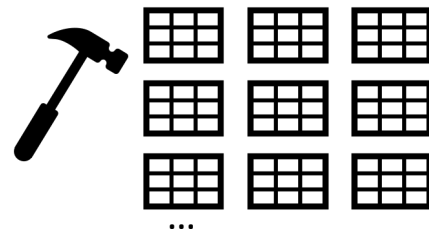
Equally defensible alternatives



1. Identify arbitrary decisions



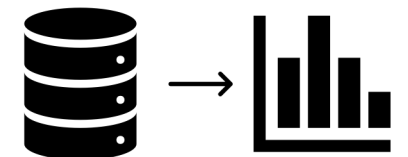
2. Build multiverse datasets



3. Analyze multiverse with the same model



4. Compile and display results



Example: Hidden Talents Study

- Research question:

Can ecologically relevant stimuli improve task performance for people living in adversity?

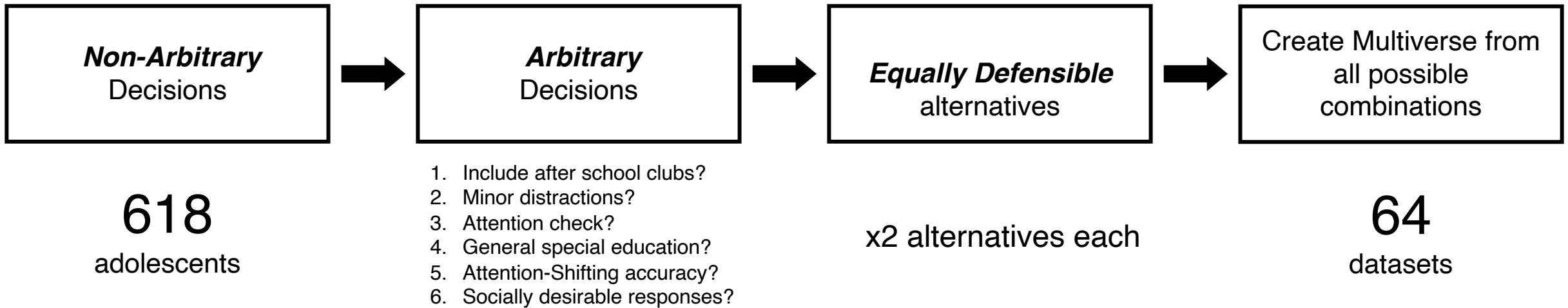
- Analysis:

Performance = adversity \times stimulus type (abstract or real-world)

- Sample:

