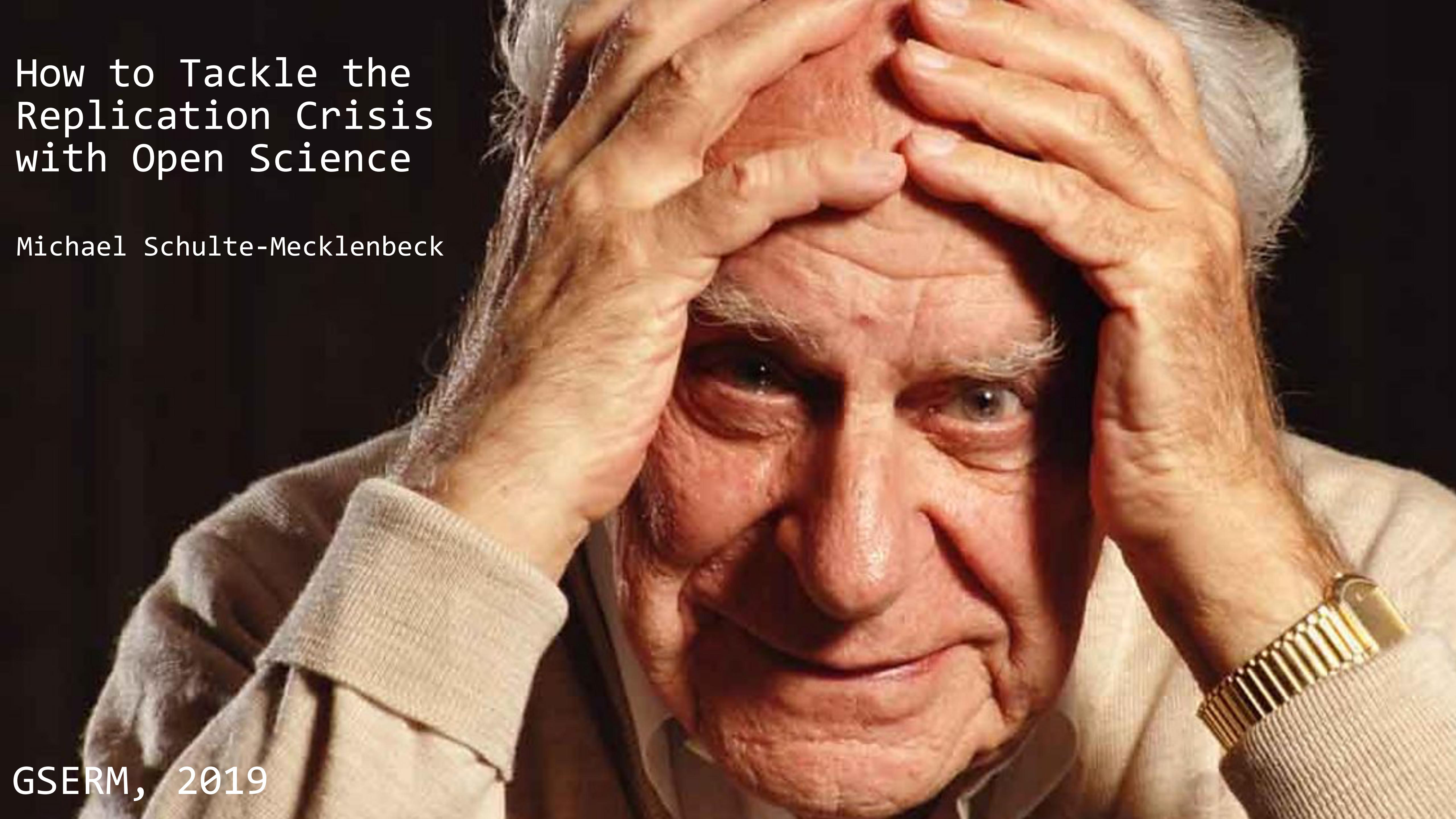


# How to Tackle the Replication Crisis with Open Science

Michael Schulte-Mecklenbeck



GSERM, 2019



Karl Popper  
@therealphilosopher



Only when certain events recur in accordance with rules or regularities, as in the case of **repeatable experiments**, can our observation be tested – in principle – by anyone. 1/2



Karl Popper  
@therealphilosopher

Only by such **repetitions** can we convince ourselves that we are ... dealing with ... events that, because of their **regularity** and **reproducibility**, are in principle intersubjectively testable. 2/2



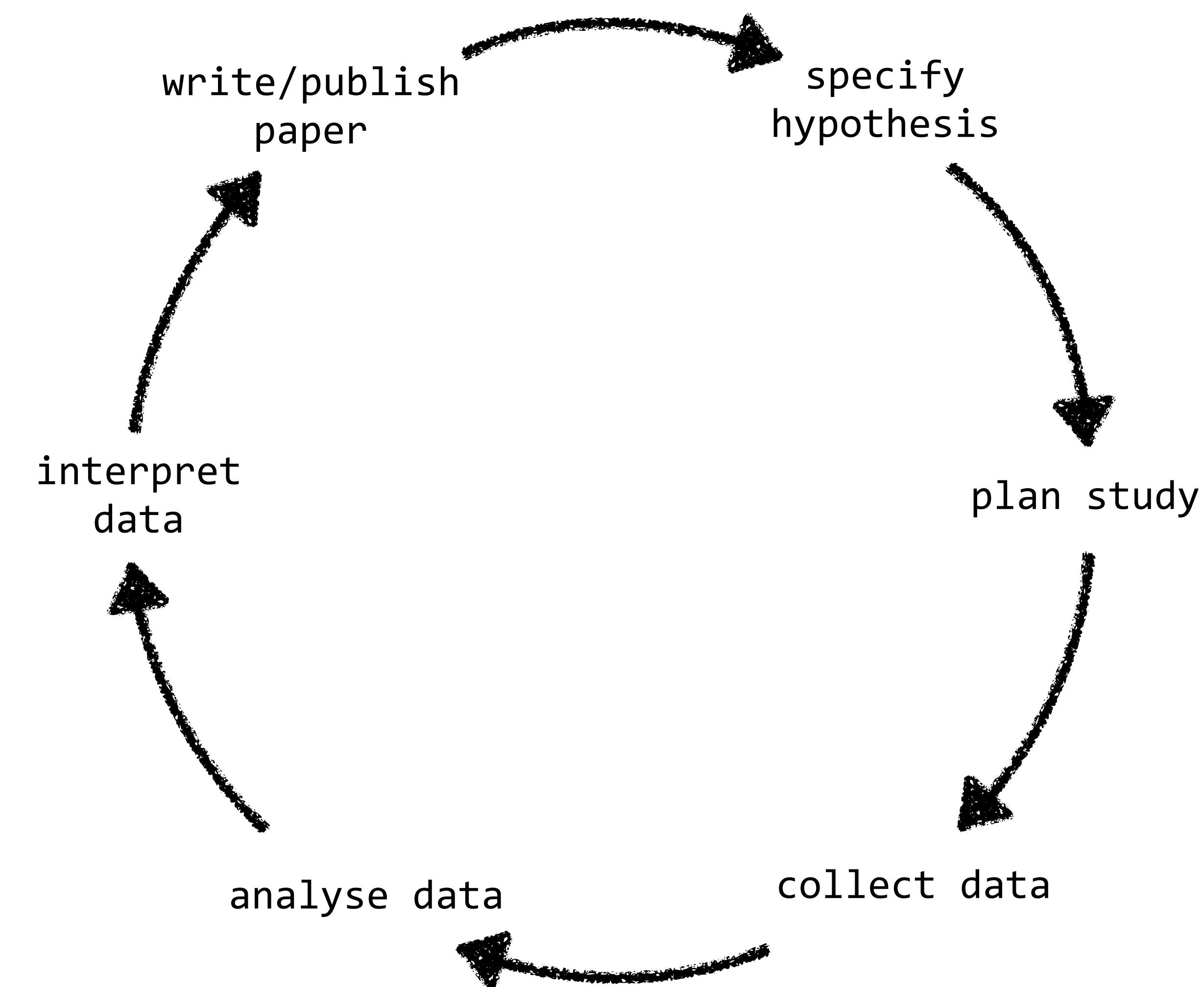
**TED Ed**  
Lessons Worth  
Sharing

What's going to happen tonight?

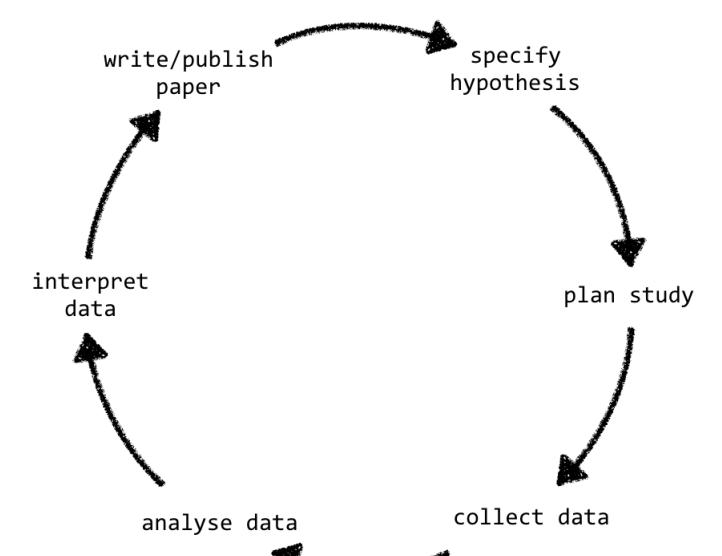
18.15 - 18.55 Scientific Method, Who are you?  
19.05 - 19.45 The problems + The catalysts  
20.05 - 20.45 The solutions  
20.55 - 21.35 Your OSF account  
Open Questions  
Where to go from here

How does  
[consumer | empirical]  
science work?

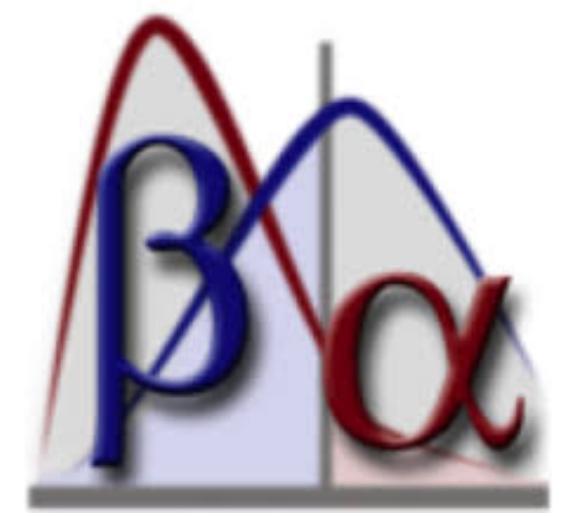
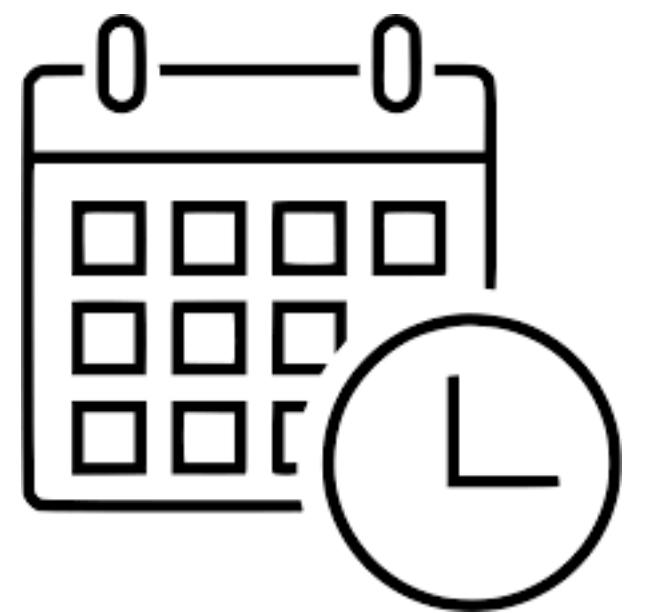
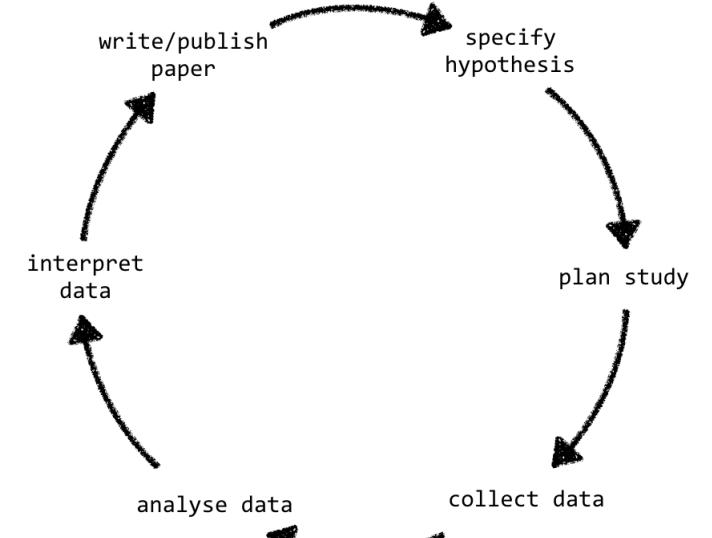
# The scientific method



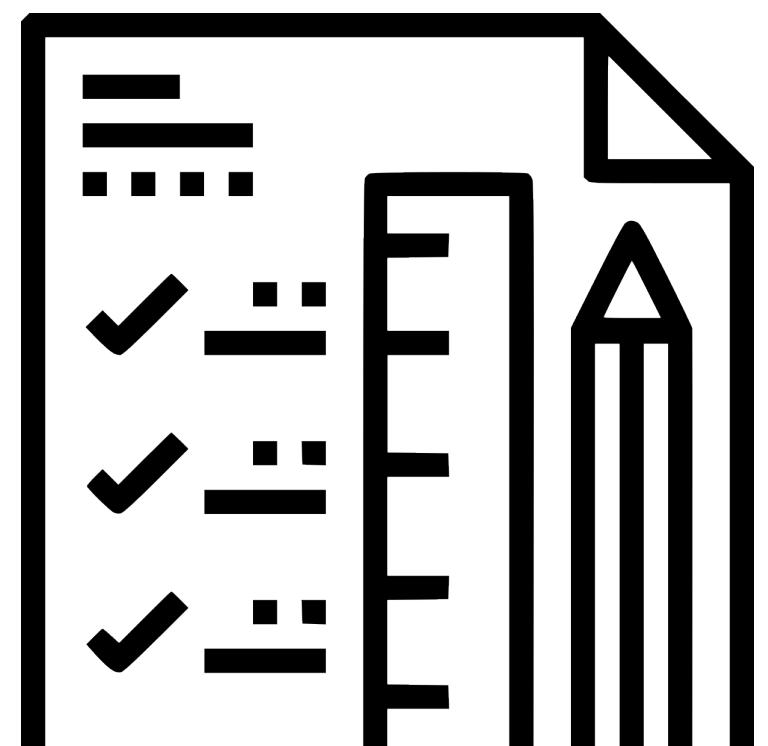
# Specify hypothesis



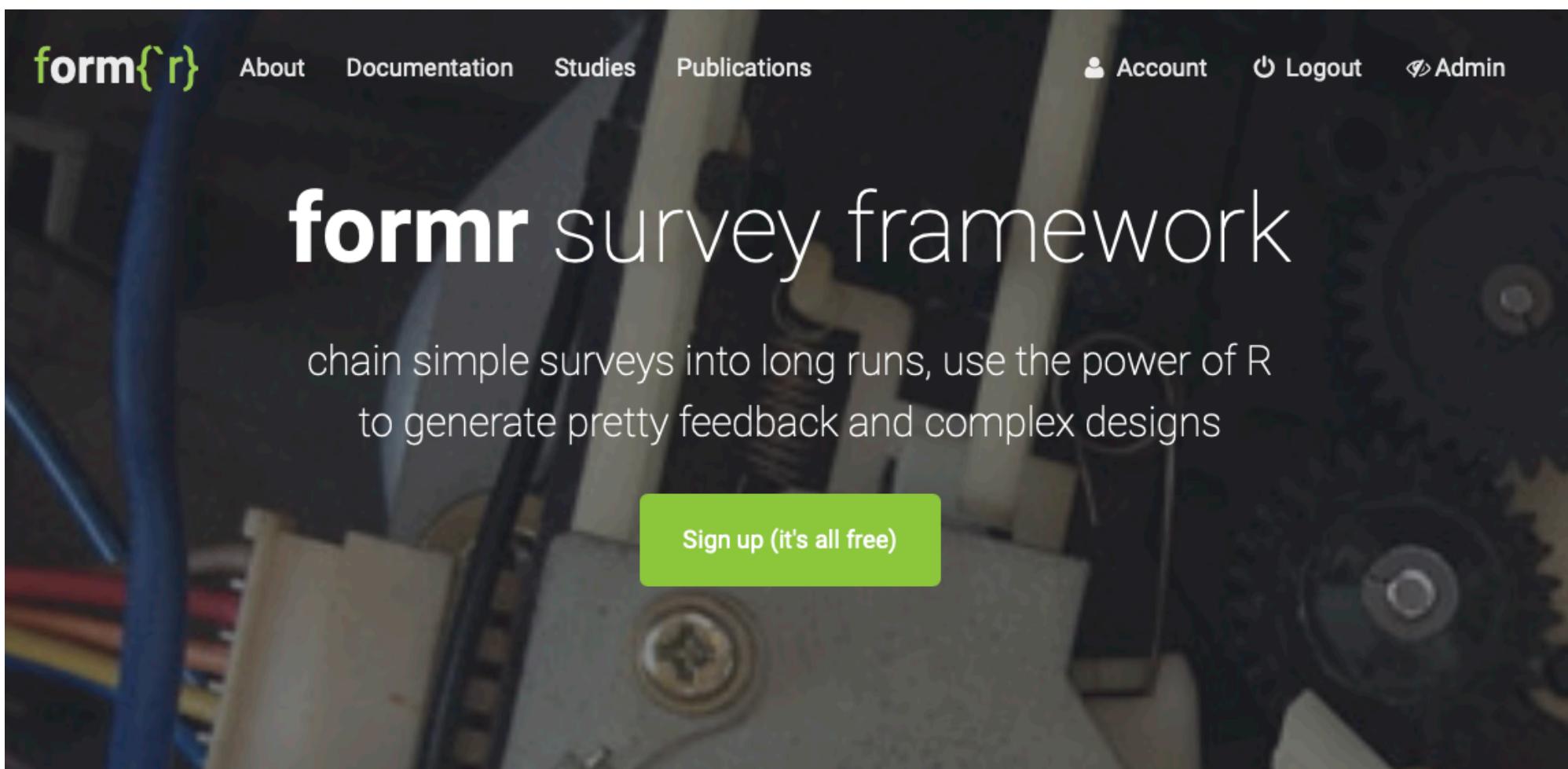
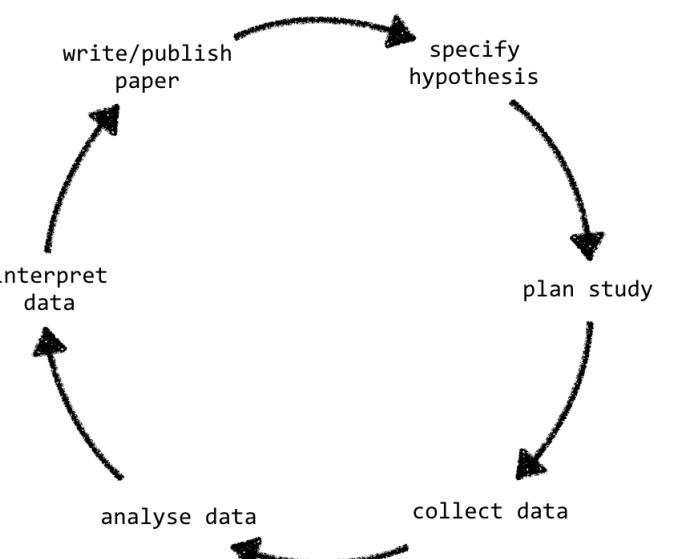
# Plan study



G\*Power  
pwr-package



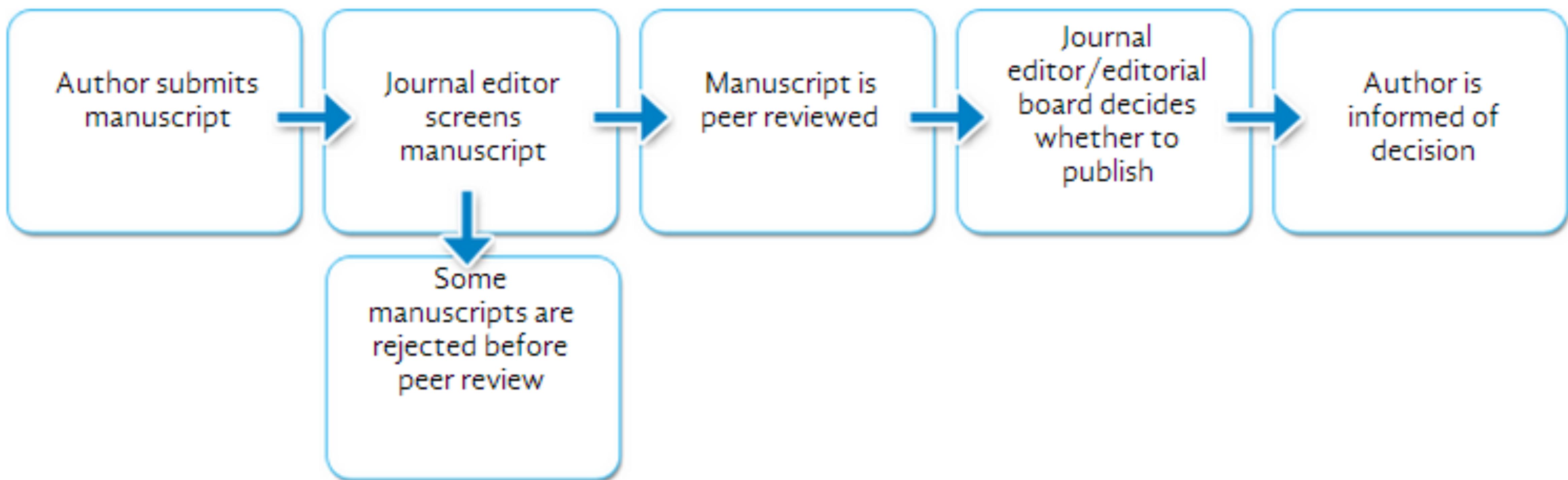
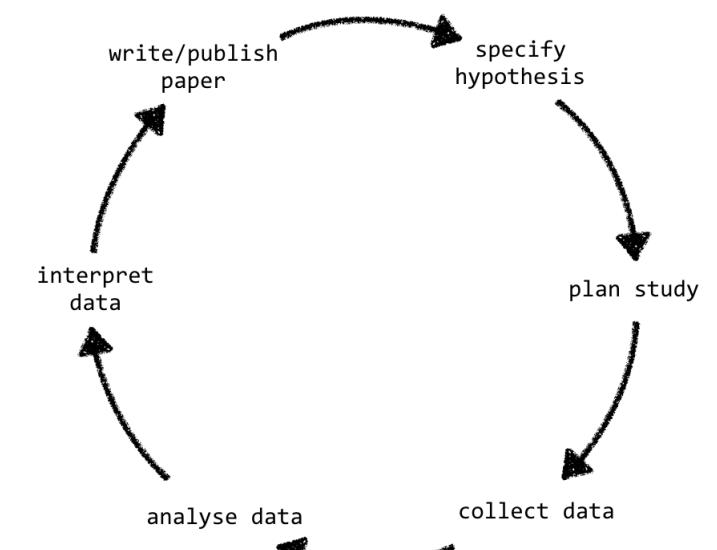
# Collect / Analyse / Interpret data



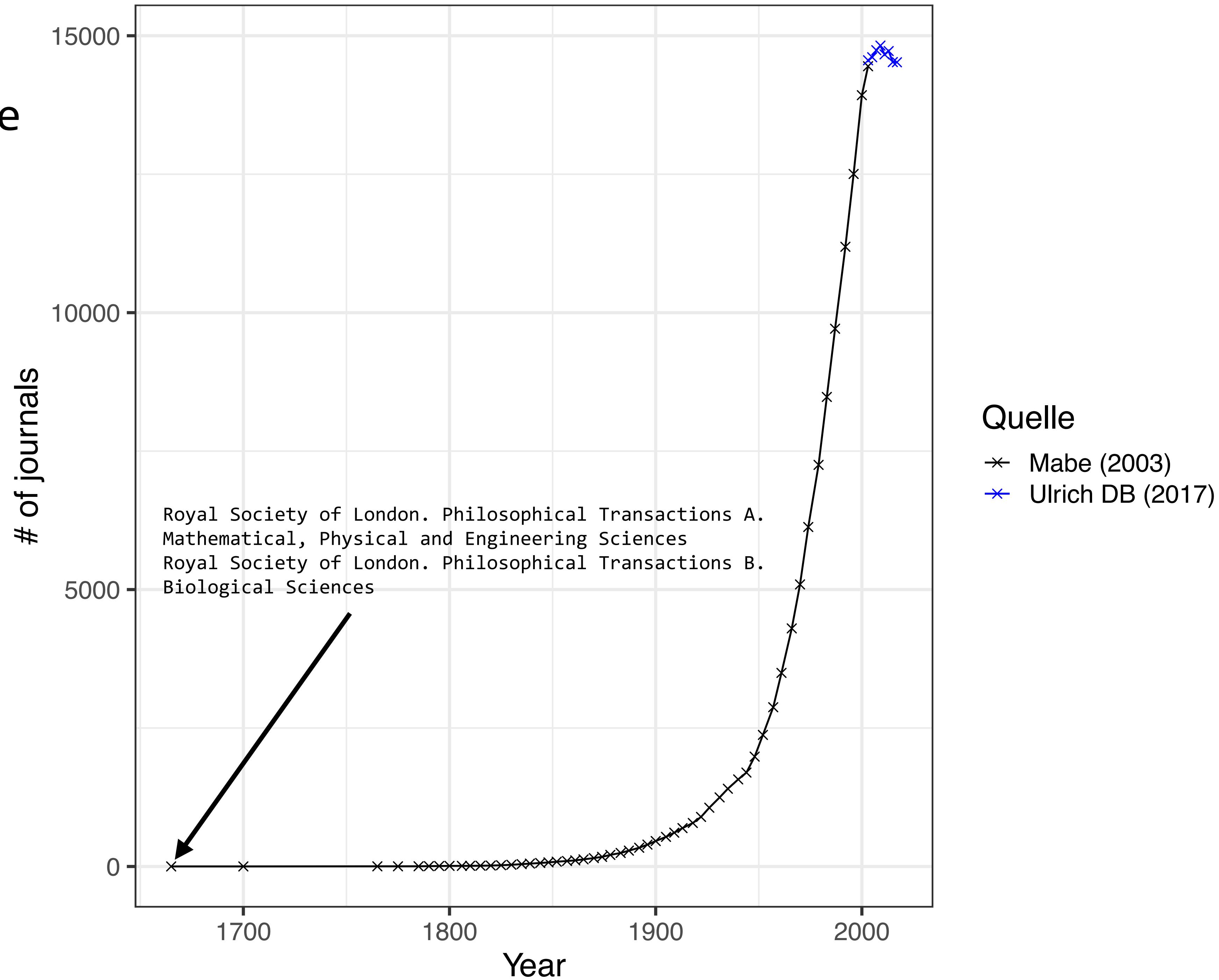
 **JASP**  
Stats.  
Open.  
Now.

**jamovi**

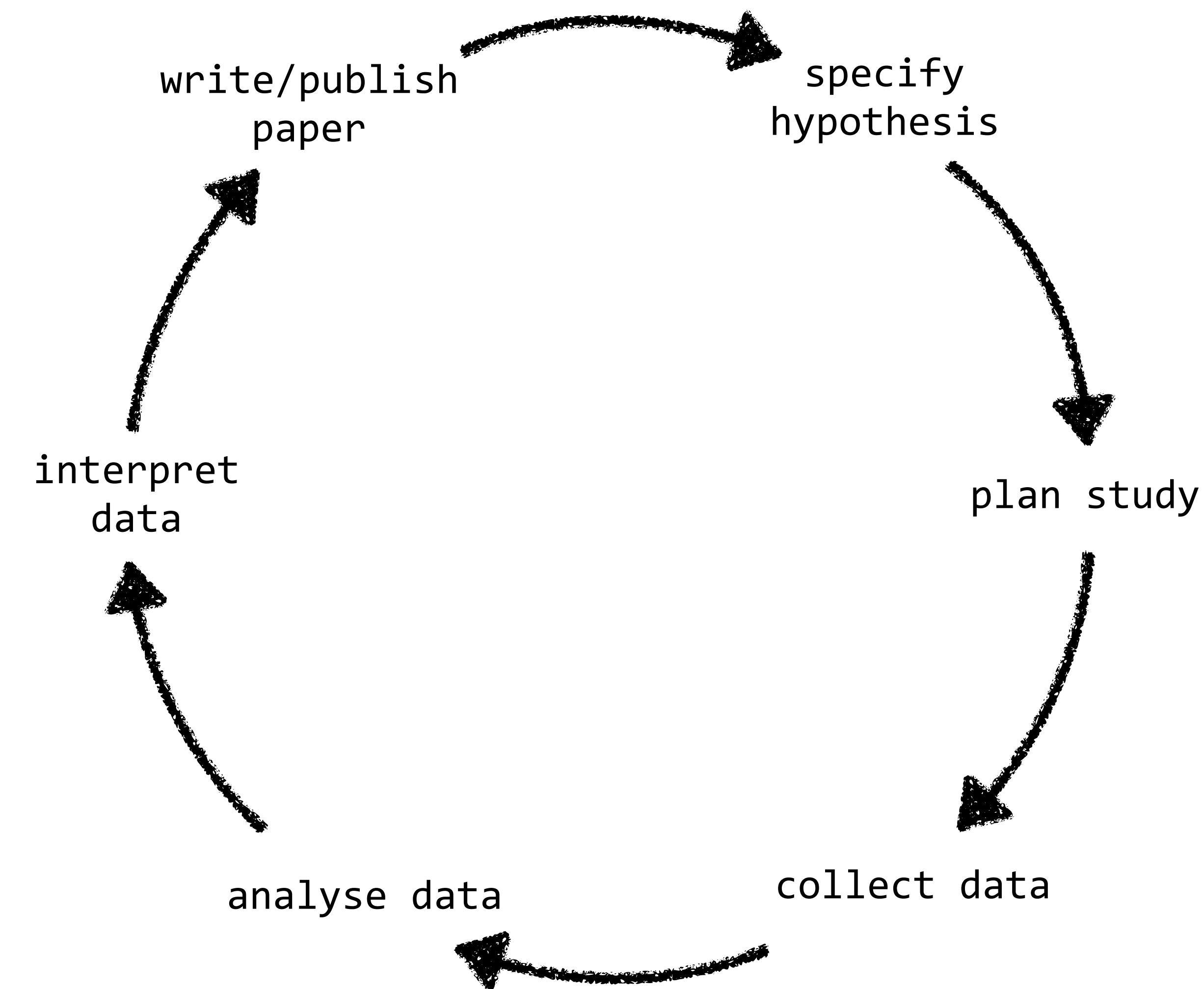
# Publication process

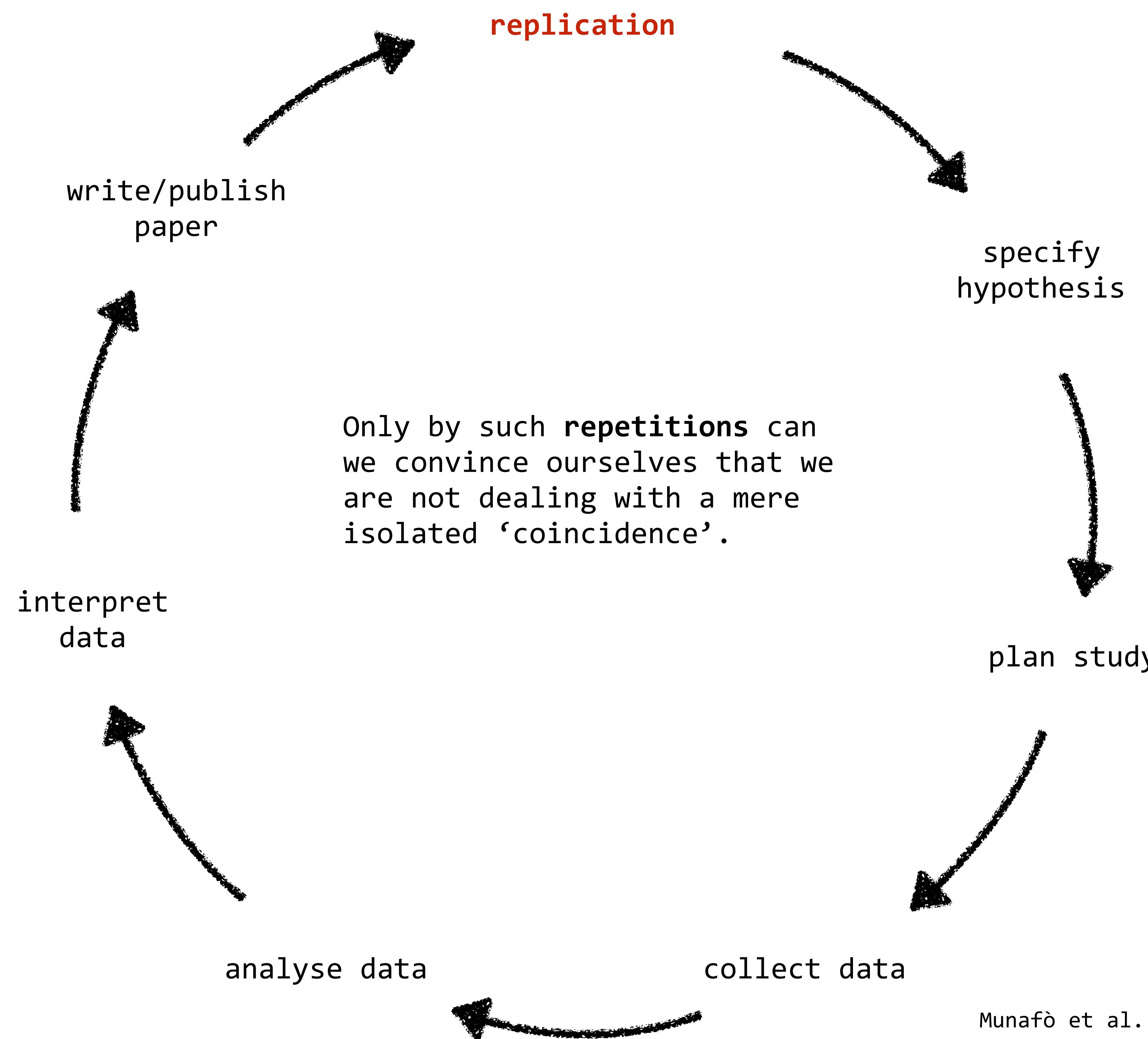


# Currency of science



# The scientific method





# Who are you?

Main study subject

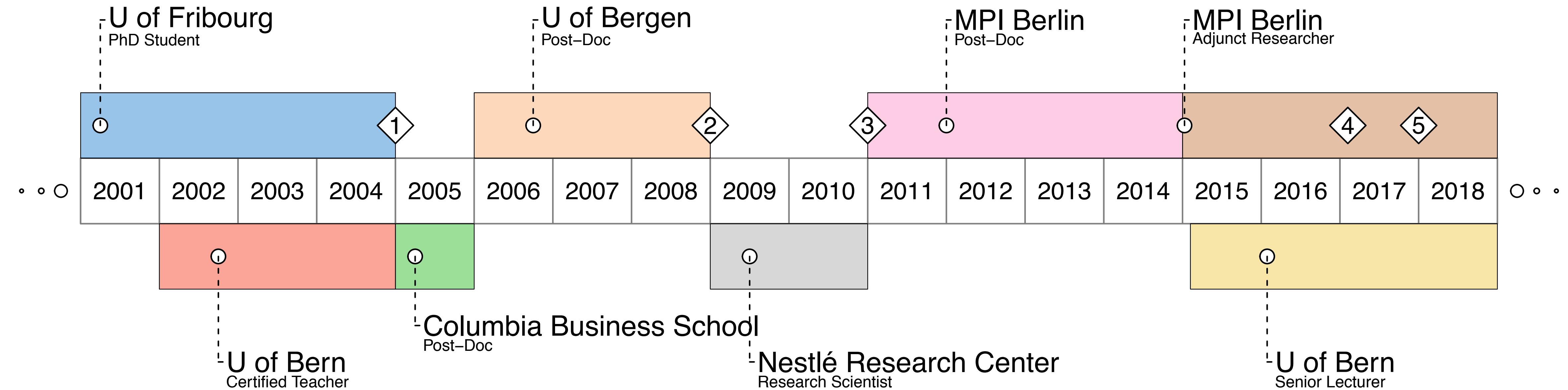
What keeps you up at night? (1 sentence - elevator talk)

R or SPSS?

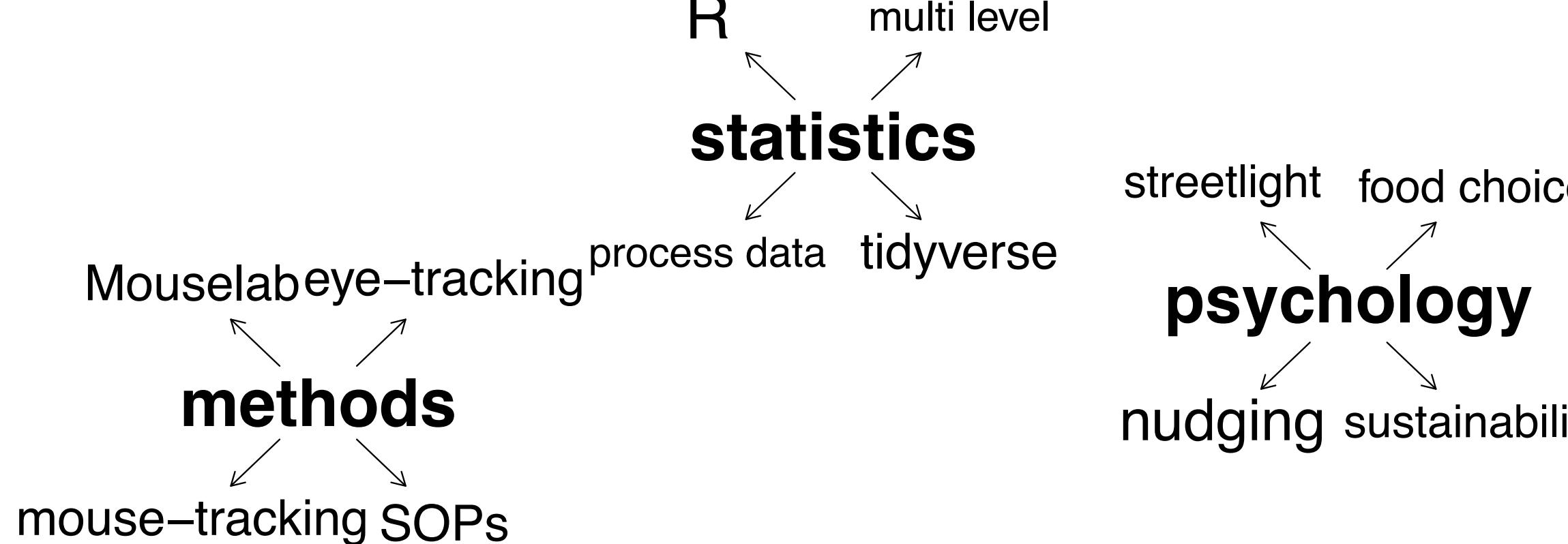
Beer or Wine?

Favourite band? (current or past)

# Appointments



# Teaching Interests | Milestones



- 1 PhD in Cognitive Science
- 2 Industrial Consumer Behavior Research
- 3 Handbook of Process Tracing Methods for Decision Research
- 4 Process tracing methods in decision making: On growing up in the 70ties. Current Directions in Psychological Science
- 5 PD in Business Administration

# Overview

- **The problem**  
Why most of published research findings are false.
- **The catalysts**  
Questionable Research Practices  
Fraud
- **More bad news: replication failures**  
Business  
Psychology
- **The solutions**  
Registered Replication Report  
Pre-Registration  
Standards  
Open Science ([osf.io](https://osf.io))  
Theory

# Is most published research false?

## Essay

# Why Most Published Research Findings Are False

John P. A. Ioannidis

### Summary

There is increasing concern that most current published research findings are false. The probability that a research claim is true may depend on study power and bias, the number of other studies on the same question, and, importantly, the ratio of true to no relationships among the relationships probed in each scientific field. In this framework, a research finding is less likely to be true when the studies conducted in a field are smaller; when effect sizes are smaller; when there is a greater number and lesser preselection of tested relationships; where there is greater flexibility in designs, definitions, outcomes, and analytical modes; when there is greater financial and other interest and prejudice; and when more teams are involved in a scientific field in chase of statistical significance. Simulations show that for most study designs and settings, it is more likely for a research claim to be false than true. Moreover, for many current scientific fields, claimed research findings may often be simply accurate measures of the prevailing bias. In this essay, I discuss the implications of these problems for the conduct and interpretation of research.