681 adolescents from after schools clubs and middle schools in US

Hidden Talents Multiverse

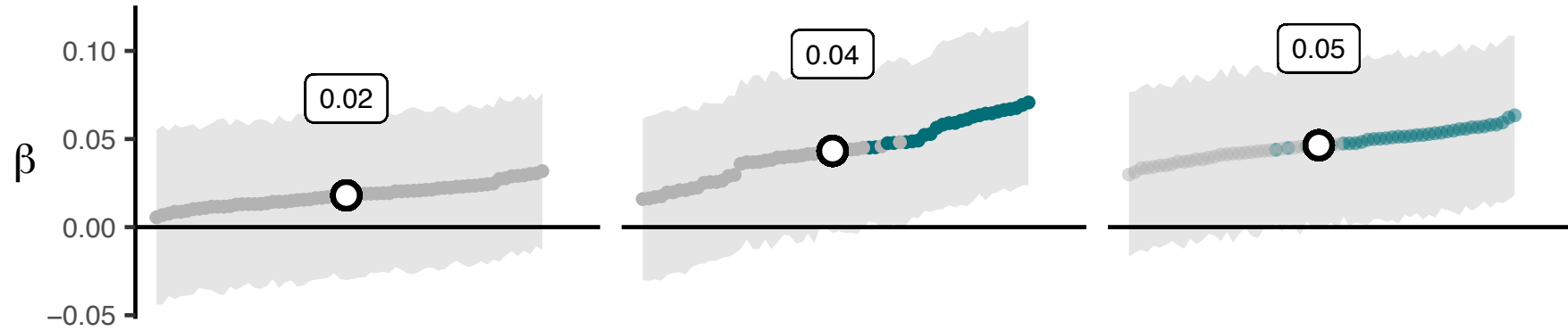


Unpredictability

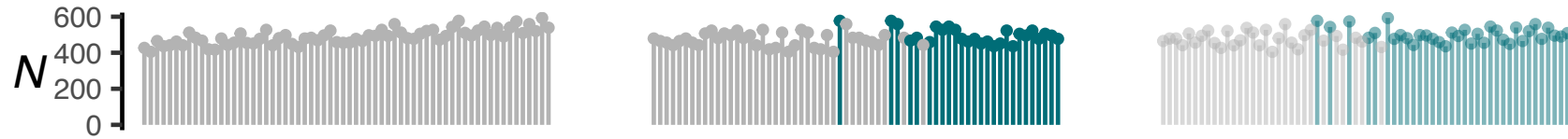
Violence

Poverty

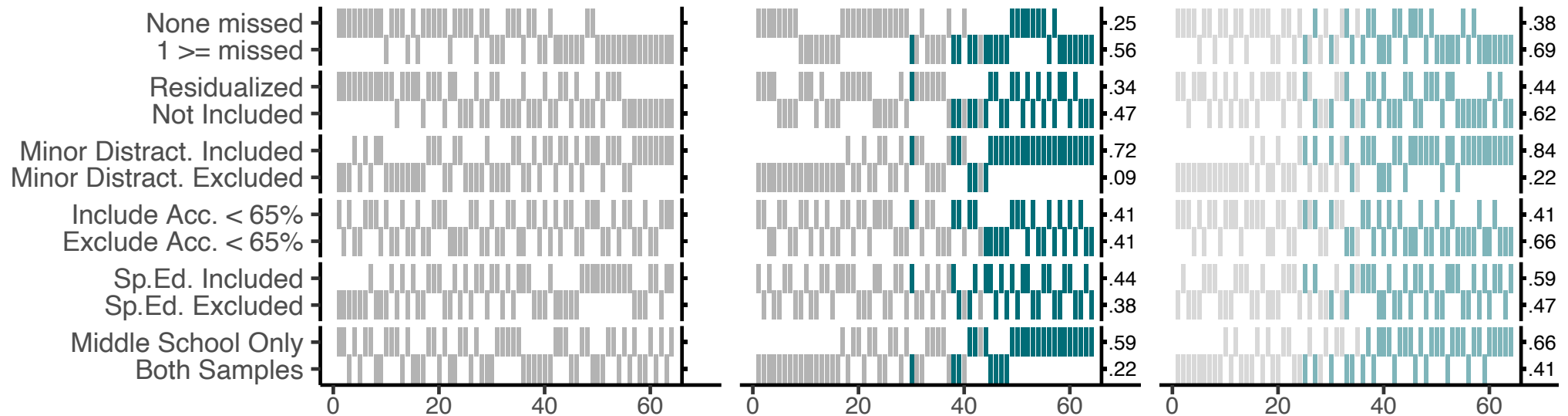
Effect Size Curve



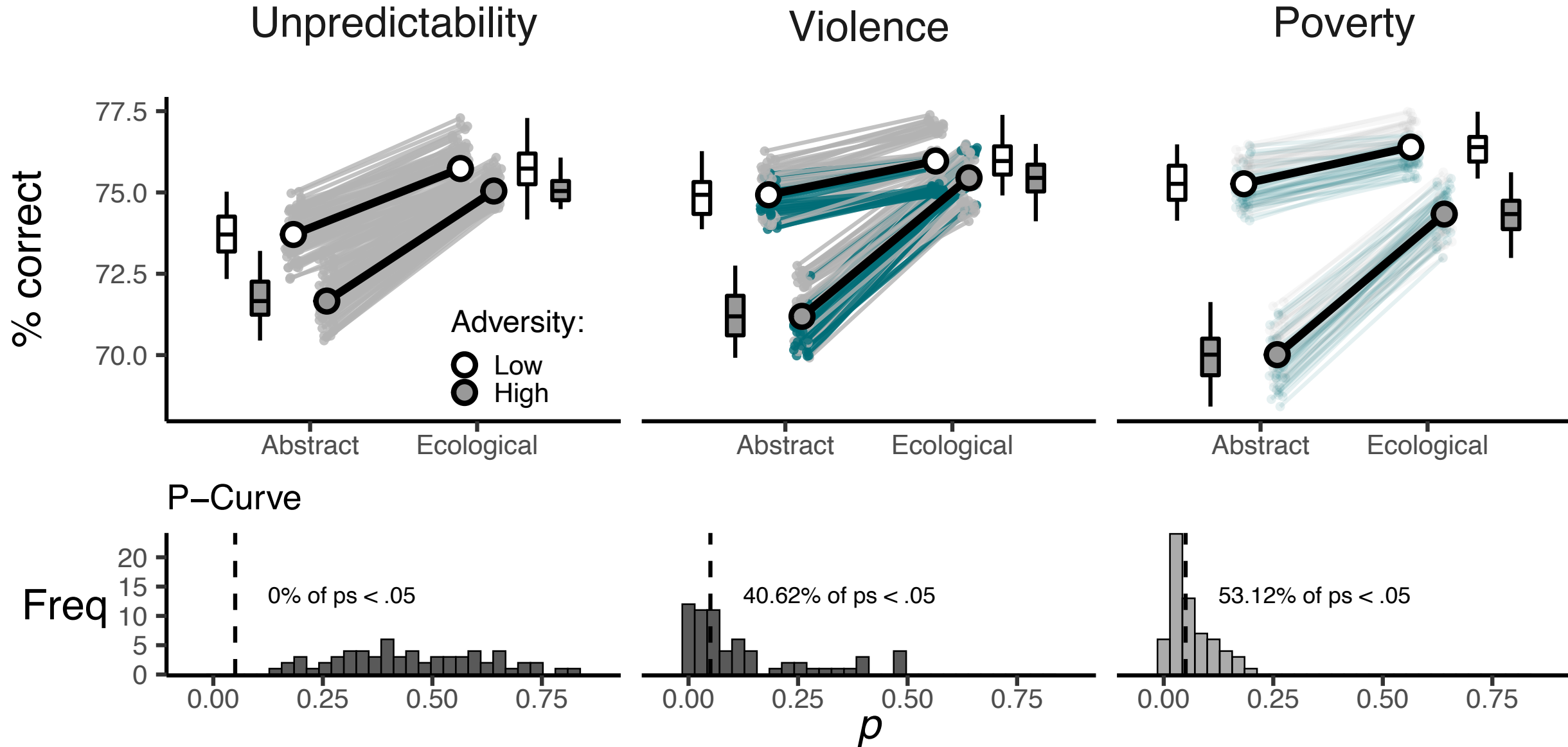
Sample Sizes



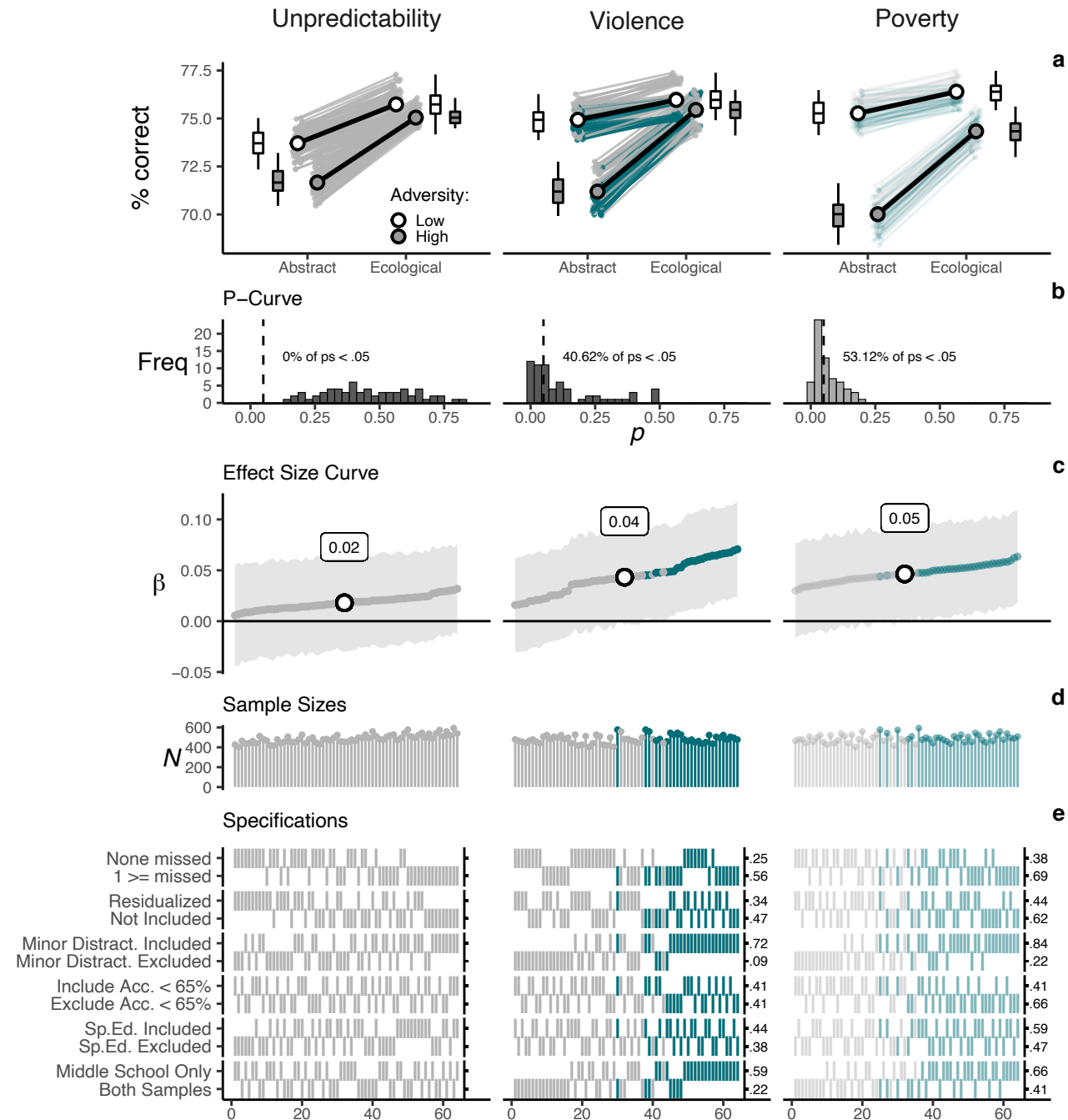
Specifications



Working Memory Updating



Working Memory Updating



Promise & Pitfalls



- Only use with **arbitrary** data processing decisions
- Ask yourself:
Does my analysis always test the same question?

- Promise

- Powerful exploratory tool
- Can be used with any statistical procedure (for programmers: it's just a loop!)
- Provides new guidelines for data decisions
- Come with some pretty cool plots 🧐

- Pitfalls:

- What's arbitrary?
- How should draw inferences from a multiverse analysis?

Questions?



Resources

- Conceptual Papers:
 - Steegen, S., Tuerlinckx, F., Gelman, A., & Vanpaemel, W. (2016). Increasing Transparency Through a Multiverse Analysis. *Perspectives on Psychological Science*, 11(5), 702–712. <https://doi.org/10.1177/1745691616658637>