Published research findings are sometimes refuted by subsequent evidence, with ensuing confusion and disappointment. Refutation and controversy is seen across the range of research designs, from clinical trials and traditional epidemiological studies [1–3] to the most modern molecular research [4,5]. There is increasing concern that in modern research, false findings may be the majority or even the vast majority of published research claims [6–8]. However, this should not be surprising. It can be proven that most claimed research findings are false. Here I will examine the key

The Essay section contains opinion pieces on topics of broad interest to a general medical audience.

factors that influence this problem and some corollaries thereof.

### Modeling the Framework for False Positive Findings

Several methodologists have pointed out [9–11] that the high rate of nonreplication (lack of confirmation) of research discoveries is a consequence of the convenient, yet ill-founded strategy of claiming conclusive research findings solely on the basis of a single study assessed by formal statistical significance, typically for a *p*-value less than 0.05. Research is not most appropriately represented and summarized by *p*-values, but, unfortunately, there is a widespread notion that medical research articles

### It can be proven that most claimed research findings are false.

should be interpreted based only on *p*-values. Research findings are defined here as any relationship reaching formal statistical significance, e.g., effective interventions, informative predictors, risk factors, or associations. “Negative” research is also very useful. “Negative” is actually a misnomer, and the misinterpretation is widespread. However, here we will target relationships that investigators claim exist, rather than null findings.

As has been shown previously, the probability that a research finding is indeed true depends on the prior probability of it being true (before doing the study), the statistical power of the study, and the level of statistical significance [10,11]. Consider a 2 × 2 table in which research findings are compared against the gold standard of true relationships in a scientific field. In a research field both true and false hypotheses can be made about the presence of relationships. Let *R* be the ratio of the number of “true relationships” to “no relationships” among those tested in the field. *R*

is characteristic of the field and can vary a lot depending on whether the field targets highly likely relationships or searches for only one or a few true relationships among thousands and millions of hypotheses that may be postulated. Let us also consider, for computational simplicity, circumscribed fields where either there is only one true relationship (among many that can be hypothesized) or the power is similar to find any of the several existing true relationships. The pre-study probability of a relationship being true is  $R/(R + 1)$ . The probability of a study finding a true relationship reflects the power  $1 - \beta$  (one minus the Type II error rate). The probability of claiming a relationship when none truly exists reflects the Type I error rate,  $\alpha$ . Assuming that *c* relationships are being probed in the field, the expected values of the 2 × 2 table are given in Table 1. After a research finding has been claimed based on achieving formal statistical significance, the post-study probability that it is true is the positive predictive value, PPV. The PPV is also the complementary probability of what Wacholder et al. have called the false positive report probability [10]. According to the 2 × 2 table, one gets  $PPV = (1 - \beta)R/(R - \beta R + \alpha)$ . A research finding is thus

**Citation:** Ioannidis JPA (2005) Why most published research findings are false. PLoS Med 2(8):e124.

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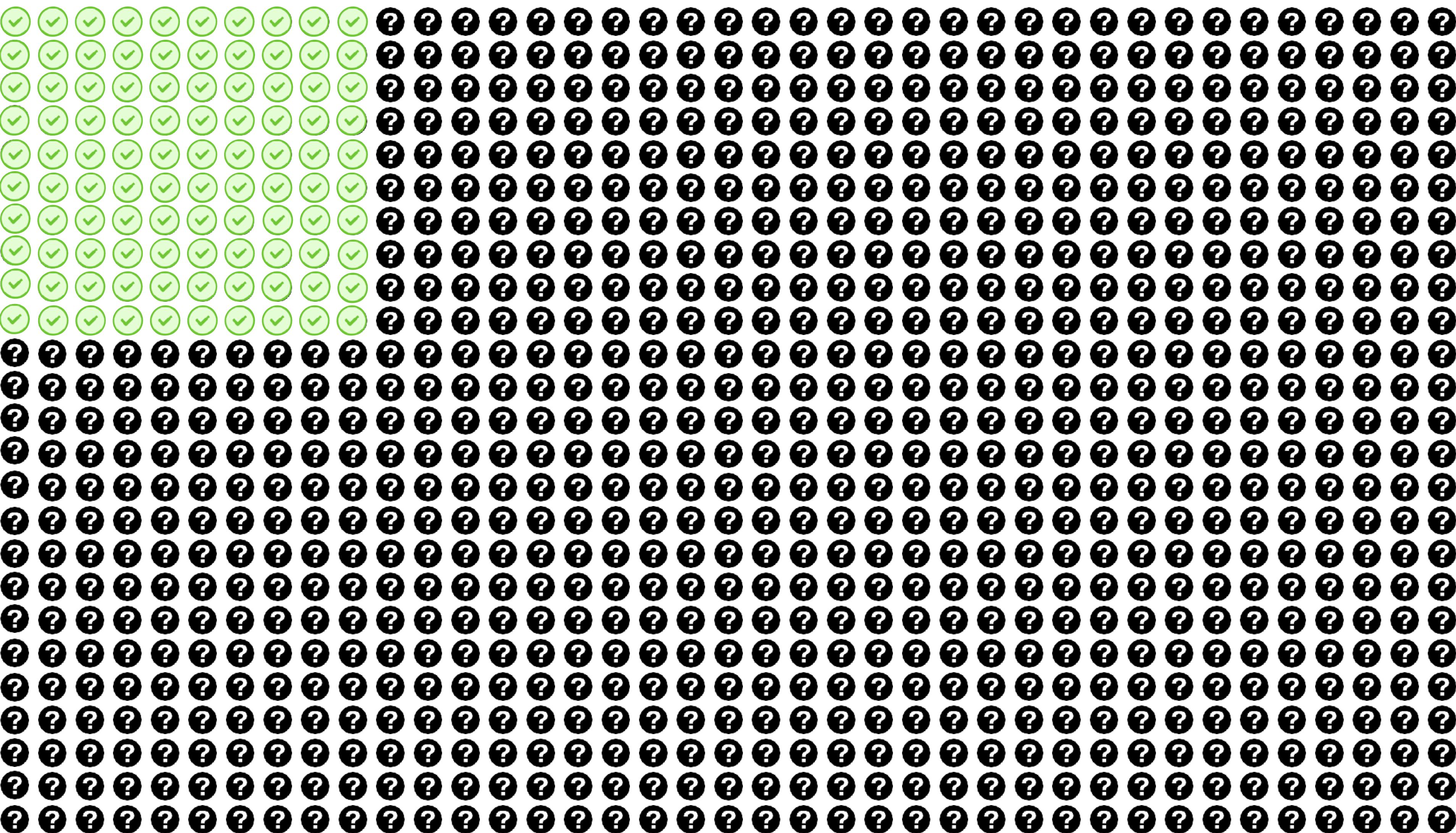
**Abbreviation:** PPV, positive predictive value

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**Competing Interests:** The author has declared that no competing interests exist.

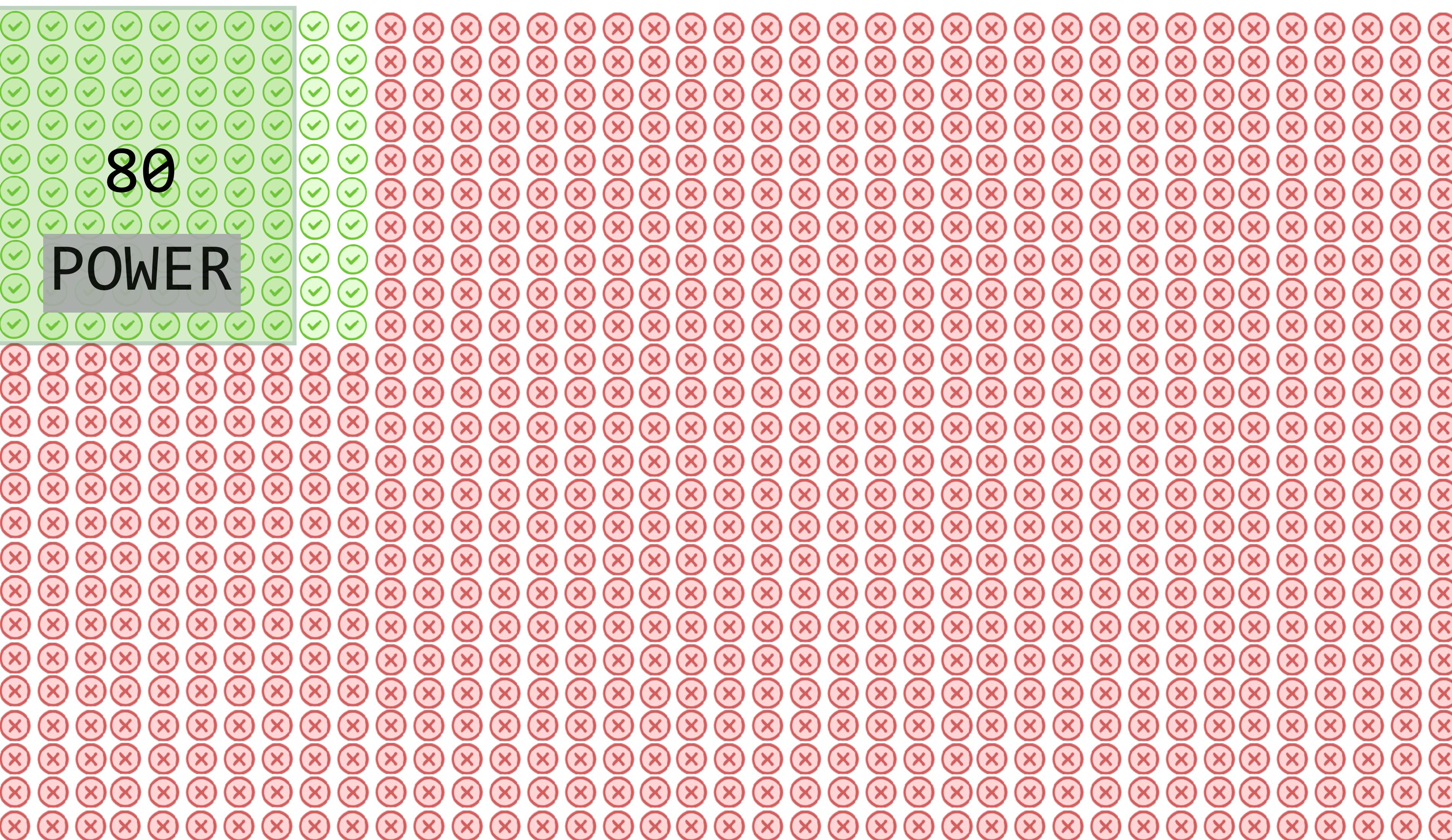
**DOI:** 10.1371/journal.pmed.0020124

100



100

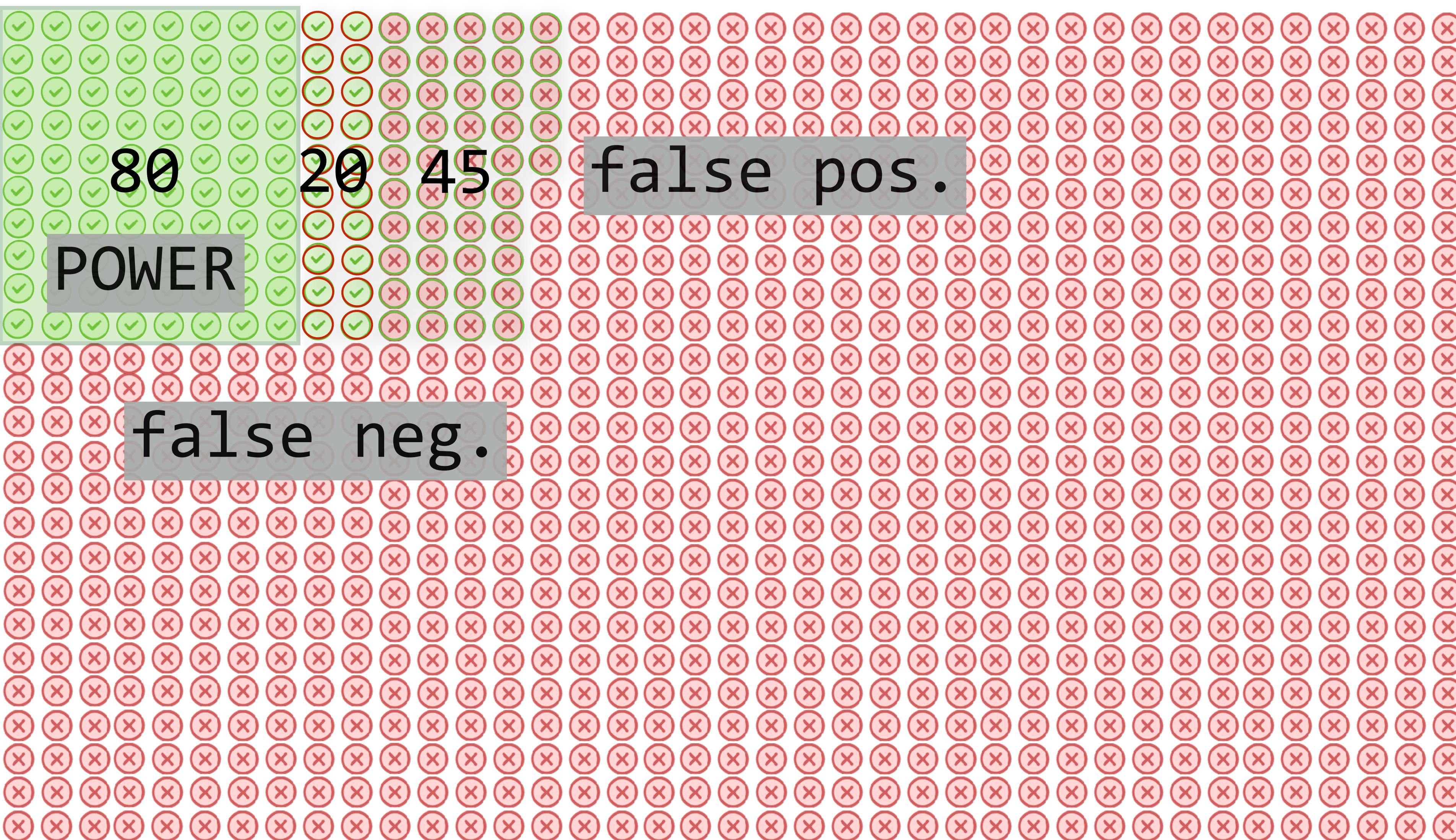
900



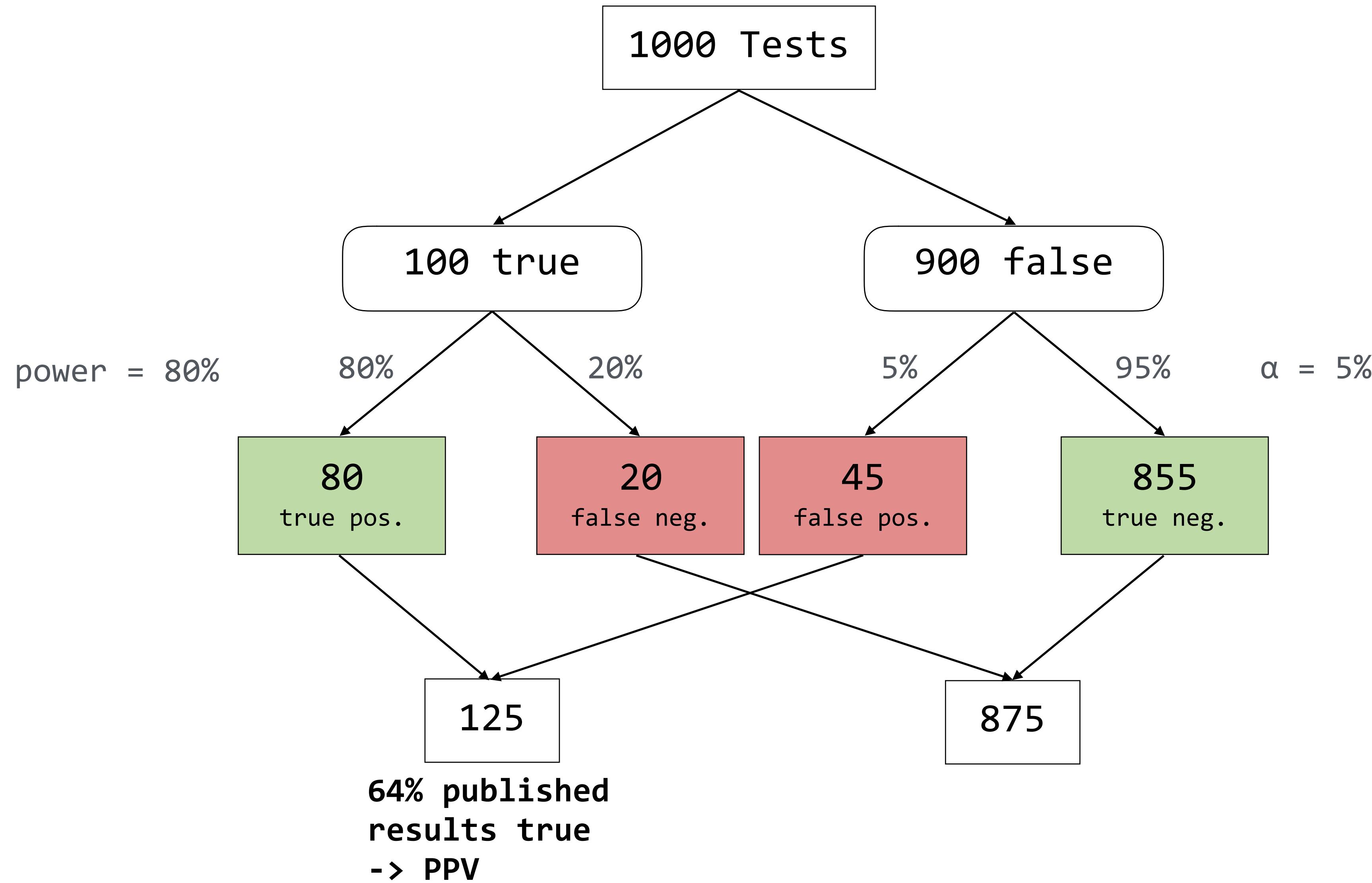
State of the world

100

900



# ~ optimal circumstances!



How are circumstances?

# The catalysts

Questionable Research Practices  
(QRPs)

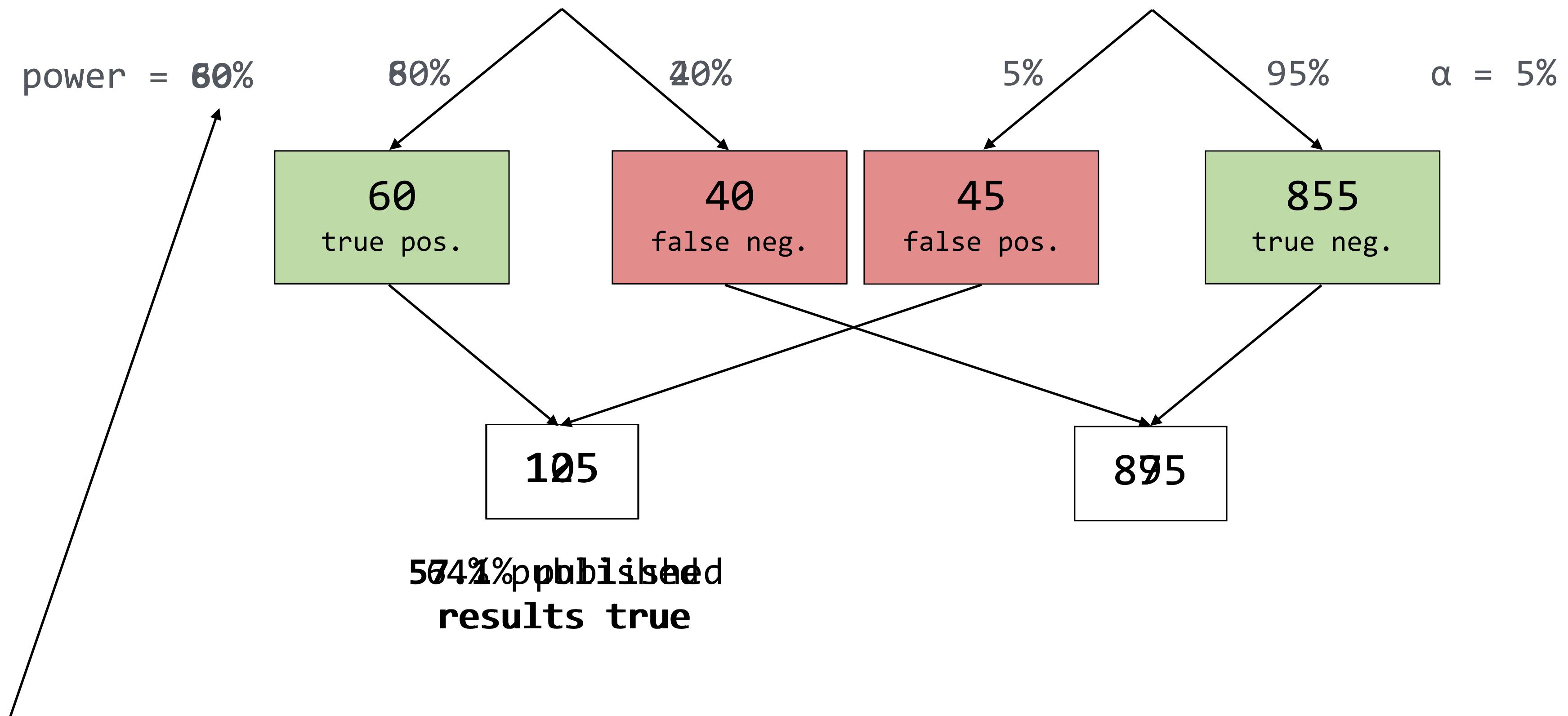
Fraud

# Questionable Research Practices (QRP)



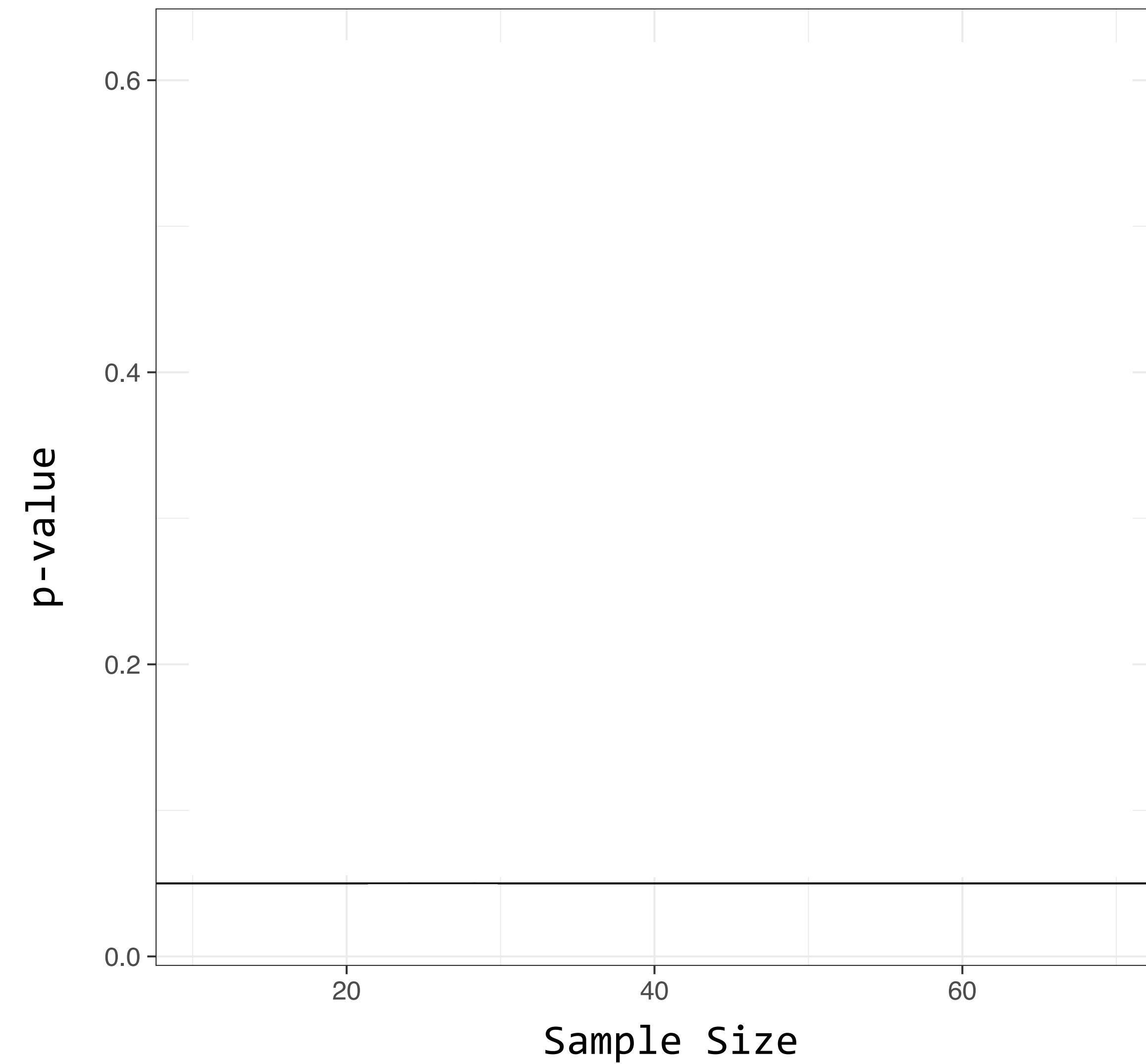
low power  
optional stopping  
positive results  
HARKing  
cherry picking  
p-hacking

# QRP 1: Low Power

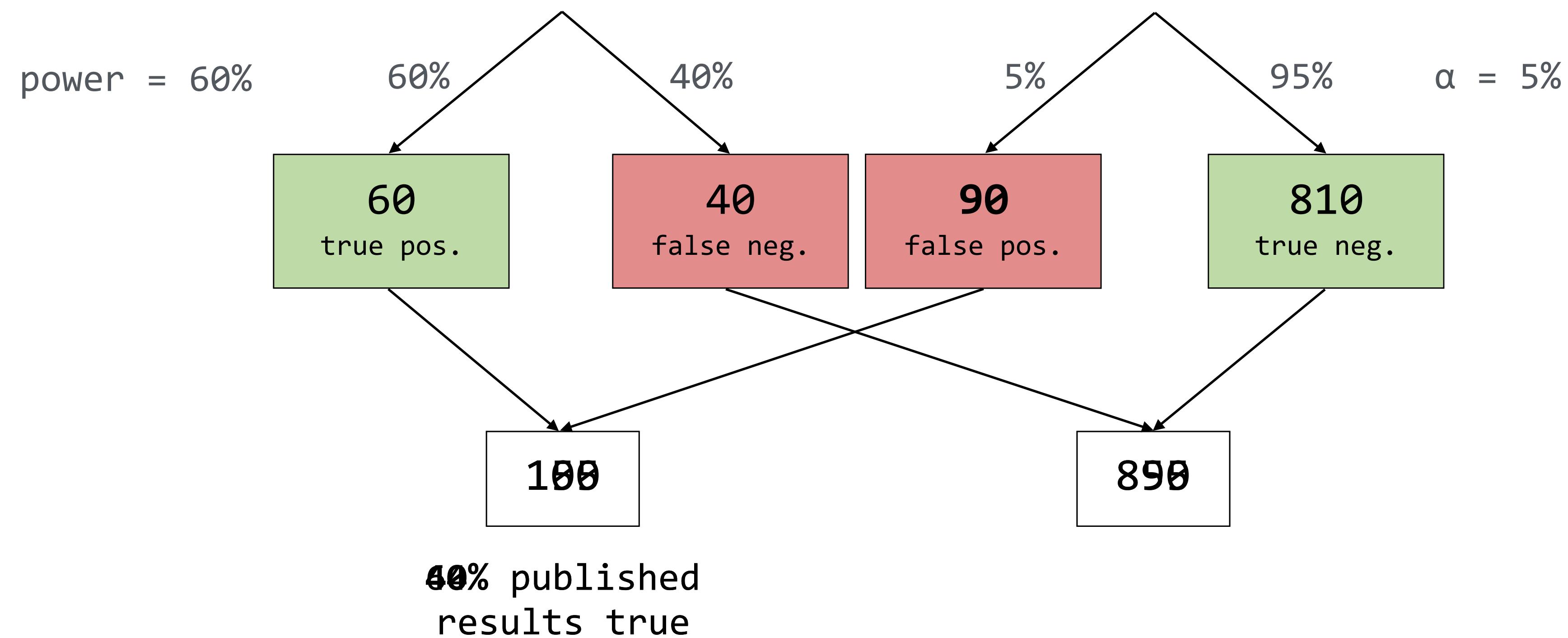


Strategic Management Journal  
Management International Review  
Academy of Management Journal  
Journal of International Business Studies  
Journal of Marketing Research

QRP 2: Let's add another 10 participants



## QRP 2: Researcher's degrees of freedom



## QRP 3: Positive results

# ACCENTUATE THE POSITIVE

A literature analysis across disciplines reveals a tendency to publish only ‘positive’ studies — those that support the tested hypothesis. Psychiatry and psychology are the worst offenders.



PHYSICAL



BIOLOGICAL



SOCIAL

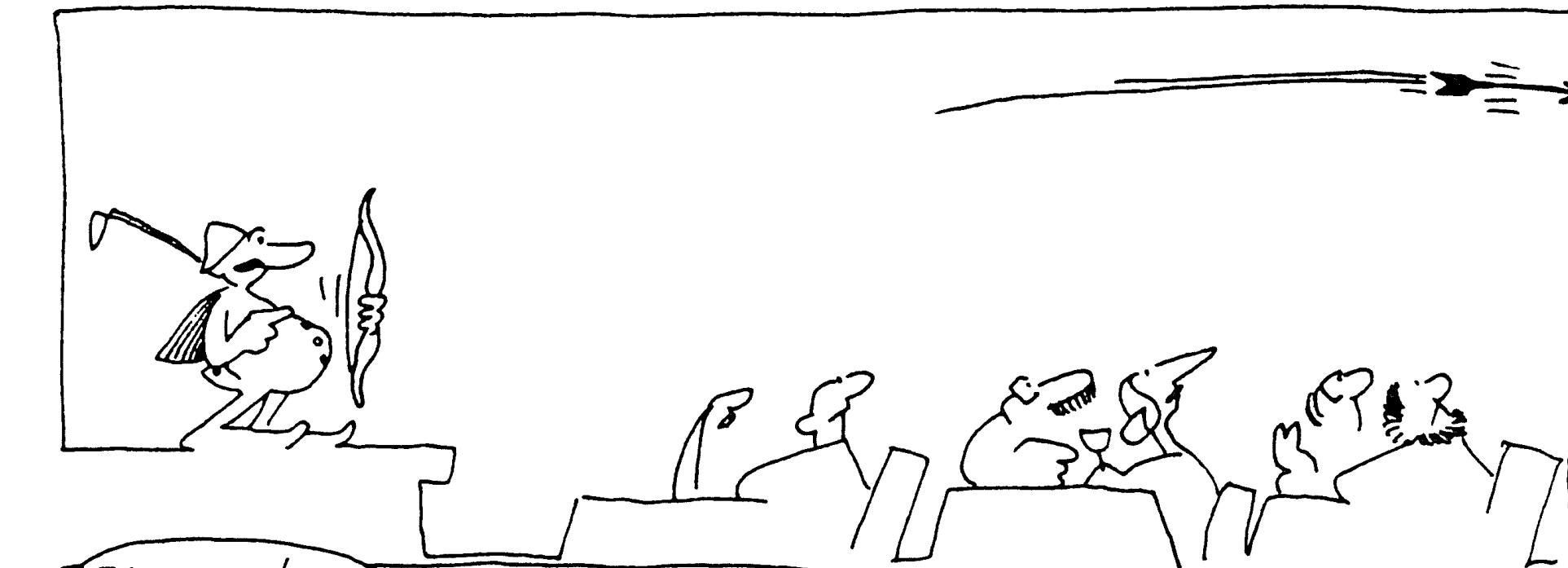
Space sciences  
Geosciences  
Environment/Ecology  
Plant and animal sciences  
Computer science  
Physics  
Neuroscience and behaviour  
Microbiology  
Chemistry  
Social sciences  
Immunology  
Molecular biology and genetics  
Economics and business  
Biology and biochemistry  
Clinical medicine  
Pharmacology and toxicology  
Materials science  
Psychiatry/psychology

50% | 60% | 70% | 80% | 90%

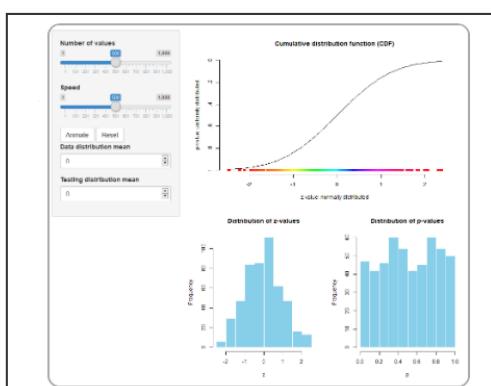
Proportion of papers supporting  
tested hypothesis

## QRP 4: HARKing

Hypothesizing  
After the Results  
are Known



# QRP 5: Let's do some p-hacking!



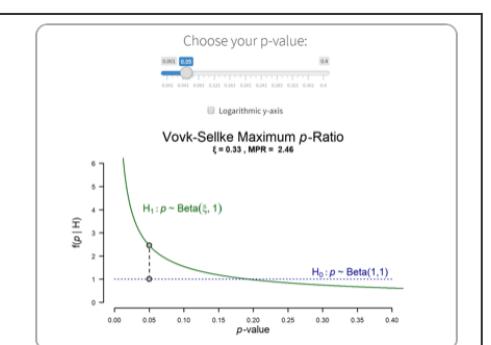
From z to p: A visualization of the link between the two distributions

by Sven Hilbert

[p-value](#)

[plot](#)

Ever wondered why p-values are uniformly distributed if the H<sub>0</sub> is accurate, even though the data are normally distributed? This animated app visualizes the connection of the two via the CDF and lets you explore the relationship between effect size and skewness of the distribution of p-values.



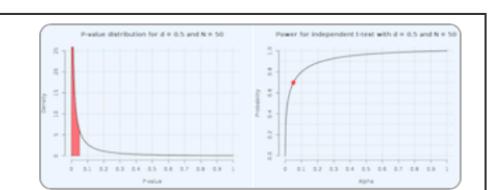
Exploring the diagnosticity of the p-value

by Erik-Jan van Kesteren and Eric-Jan Wagenmakers

[p-value](#)

[plot](#)

Explore the Vovk-Sellke Maximum p-Ratio, a measure that indicates the maximum diagnosticity of a given p-value. Choose your own p-value to find out how diagnostic it is for your research!



P-value distribution and power curves for an independent two-tailed t-test

by Daniel Lakens

[p-value](#)

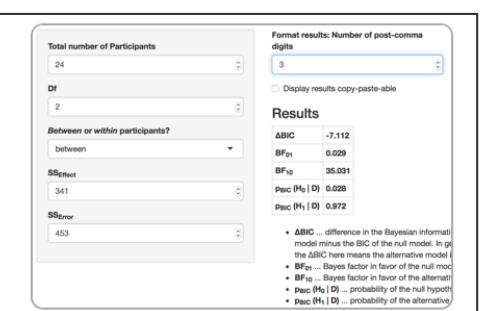
[power](#)

Plot the theoretical p-value distribution and power curve for an independent t-test based on the effect size, sample size, and alpha.

Univariate k-Means Clustering with elbow method  
by Jan Freyberg

[clustering](#)

Identify how many clusters your one-dimensional data can be grouped in and how much variance you can explain with these clusters by using the "elbow method".

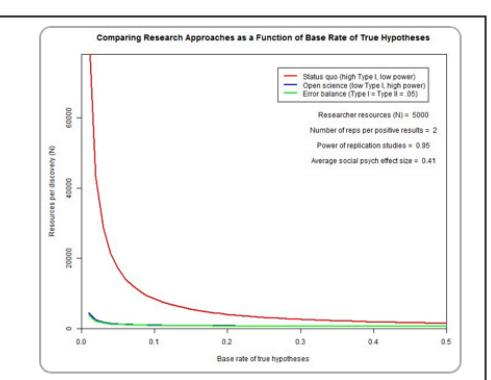


BIC approximation for ANOVA designs

by Christoph Huber-Huber

[Bayes](#)

Obtain a Bayesian interpretation of your ANOVA results with this app. You just need to enter your sum of squares and some information about your design.

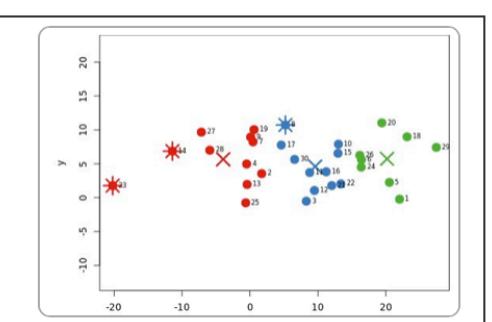


N per discovery

by Etienne LeBel

[paper](#)

App to explore the cost-

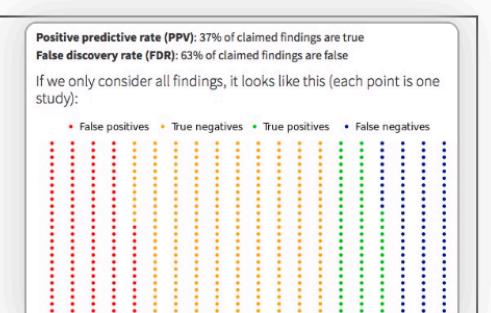


2D Outlier analysis

by Rajiv Shah

[outlier](#)

The app allows you to see the trade-offs on various types of



When does a significant p-value indicate a true effect?

by Michael Zehetleitner and Felix Schönbrodt

[teaching](#)

p-hacker: Train your p-hacking skills!

Manual

Technical Details

New study Now: p-hack!

Settings for initial data collection:

Name for experimental group  
Type in your favorite effect

Name for control group  
Control group

Initial # of participants in each group  
20

True effect (Cohen's d)  
0.5

Number of DVs  
4

Run new experiment  
(Discards previous data)

No study run yet - click on 'Run new experiment' at the bottom of the left panel!

Does coffee consumption  
improve cognitive  
functions?



# Let's run a study

## Settings for initial data collection:

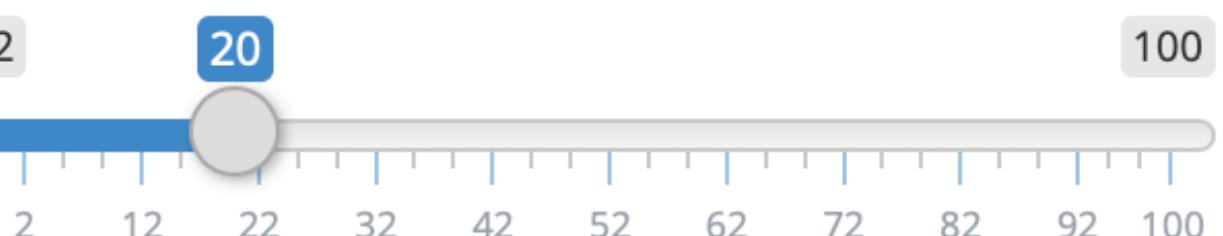
Name for experimental group

Coffee

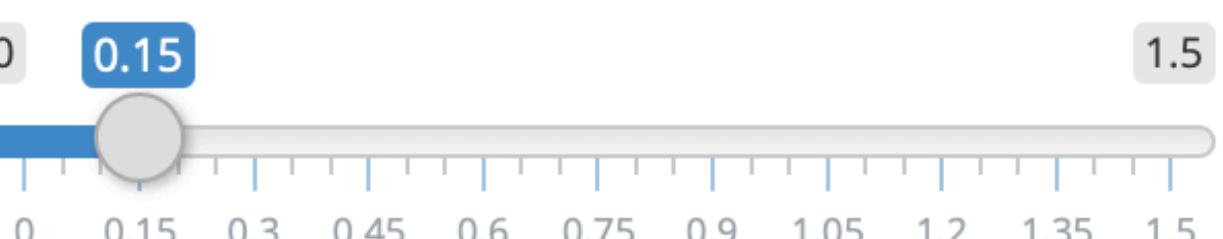
Name for control group

Control group

Initial # of participants in each group



True effect (Cohen's d)



Number of DVs



Run new experiment

(Discards previous data)

Use seed (automatically incremented)

30



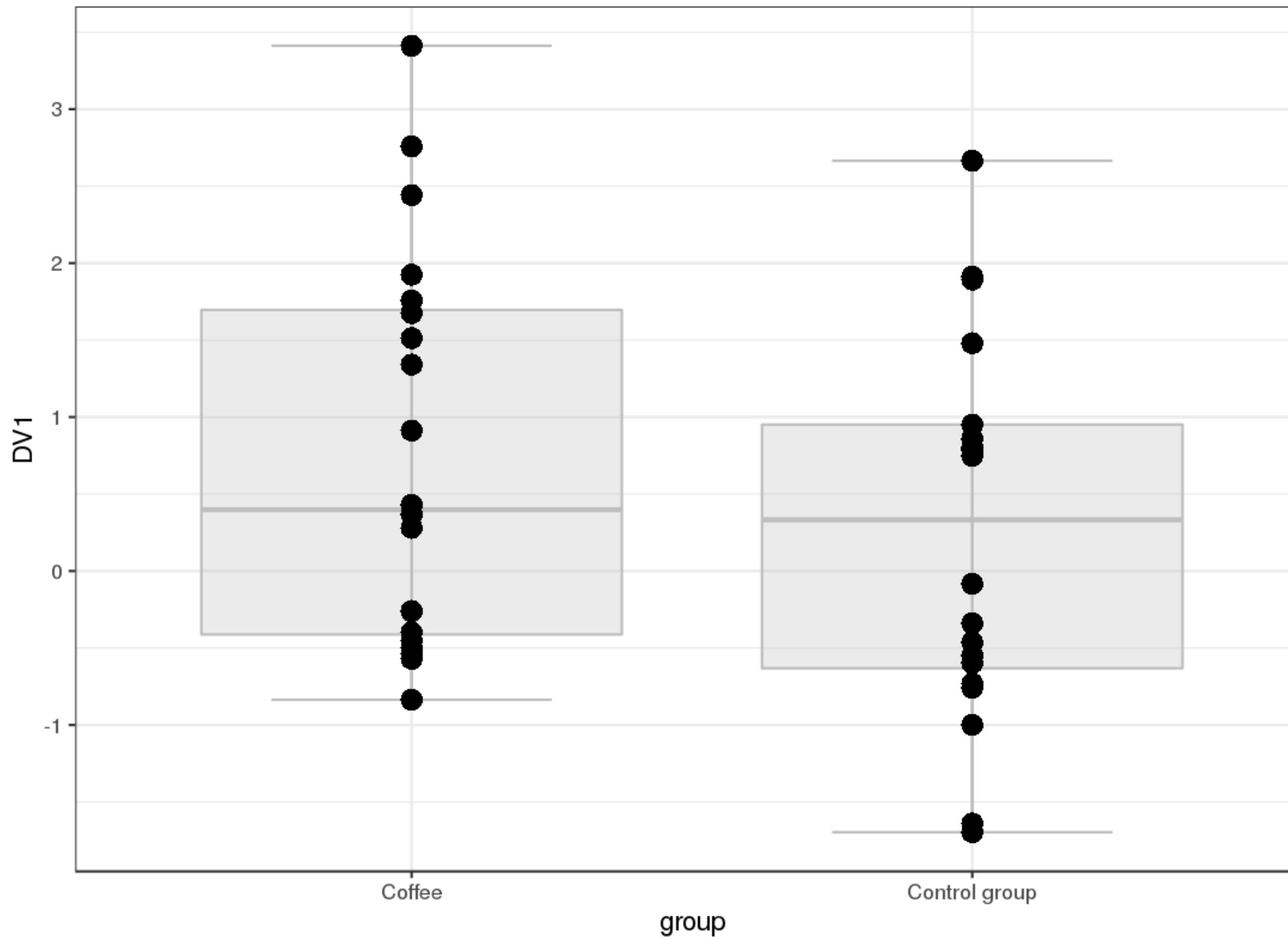
Remove some outliers!