 - Del Giudice, M., & Gangestad, S. W. (2021). A Traveler's Guide to the Multiverse: Promises, Pitfalls, and a Framework for the Evaluation of Analytic Decisions. *Advances in Methods and Practices in Psychological Science*. <https://doi.org/10.1177/2515245920954925>
 - Simonsohn, U., Simmons, J. P., & Nelson, L. D. (2020). Specification curve analysis. *Nature Human Behaviour*, 4(11), 1208–1214. <https://doi.org/10.1038/s41562-020-0912-z>
 - Patel, C. J., Burford, B., & Ioannidis, J. P. A. (2015). Assessment of vibration of effects due to model specification can demonstrate the instability of observational associations. *Journal of Clinical Epidemiology*, 68(9), 1046–1058. <https://doi.org/10.1016/j.jclinepi.2015.05.029>
 - Muñoz, J., & Young, C. (2018). We Ran 9 Billion Regressions: Eliminating False Positives through Computational Model Robustness. *Sociological Methodology*, 48(1), 1–33. <https://doi.org/10.1177/0081175018777988>
 - Lundberg, I., Johnson, R., & Stewart, B. (2020, January 7). What is Your Estimand? Defining the Target Quantity Connects Statistical Evidence to Theory. <https://doi.org/10.31235/osf.io/ba67n>
- Empirical examples
 - Orben, A., Dienlin, T., & Przybylski, A. K. (2019). Social media's enduring effect on adolescent life satisfaction. *Proceedings of the National Academy of Sciences of the United States of America*, 116(21), 10226–10228. <https://doi.org/10.1073/pnas.1902058116>
 - Orben, A., & Przybylski, A. K. (2019a). The association between adolescent well-being and digital technology use. *Nature Human Behaviour*, 3(2), 173–182. <https://doi.org/10.1038/s41562-018-0506-1>
 - Orben, A., & Przybylski, A. K. (2019b). Screens, Teens, and Psychological Well-Being: Evidence From Three Time-Use-Diary Studies. *Psychological Science*, 30(5), 682–696. <https://doi.org/10.1177/0956797619830329>
 - Heyman, T., & vanpaemel, w. (2020, July 14). Multiverse analyses in the classroom. <https://doi.org/10.31234/osf.io/4eh6b>
- Blog Posts
 - 100% CI: <http://www.the100.ci/2021/03/07/multiverse-analysis/>
 - My website: <https://www.ethan-young.com/code/multiverse/>
- R packages:
 - specr <https://philippmasur.de/2020/01/02/how-to-do-specification-curve-analyses-in-r-introducing-specr/>