## Scatterplot: Remove outliers! (full group)

Choose DV to plot

DV1

**Best DV is selected by default**



To Do...

# p-hack!



New study

Now: p-hack!

## Basic tools to improve your p-value:

- Control for SES
- Control for age
- Control for gender
- Interaction with gender

Add 5 new participants

Add 10 new participants

Unlock the expert feature: Subgroup analysis!

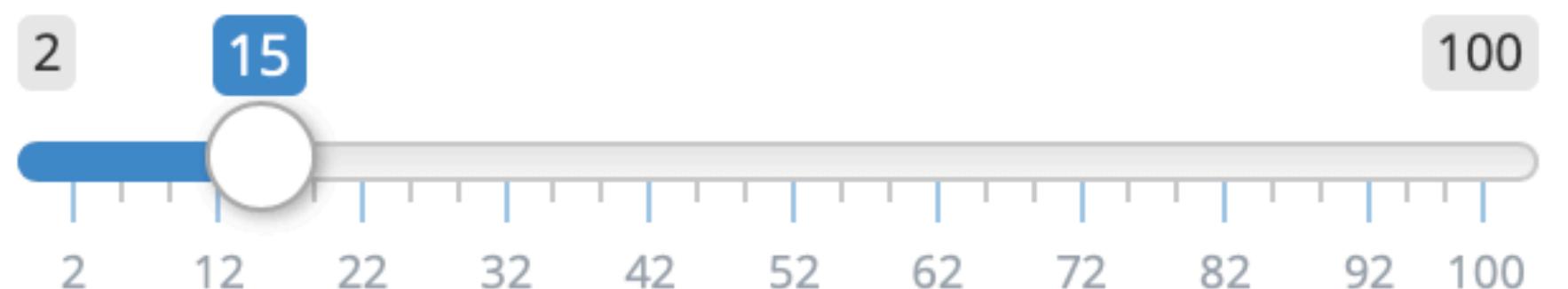
- Do an expert subgroup analysis

## Tests for each DV (full group)

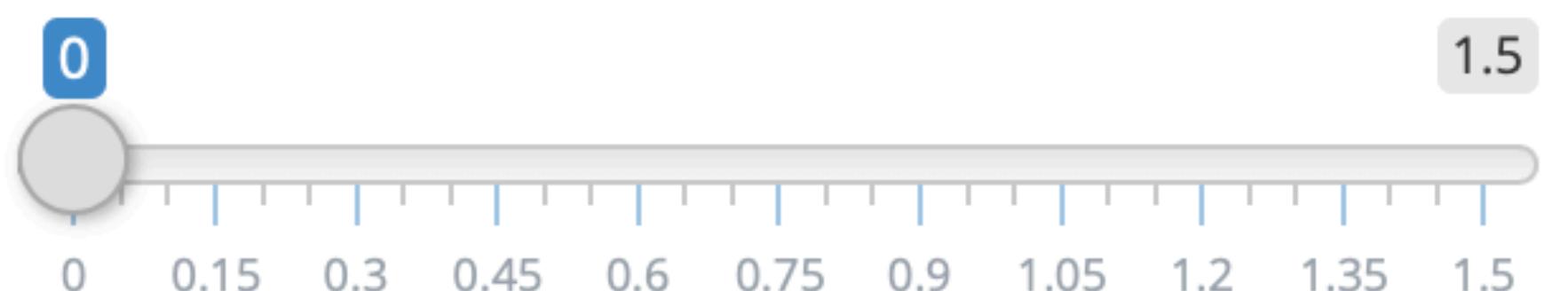
Name	N	Statistic	p-Value	Sign.	Actions
DV1	40	F(1, 38) = 1.54	p = .222	ns	<button>Save</button>
DV2	40	F(1, 38) = 0	p = .980	ns	<button>Save</button>
DV3	40	F(1, 38) = 0	p = .997	ns	<button>Save</button>
DV4	40	F(1, 38) = 0.18	p = .673	ns	<button>Save</button>
DV_all	40	F(1, 38) = 0.12	p = .732	ns	<button>Save</button>

## Bonus task

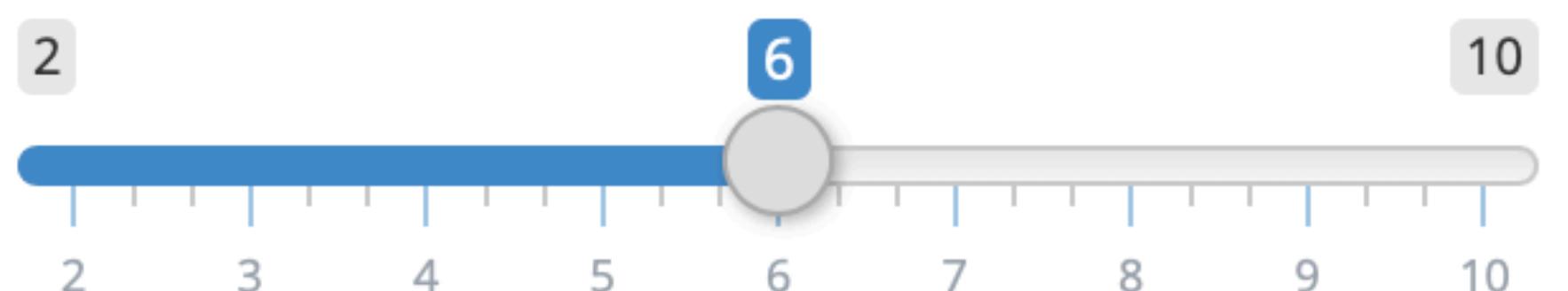
Initial # of participants in each group



True effect (Cohen's d)



Number of DVs

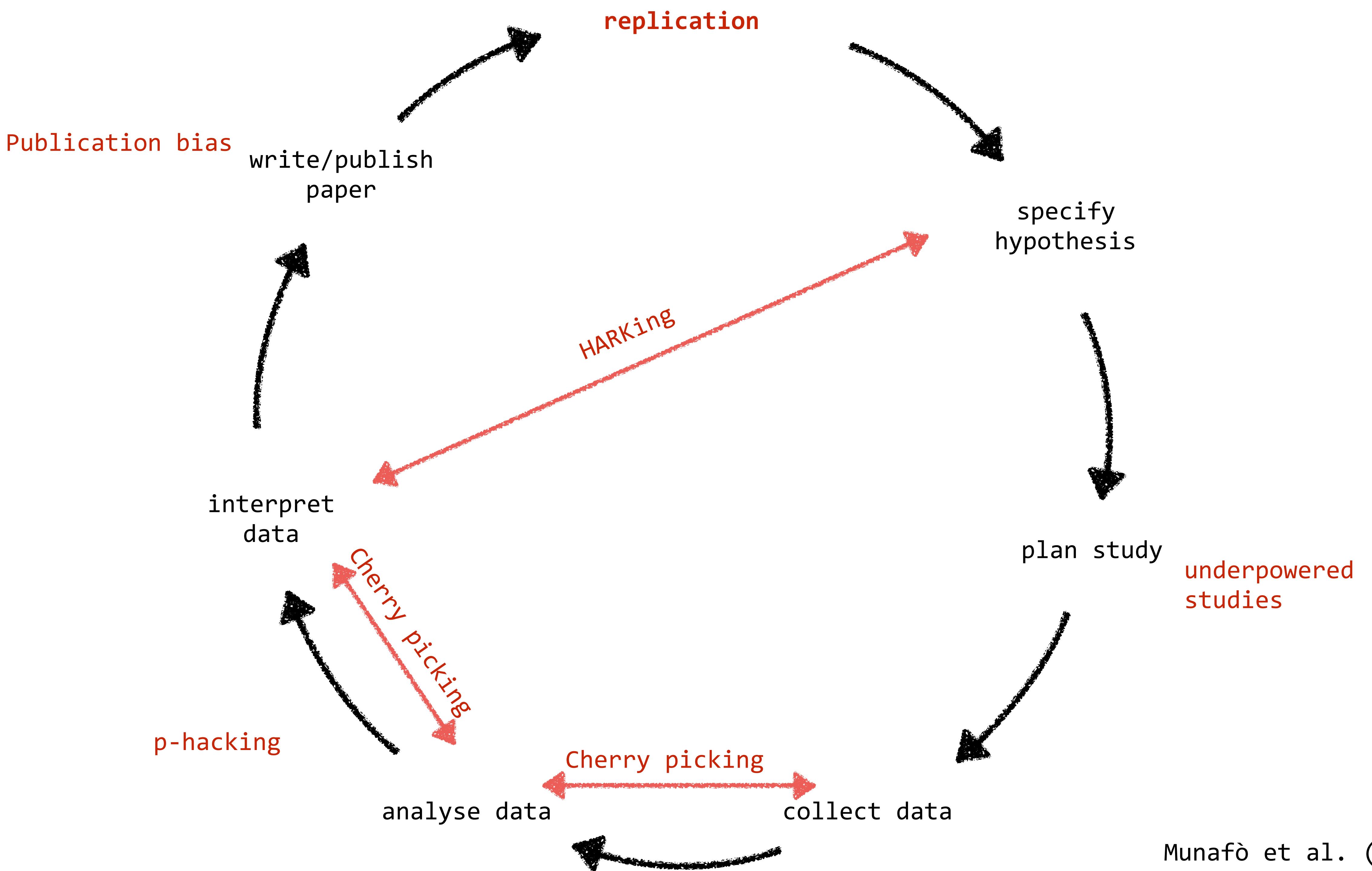


Run new experiment

(Discards previous data)

Use seed (automatically incremented)

30





## Report finds massive fraud at Dutch universities



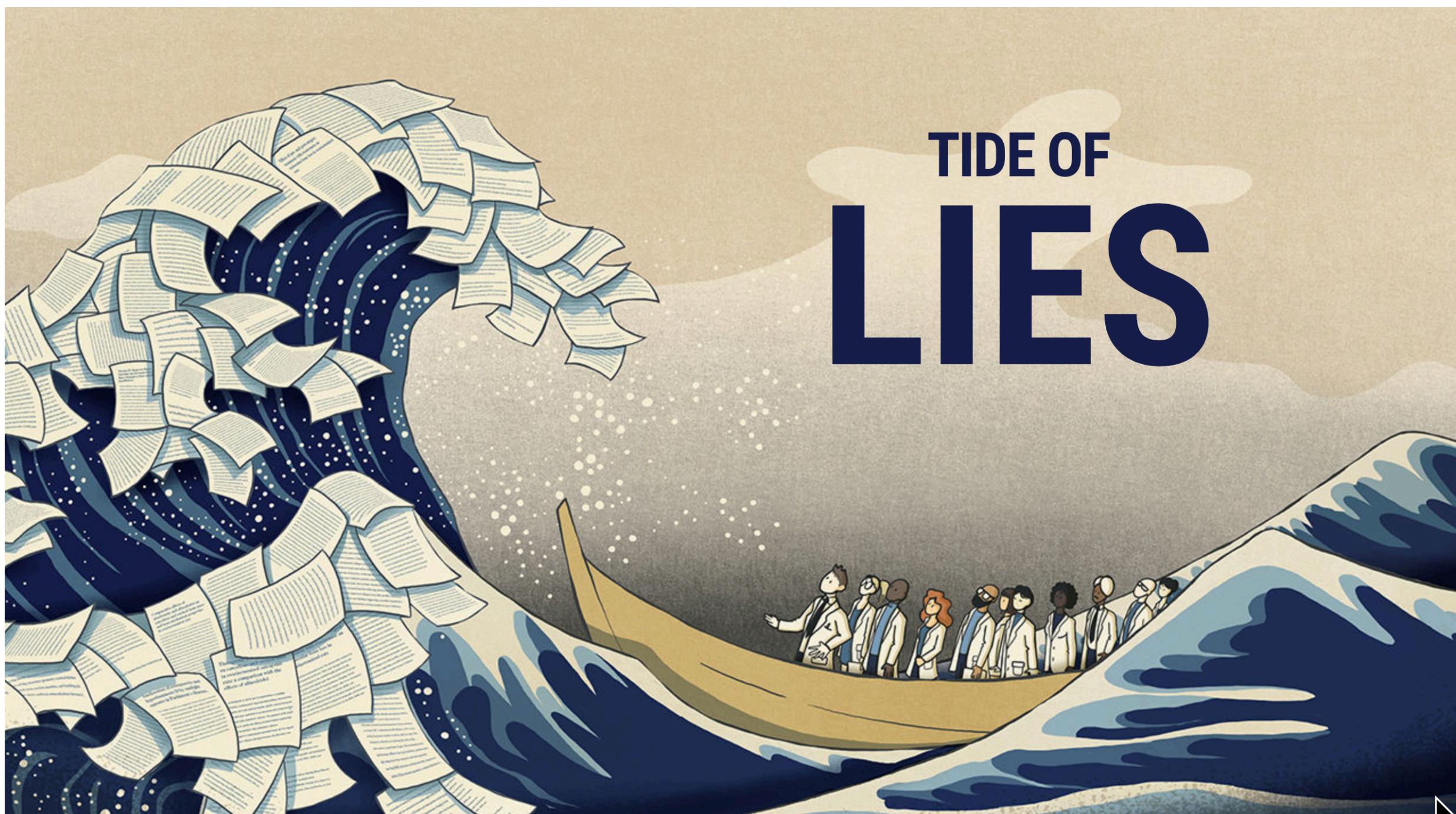
forged data in at least  
**55 published papers and**  
**10 dissertations**

Yoshihiro Sato

374 patients in 4 months

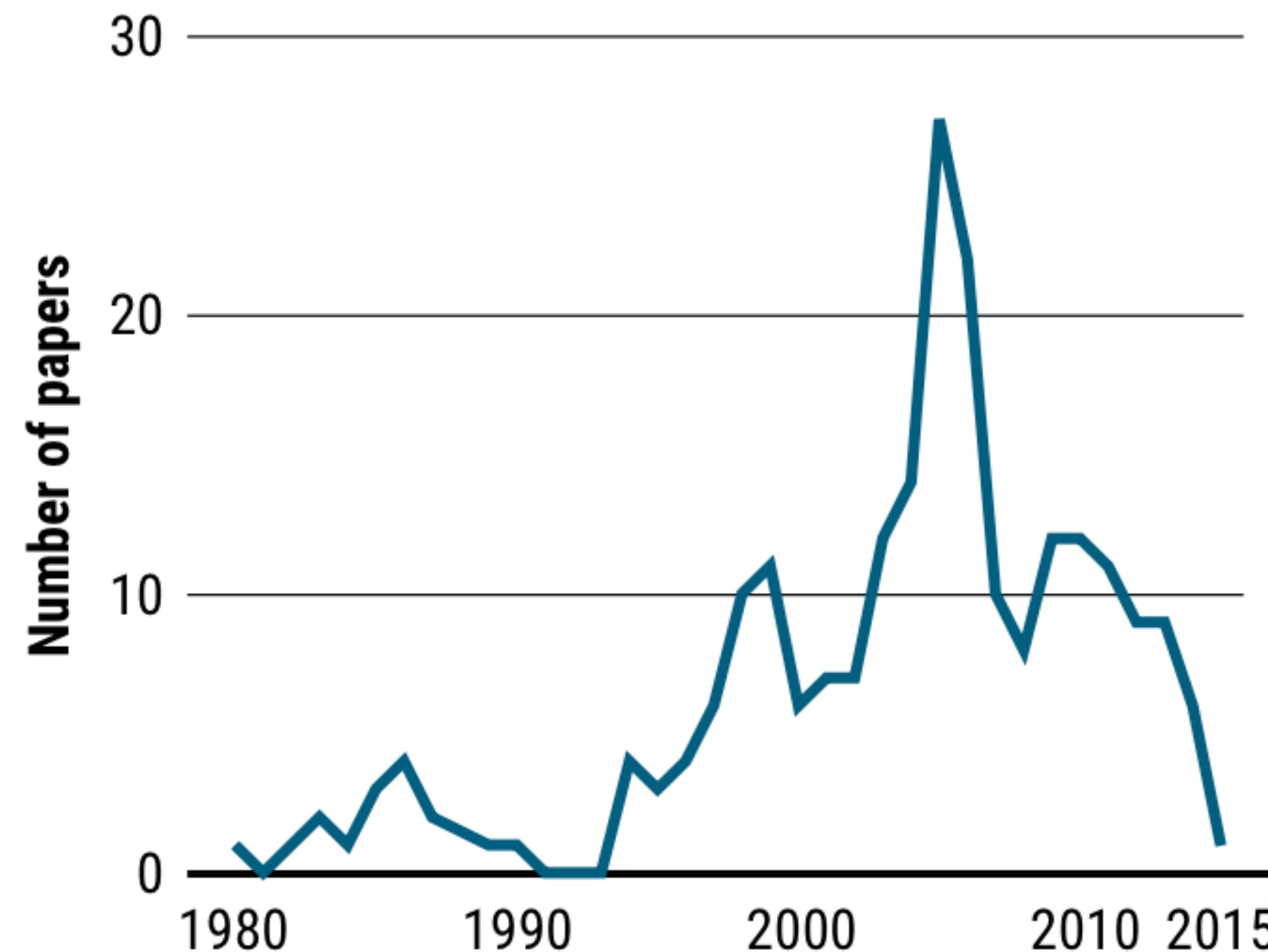
Parkinson's  
Alzheimer  
Hip operations

In two papers Sato described different trials—one in stroke victims, the other in Parkinson's disease patients—but the control and study groups in both studies had the exact same mean body mass index.

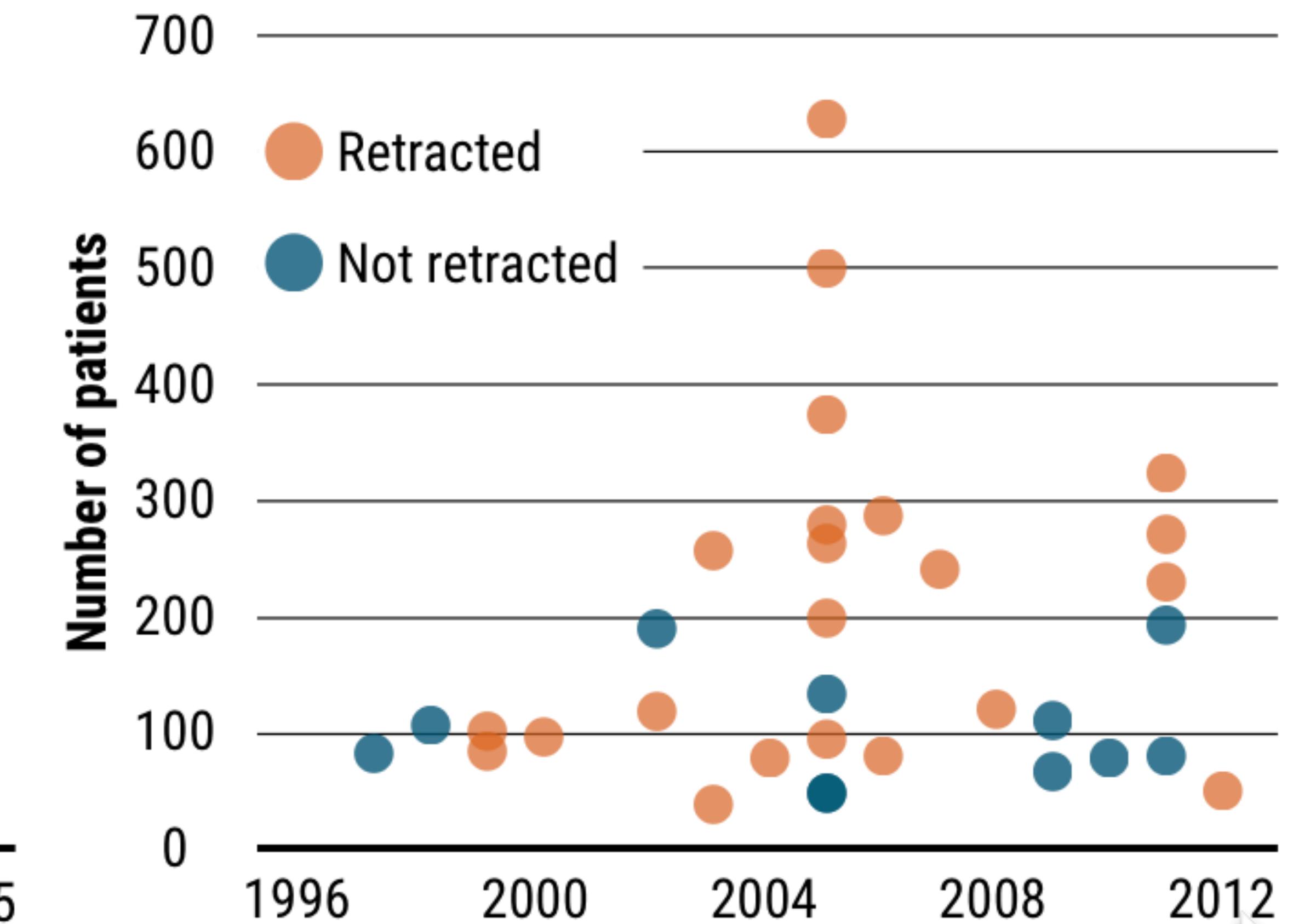


# Sato's Ripple effects

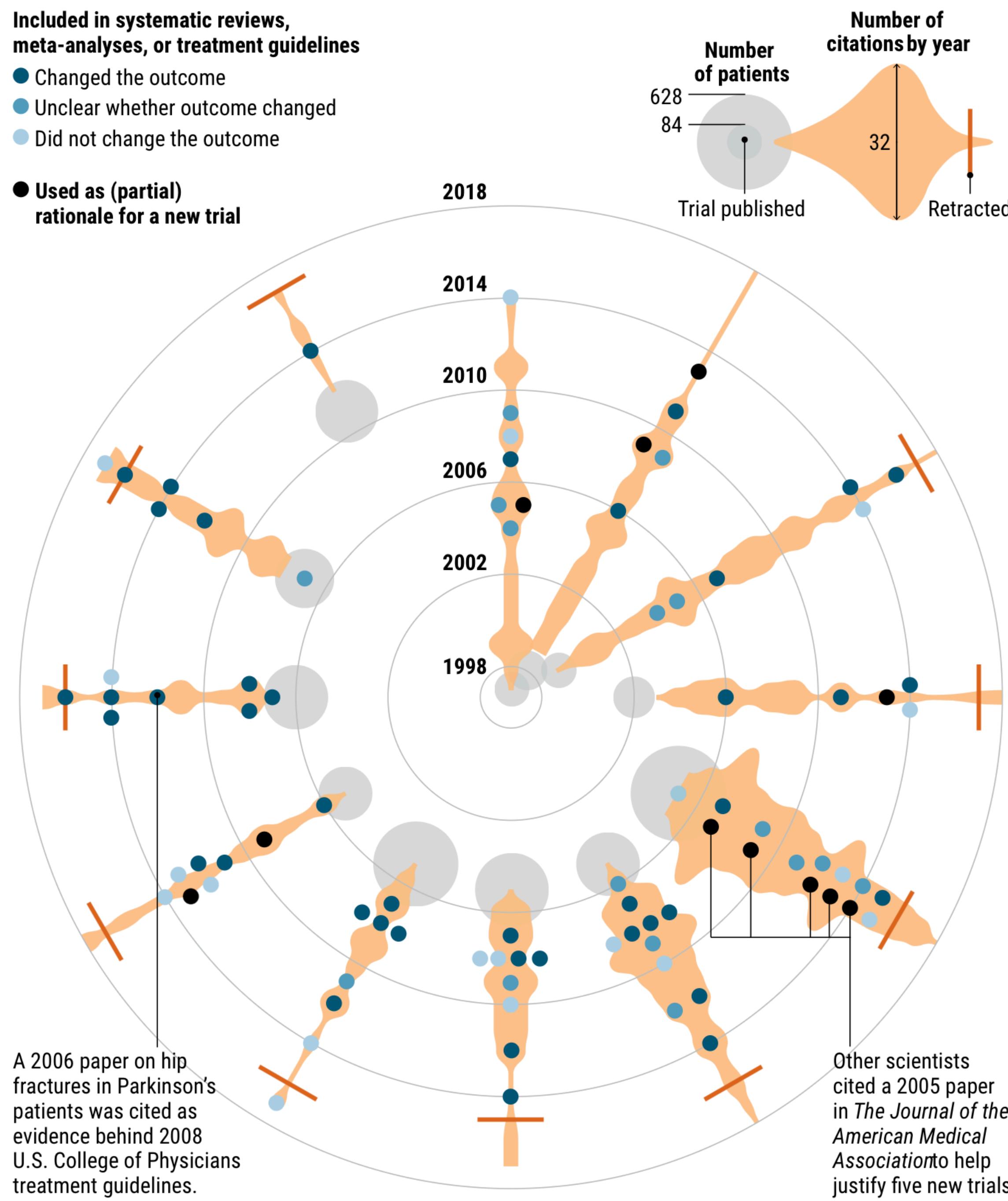
**Total scientific output**



**Clinical trials**



# Ripple effects



## Andrew Wakefield

A portrait photograph of Andrew Wakefield, a man with light brown hair, wearing a light blue suit jacket over a white shirt. He is looking slightly to his left with a faint smile.

**“I believe there is a causal association between the Measles Mumps Rubella vaccine and autism in many children for several reasons.”**

**Andrew Wakefield**

[www.VAXXED.com](http://www.VAXXED.com)

[www.StopMandatoryVaccination.com](http://www.StopMandatoryVaccination.com)

## How The MMR Vaccine Is Linked To Autism and The CDC Cover-Up

• Larry Cook • May 27, 2016 • Vaccine Injury

Andrew Wakefield

$N = 12$   
cited 3071 times!

selective sample

funded by lawyers  
who had been  
engaged by  
parents in  
lawsuits against  
vaccine-producing  
companies

Retracted 2010

# THE LANCET

Volume 351, Issue 9103, 28 February 1998, Pages 637-641



Early Report

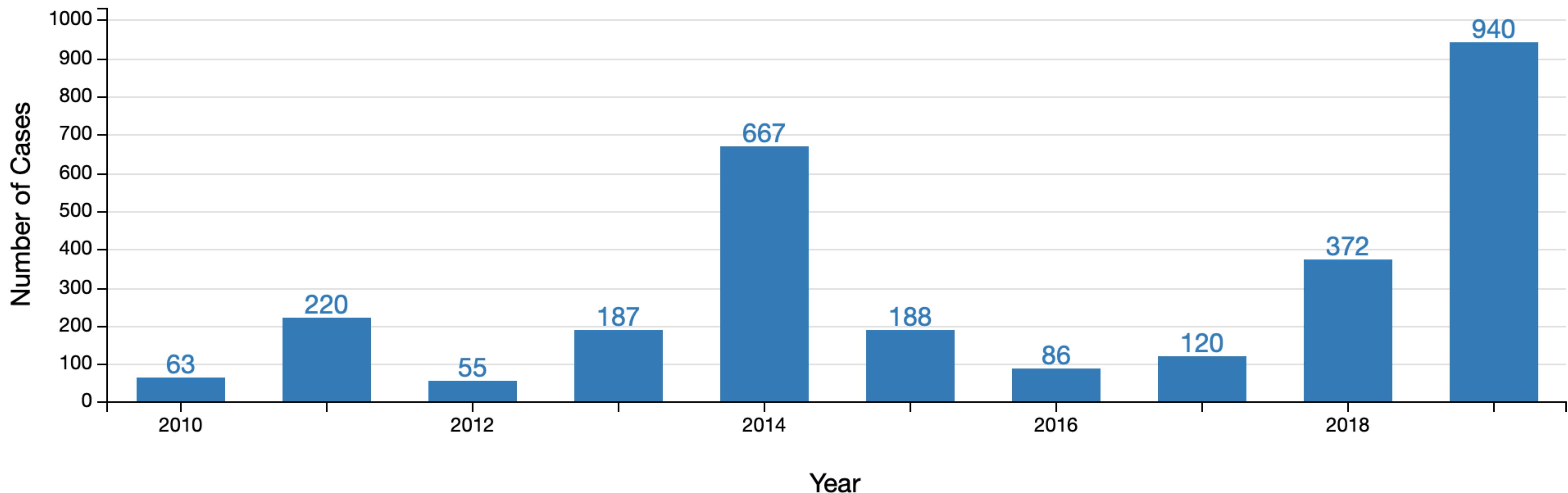
## RETRACTED: Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children

Dr AJ Wakefield FRCS<sup>a</sup> ♀, SH Murch MB<sup>b</sup>, A Anthony MB<sup>a</sup>, J Linnell PhD<sup>a</sup>, DM Casson MRCP<sup>b</sup>, M Malik MRCP<sup>b</sup>, M Berelowitz FRCPsych<sup>c</sup>, AP Dhillon MRCPPath<sup>a</sup>, MA Thomson FRCP<sup>b</sup>, P Harvey FRCP<sup>d</sup>, A Valentine FRCR<sup>e</sup>, SE Davies MRCPPath<sup>a</sup>, JA Walker-Smith FRCP<sup>a</sup>



# Number of Measles Cases Reported by Year

2010-2019\*\* (as of May 24, 2019)



CH: Incidence increase from 2,5 (2018) to 19,5 (2019) cases per million  
2019: 2 deaths (30; 70 years old men)

# Retraction Watch

## Leaderboard

Who has the most retractions? Here's our unofficial list (see notes on methodology), which we'll update as more information comes to light:

1. [Yoshitaka Fujii](#) (total retractions: 183) See also: [Final report of investigating committee](#), [our reporting](#), [additional coverage](#)
2. [Joachim Boldt](#) (96) See also: [Editors-in-chief statement](#), [our coverage](#)
3. [Yoshihiro Sato](#) (59) See also: [our coverage](#)
4. [Diederik Stapel](#) (58) See also: [our coverage](#)
5. [Jun Iwamoto](#) (51) See also: [our coverage](#)
6. [Yuhji Saitoh](#) (50) See also: [our coverage](#)
7. [Adrian Maxim](#) (48) See also: [our coverage](#)
8. [Chen-Yuan \(Peter\) Chen](#) (43) See also: [SAGE](#), [our coverage](#)
9. [Fazlul Sarkar](#) (41) See also: [our coverage](#)
10. [Hua Zhong](#) (41) See also: [journal notice](#)
11. [Shigeaki Kato](#) (40) See also: [our coverage](#)
12. [James Hunton](#) (37) See also: [our coverage](#)
13. [Hyung-In Moon](#) (35) See also: [our coverage](#)
14. [Naoki Mori](#) (32) See also: [our coverage](#)
15. [Jan Hendrik Schön](#) (32) See also: [our coverage](#)
16. [Soon-Gi Shin](#) (30) See also: [our coverage](#)
17. [Tao Liu](#) (29) See also: [our coverage](#)
18. [Bharat Aggarwal](#) (28) See also: [our coverage](#)
19. [Cheng-Wu Chen](#) (28) See also: [our coverage](#)
20. [A Salar Elahi](#) (27) See also: [our coverage](#)

# Overview

- **The problem**  
Why most of published research findings are false.
- **The catalysts**  
Questionable Research Practices  
Fraud
- **More bad news: replication failures**  
Business  
Psychology
- **The solutions**  
Registered Replication Report  
Pre-Registration  
Standards  
Open Science ([osf.io](https://osf.io))  
Theory

# More bad news: replication failures

Business  
Psychology

**Replications and Extensions in Marketing –  
Rarely Published But Quite Contrary\***

Raymond Hubbard  
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J. Scott Armstrong  
*The Wharton School, University of Pennsylvania, Philadelphia, PA 19104, USA*

**Abstract**

Replication is rare in marketing. Of 1,120 papers sampled from three major marketing journals, none were replications. Only 1.8% of the papers were extensions, and they consumed 1.1% of the journal space. On average, these extensions appeared seven years after the original study. The publication rate for such works has been decreasing since the 1970s. Published extensions typically produced results that conflicted with the original studies; of the 20 extensions published, 12 conflicted with the earlier results, and only 3 provided full confirmation. Published replications do not attract as many citations after publication as do the original studies, even when the results fail to support the original studies.

---

"Replicability is almost universally accepted as the most important criterion of genuine scientific knowledge..."

Rosenthal and Rosnow, 1984, p. 9

"Replicability . . . is the Supreme Court of the scientific system."

Collins, 1985, p. 19

**1. Introduction**

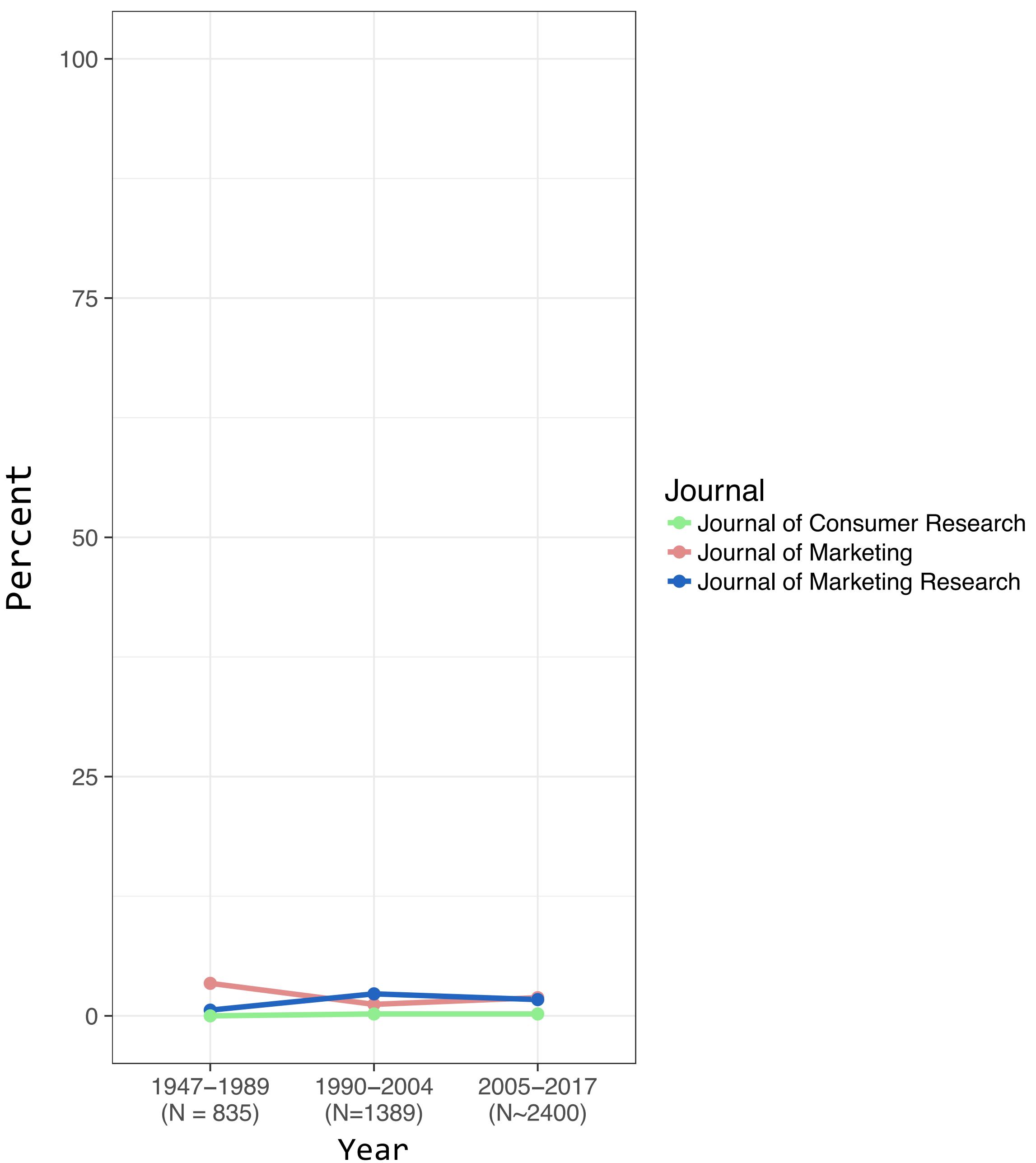
As suggested by the above quotations, replication is held in high regard by some scientists. Other things being equal, the failure to obtain similar findings in a replication indicates the need for further work in the area. A successful replication, on the other hand, promotes confidence in the reliability of the results, and suggests the need to study whether the findings can be generalized to different populations, products, geographical areas, and so on. Replications

**Published replications  
do not attract as many  
citations.**

---

\* The authors thank Richard Bagozzi, Gregory Boller, Stephen Brown, Gilbert Churchill, Andrew Ehrenberg, James Engel, Anthony Greenwald, Robert Mittelstaedt, Leonard Reid, Robert Rosenthal, Daniel Vetter, the editor, and three anonymous reviewers for comments on earlier versions of this paper. Daniel Vetter also assisted with the classification of the replications and extensions. Editorial assistance was provided by Jennifer Armstrong and Phan Lam. Any remaining errors are our responsibility.

## Replications in CB



Hubbard & Armstrong (1994); Evanschitzky, Baumgarth, Hubbard, & Armstrong (2007)



## EDITORIAL

# Science's reproducibility and replicability crisis: International business is not immune

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Wayne F. Cascio<sup>2</sup> and  
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### Abstract

International business is not immune to science's reproducibility and replicability crisis. We argue that this crisis is not entirely surprising given the methodological practices that enhance systematic capitalization on chance. This occurs when researchers search for a maximally predictive statistical model based on a particular dataset and engage in several trial-and-error steps that are rarely disclosed in published articles. We describe systematic capitalization on chance, distinguish it from unsystematic capitalization on chance, address five common practices that capitalize on chance, and offer actionable strategies to minimize the capitalization on chance and improve the reproducibility and replicability of future IB research.

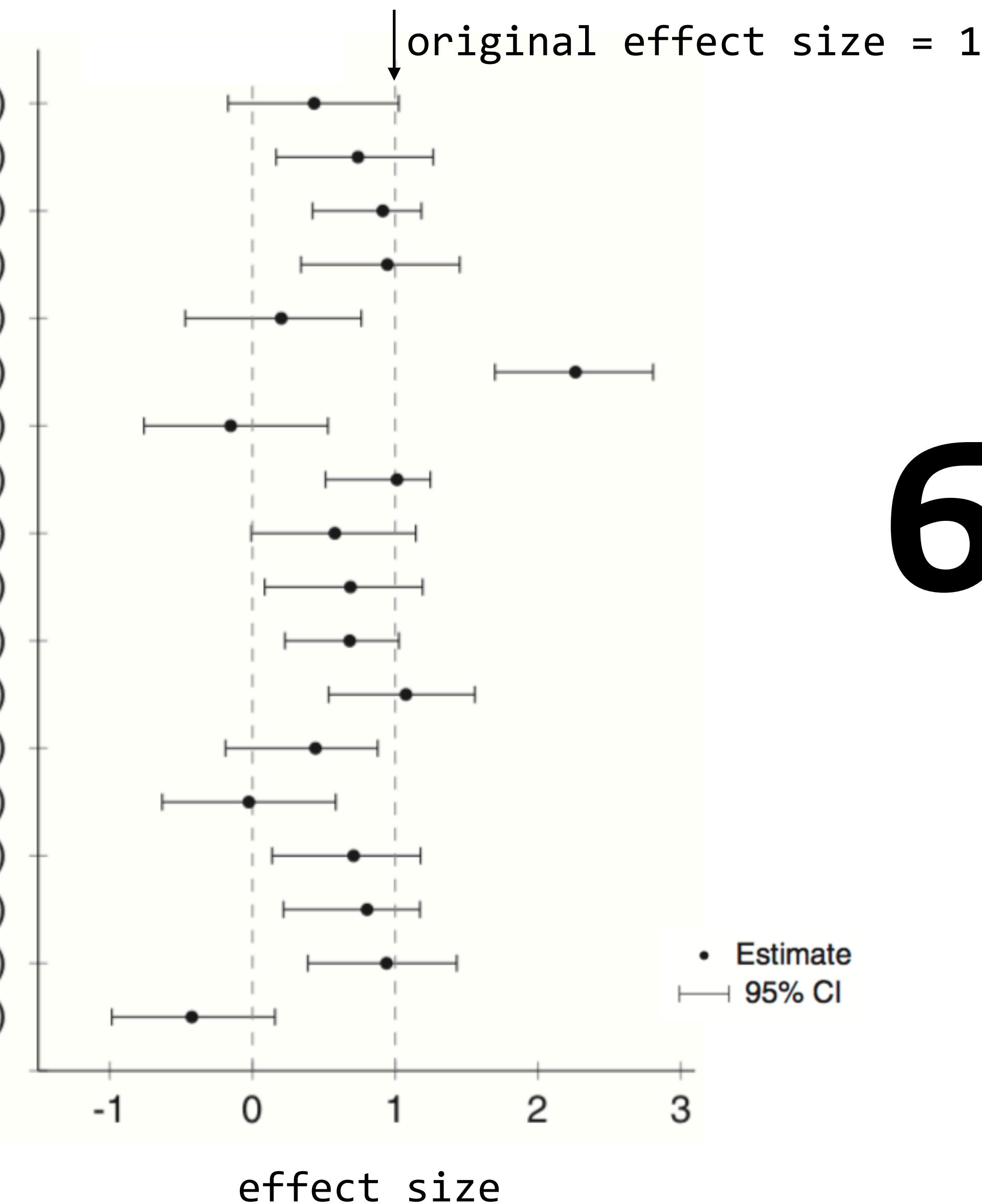
*Journal of International Business Studies* (2017). doi:10.1057/s41267-017-0081-0

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**Keywords:** capitalization on chance; quantitative methods; reproducibility; replicability; credibility

# Replication in economics

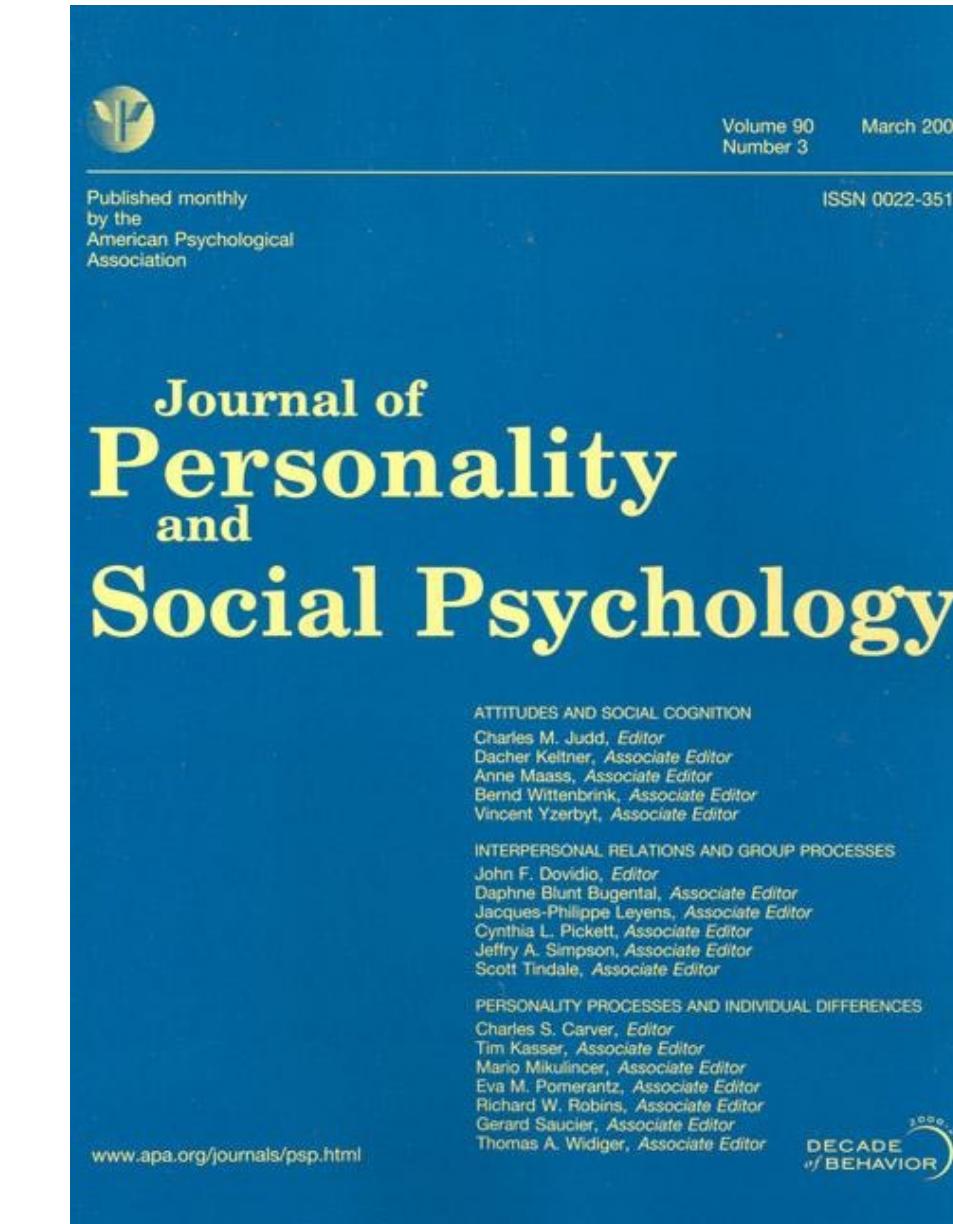
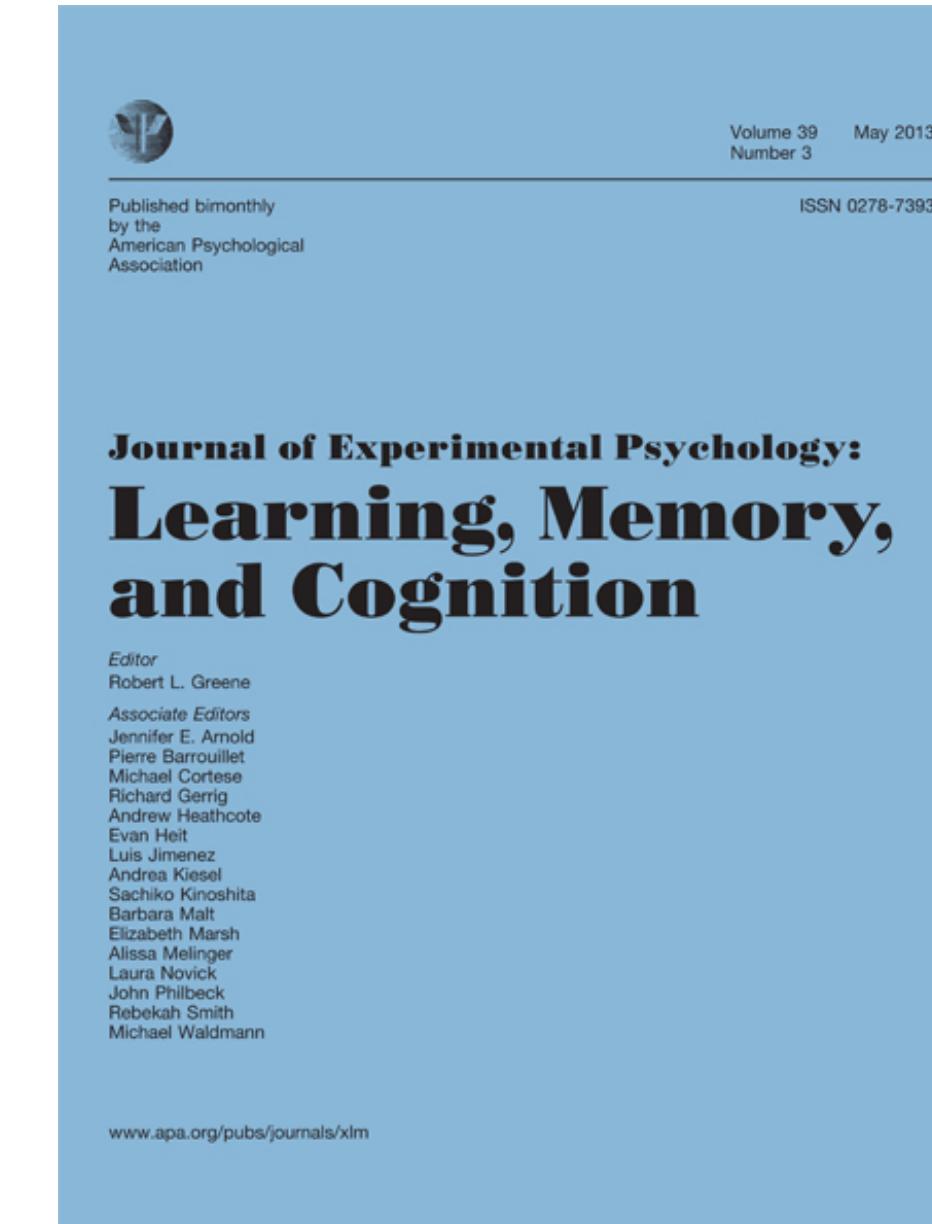
- Abeler et al., AER 2011 (33)
- Ambrus and Greiner, AER 2012 (34)
- Bartling et al., AER 2012 (35)
- Charness and Dufwenberg, AER 2011 (36)
- Chen and Chen, AER 2011 (37)
- de Clippel et al., AER 2014 (38)
- Duffy and Puzzello, AER 2014 (39)
- Dulleck et al., AER 2011 (40)
- Ericson and Fuster, QJE 2011 (41)
- Fehr et al., AER 2013 (42)
- Friedman and Oprea, AER 2012 (43)
- Fudenberg et al., AER 2012 (44)
- Huck et al., AER 2011 (45)
- Ifcher and Zarghamee, AER 2011 (46)
- Kessler and Roth, AER 2012 (47)
- Kirchler et al., AER 2012 (48)
- Kogan et al., AER 2011 (49)
- Kuziemko et al., QJE 2014 (50)



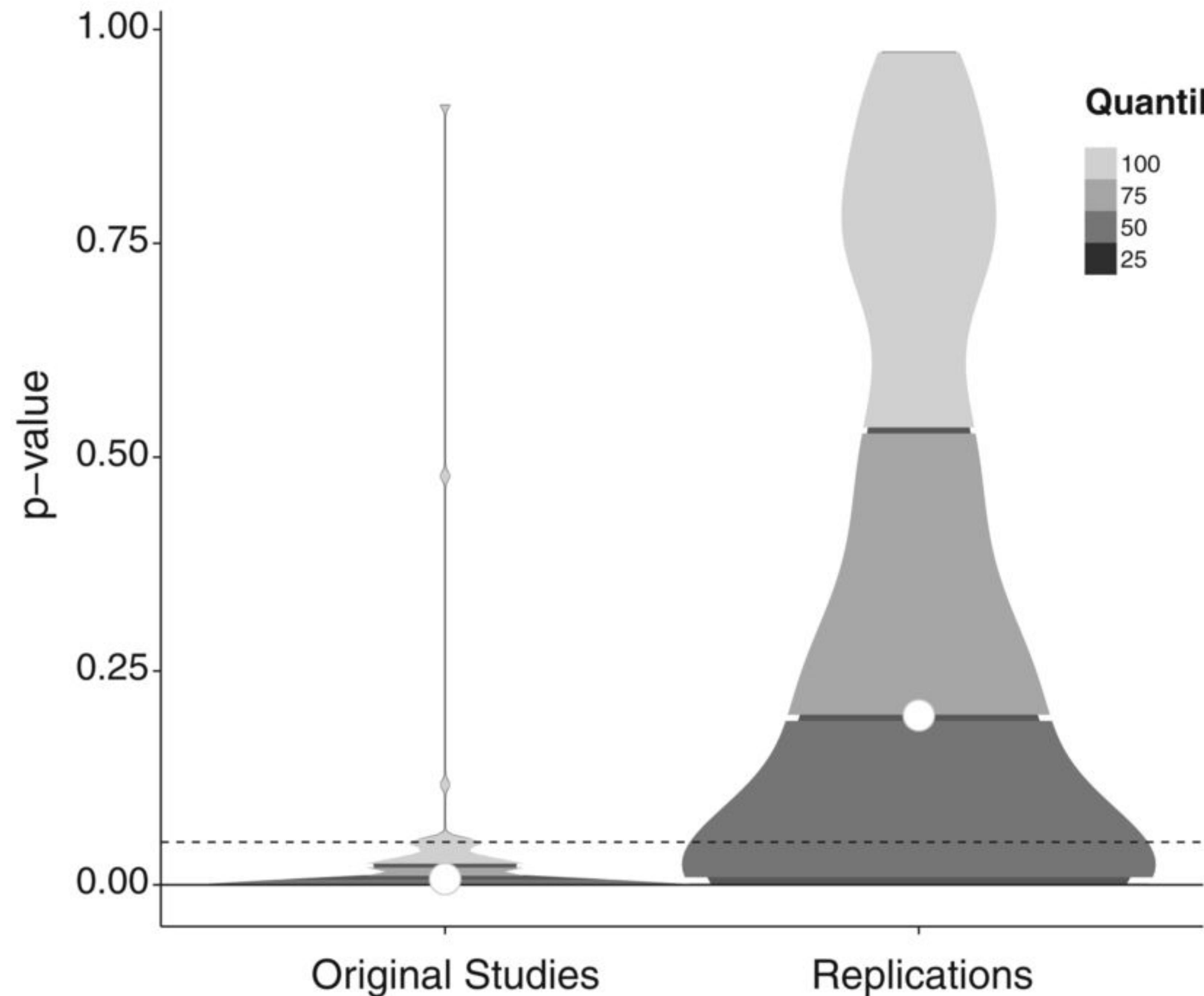
# Reproducibility Project: Psychology (RP:P)

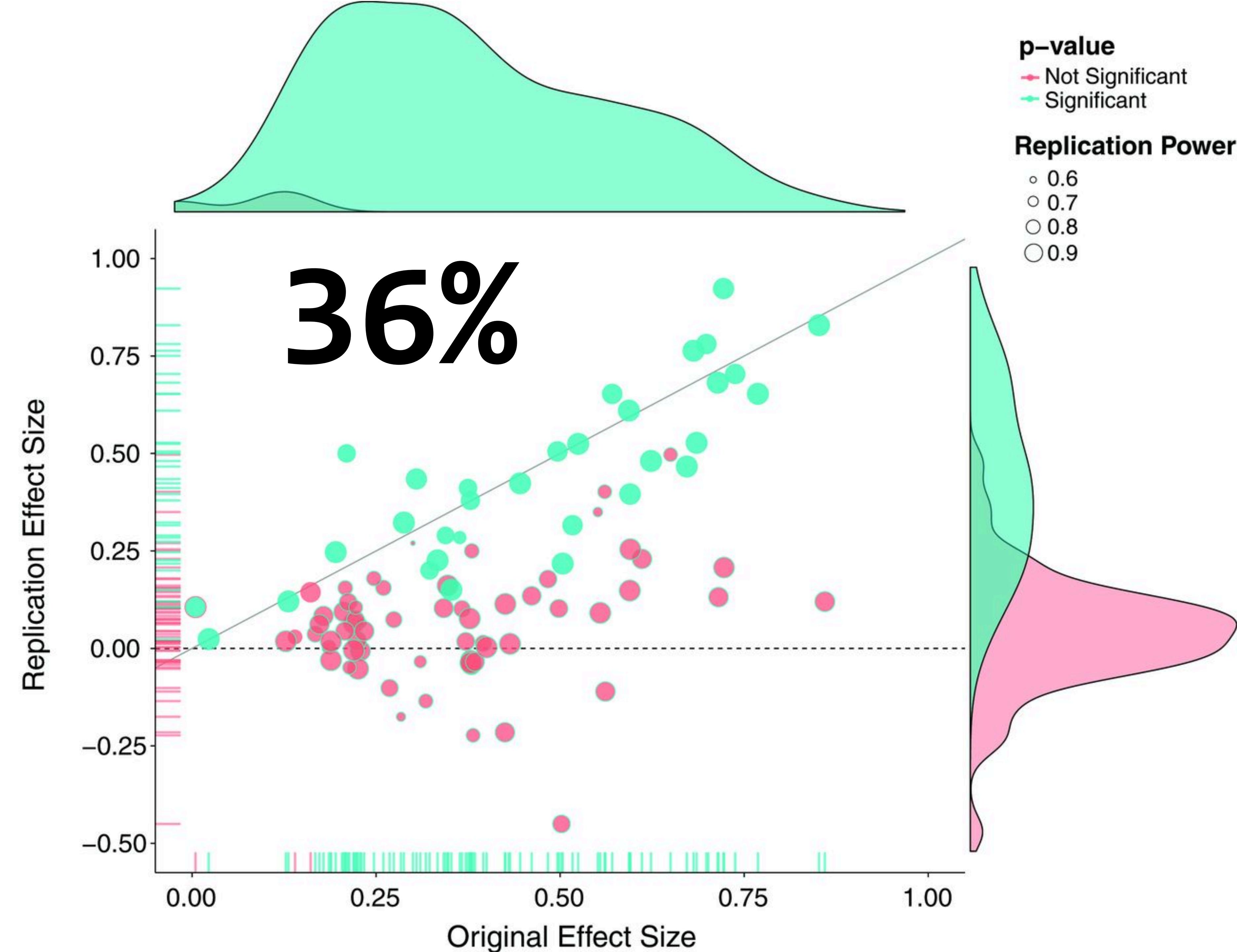
Contributors: [Alexander A. Aarts](#), [Anita Alexander](#), [Anna Dreber Almenberg](#), [Leslie Cramblet Alvarez](#), [Christopher Jon Anderson](#), [Joanna Anderson](#), [Peter Raymond Attridge](#), [Angela Attwood](#), [Jordan Axt](#), [Molly Babel](#), [Erica Baranski](#), [Michael Barnett-Cowan](#), [Elizabeth Bartmess](#), [Raoul Bell](#), [Frank Bosco](#), [Mark Brandt](#), [Monica Britos](#), [Hilmar Brohmer](#), [Benjamin T. Brown](#), [Kristina Brown](#), [Jovita Brüning](#), [Ann Calhoun-Sauls](#), [Shannon Callahan](#), [Elizabeth Chagnon](#), [Jesse J. Chandler](#), [Christopher R. Chartier](#), [Felix Cheung](#), [Phuonguyen Chu](#), [Linda Cillessen](#), [Russ Clay](#), [Hayley Cleary](#), [Mark Cloud](#), [Michael Cohn](#), [Johanna Cohoon](#), [John Conway](#), [Giulio Costantini](#), [Wil Cunningham](#), [Jessica Curtis](#), [Jamie DeCoster](#), [Michelle DeGaetano](#), [Nicolás Della Penna](#), [Laura Dewitte](#), [Philip DiGiacomo](#), [Canay Dogulu](#), [Brent Donnellan](#), [Ryan Donohue](#), [Angela Rachael Dorrough](#), [Michelle Dugas](#), [Elizabeth Dunn](#), [Alejandro Vásquez Echeverría](#), [Casey Eggleston](#), [Jo Embley](#), [Vivien Estel](#), [Frank J. Farach](#), [Jenelle Feather](#), [Belén Fernández](#), [Susann Fiedler](#), [James G. Field](#), [Stanka Fitneva](#), [Taru Flagan](#), [Amanda Forest](#), [Eskil Forsell](#), [Joshua Foster](#), [Michael C. Frank](#), [Rebecca S. Frazier](#), [Heather Fuchs](#), [Philip Gable](#), [Jeff Galak](#), [Elisa Maria Galliani](#), [Anup Gampa](#), [Sara Garcia](#), [Douglas Gazarian](#), [Elise Giannanco](#), [Elizabeth Gilbert](#), [Roger Giner-Sorolla](#), [Andreas Glöckner](#), [Lars Goellner](#), [Jin X. Goh](#), [Rebecca Goldberg](#), [Stephen D Goldinger](#), [Patrick T. Goodbourn](#), [Shauna Gordon-McKeon](#), [Jesse Graham](#), [James A. Grange](#), [Jeremy R. Gray](#), [Joshua Hartshorne](#), [Fred Hasselman](#), [Timothy B. Hayes](#), [Emma Heikensten](#), [Grace Hicks](#), [Gea Hoogendoorn](#), [Denise Humphries](#), [Cathy O. Y. Hung](#), [Nathali Immelman](#), [Vanessa C. Irsik](#), [Georg Jahn](#), [Frank Jäkel](#), [Marc Jekel](#), [Magnus Johannesson](#), [David J. Johnson](#), [Kate Johnson](#), [Larissa Johnson](#), [William Johnston](#), [Kai Jonas](#), [Jennifer Joy-Gaba](#), [Heather Kappes](#), [Kim Kelso](#), [Mallory Kidwell](#), [Matthew Kirkhart](#), [Bennett Kleinberg](#), [Goran Knezevic](#), [Erik Knight](#), [Sena Koleva](#), [Franziska Maria Kolorz](#), [Kolina Kolai](#), [Robert Wilhelm Krause](#), [Job Krijnen](#), [Tim Kuhlmann](#), [Yoram Kevin Kunkels](#), [Calvin Lai](#), [Daniel Lakens](#), [Kristin Lane](#), [Bethany Lassetter](#), [Lili Lazarevic](#), [Etienne P. LeBel](#), [Minha Lee](#), [Kristi Lemm](#), [Carmel Levitan](#), [Julianne Lewis](#), [Melissa Lewis](#), [Lin Lin](#), [Stephanie Lin](#), [Darren Loureiro](#), [Daniel Lumian](#), [Sean Mackinnon](#), [Heather N. Mainard](#), [Denise Marigold](#), [Tylar Martinez](#), [E.J. Masicampo](#), [Michael May](#), [Pranjal Mehta](#), [Johannes Meixner](#), [Alissa Melinger](#), [Todd McElroy](#), [Kateri McRae](#), [Nicole Mechlin](#), [Jeremy K. Miller](#), [Mallorie Miller](#), [Tyler M. Miller](#), [Katherine Moore](#), [Matt Motyl](#), [Stephanie Muller](#), [Marcus Munafo](#), [Alisa Raquel Muñoz](#), [Koen Ilja Neijenhuijs](#), [Taylor Nervi](#), [Brian A. Nosek](#), [Catherine Olsson](#), [Colleen Osborne](#), [Lutz Ostkamp](#), [Helena J. M. Pennings](#), [Olivia Kathleen Perna](#), [Marco Perugini](#), [Michael Pitts](#), [Franziska Plessow](#), [Jason M. Prenoveau](#), [Kate Ratliff](#), [David Reinhard](#), [Frank Renkewitz](#), [Ashley A. Ricker](#), [Anastasia Rigney](#), [Mark Roebke](#), [Abraham M. Rutnick](#), [Robert S. Ryan](#), [Anondah Saide](#), [David Santos](#), [Rebecca Saxe](#), [René Schlegelmilch](#), [Kathleen Schmidt](#), [Sabine Scholz](#), [Larissa Seibel](#), [Dylan Selerman](#), [Samuel Shaki](#), [William B Simpson](#), [H. Colleen Sinclair](#), [Jeanine Skorinko](#), [Agnieszka Slowik](#), [Colin Tucker Smith](#), [Joel S. Snyder](#), [Courtney Soderberg](#), [Carina Sonnleitner](#), [Jeffrey R. Spies](#), [Angela D. Staples](#), [sara steegen](#), [Mia Steinberg](#), [Stefan Stieger](#), [Nina Strohminger](#), [Gavin Brent Sullivan](#), [Thomas Talhelm](#), [Megan Tapia](#), [Manuela Thomae](#), [Helen Tibboel](#), [Steve Tsang](#), [Francis Tuerlinckx](#), [Alexa Tullett](#), [Roel van Dooren](#), [wolf vanpaemel](#), [Hedderik van Rijn](#), [Anna van 't Veer](#), [Natalia Velez](#), [Marieke Vermue](#), [Mark Verschoor](#), [Michelangelo Vianello](#), [Martin Voracek](#), [Gina Vuu](#), [Erin Westgate](#), [Joeri Wissink](#), [Sining Wu](#), [Kellylynn Zuni](#), [Gillian Sandstrom](#)

# Reproducibility Project: Psychology (RP:P)

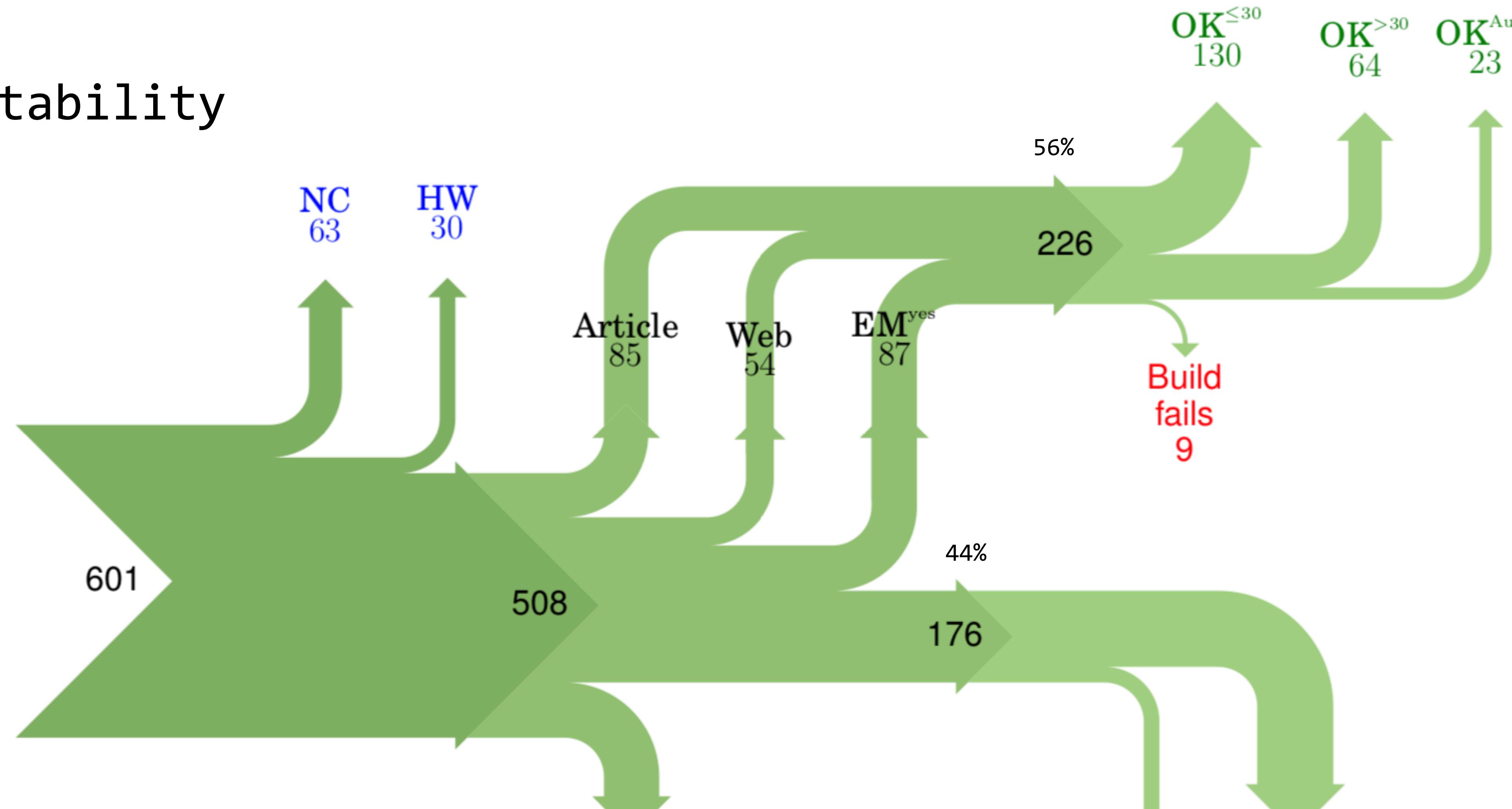


100 articles  
median power = 95%  
standardised protocol  
feedback original authors





# Repeatability



## Legend

Classification	Code Location	Build Results	
BC	Paper where the results are backed by code.	Article	OK <sup>≤30</sup> We succeed in building the system in ≤30 minutes.
NC	Paper excluded due to results not being backed by code.	Web	OK <sup>&gt;30</sup> We succeed in building the system in >30 minutes.
HW	Paper excluded due to replication requiring special hardware.	EM <sup>yes</sup>	OK <sup>&gt;Author</sup> We fail to build, but the author says the code builds with reasonable effort.
EX	Paper excluded due to overlapping author lists.	EM <sup>no</sup>	Fails We fail to build, and the author doesn't respond to survey or says code may have problems building.
		EM <sup>∅</sup>	Author does not respond to email request within 2 months.



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Disney Pixar  
**INSIDE  
OUT**

# Overview

- **The problem**  
Why most of published research findings are false.
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Fraud
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Psychology
- **The solutions**  
Registered Replication Report  
Pre-Registration  
Standards  
Open Science ([osf.io](https://osf.io))  
Theory

# The solutions

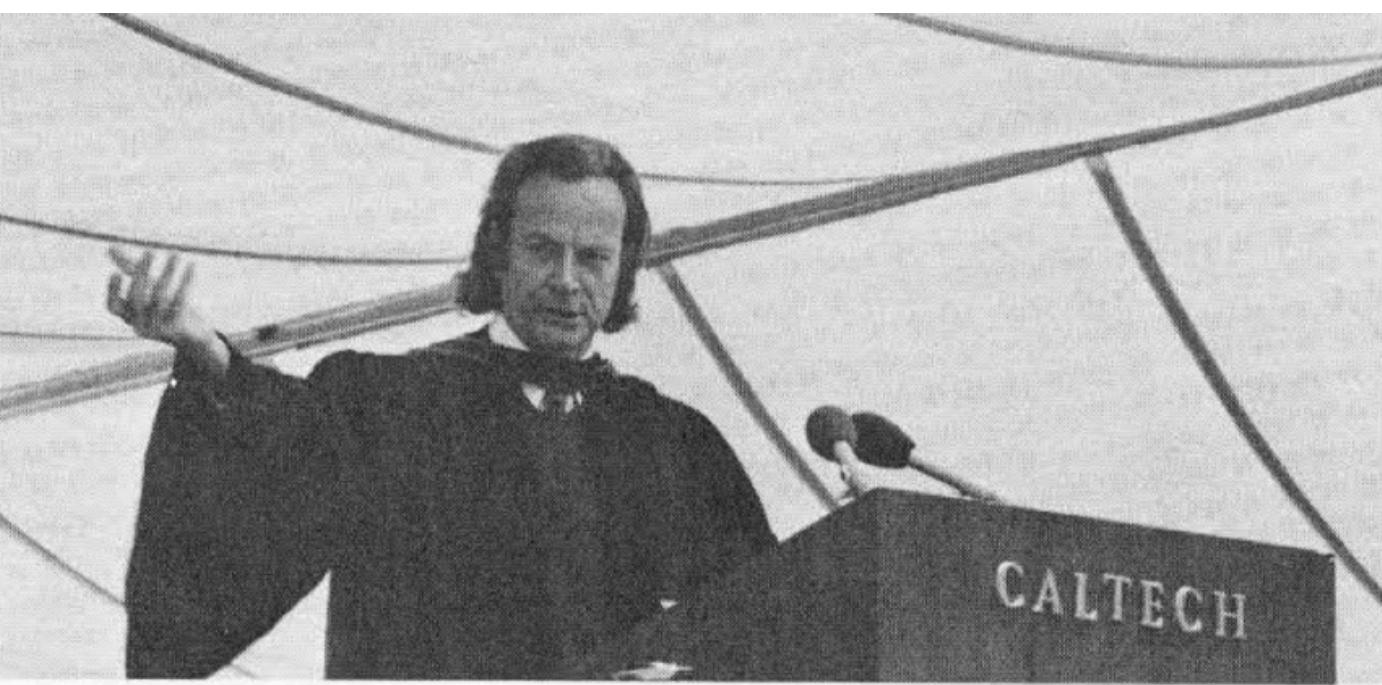
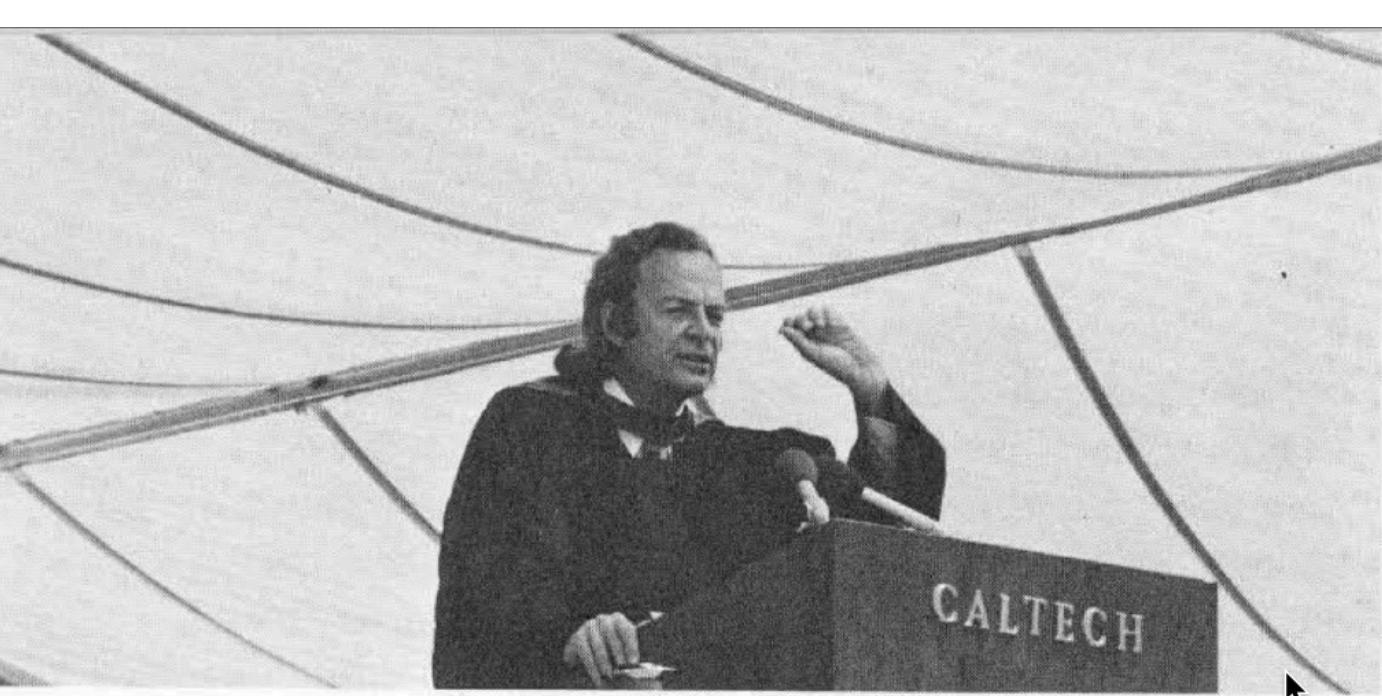
Registered Replication Report (RRR)

Pre-Registration

Open Science ([osf.io](https://osf.io))

Standards (SOPs)

Theory



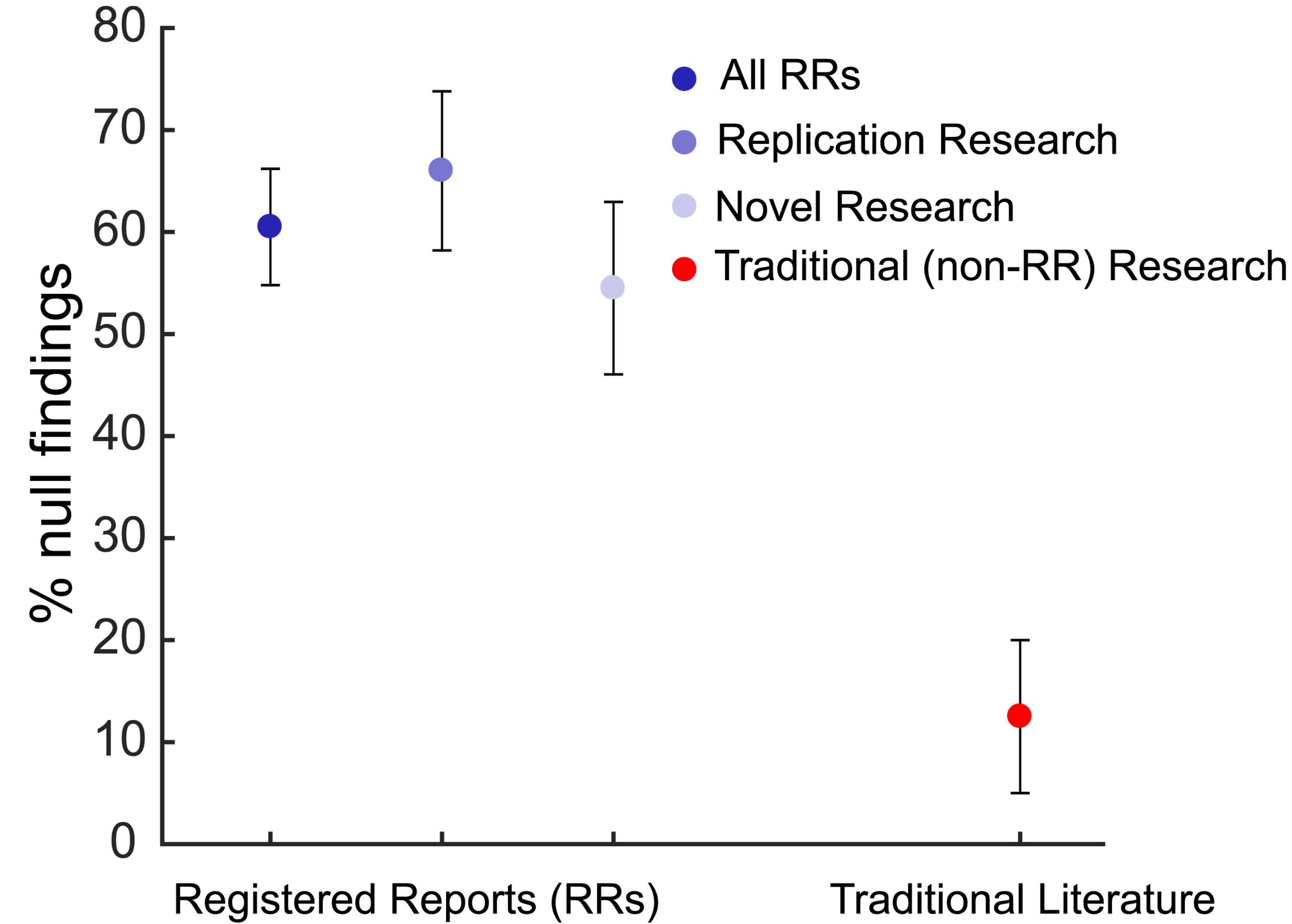
The first principle is that you **must not fool yourself**—and you are the easiest person to fool. ... After you have not fooled yourself, it's easy **not to fool other scientists**. You just have to be honest in a conventional way after that.

# Registered (Replication) Report (RRR)



What to expect  
for RR

# Percentage of null findings



# Professor Priming

Journal of Personality and Social Psychology  
1998, Vol. 74, No. 4, 865–877

Copyright 1998 by the American Psychological Association, Inc.  
0022-3514/98/\$3.00

## The Relation Between Perception and Behavior, or How to Win a Game of Trivial Pursuit

Ap Dijksterhuis and Ad van Knippenberg  
University of Nijmegen

The authors tested and confirmed the hypothesis that priming a stereotype or trait leads to complex overt behavior in line with this activated stereotype or trait. Specifically, 4 experiments established that priming the stereotype of professors or the trait *intelligent* enhanced participants' performance on a scale measuring general knowledge. Also, priming the stereotype of soccer hooligans or the trait *stupid* reduced participants' performance on a general knowledge scale. Results of the experiments revealed (a) that prolonged priming leads to more pronounced behavioral effects and (b) that there is no sign of decay of the effects for at least 15 min. The authors explain their results by claiming that perception has a direct and pervasive impact on overt behavior (cf. J. A. Bargh, M. Chen, & L. Burrows, 1996). Implications for human social behavior are discussed.

Google Scholar: 839 Zitationen (August, 2017)

Dijksterhuis & van Knippenberg (1998)

## Cover Story

**Professor condition:**  
“imagine that you are a typical university professor.

Professors, as a group, tend to have completed a doctorate degree, work in colleges or universities, dedicate their time to teaching and research, and try to publish their research in academic journals. Take a moment to imagine being a typical university professor. Think about the following questions: What are you doing in your daily life as a university professor? What are your typical activities as a university professor? What are your typical personality characteristics or attributes as a university professor? What are your typical passions or hobbies as a university professor? Write your answers to these on the next page in the first person, as if you actually are a university professor. You will have 5 minutes to complete this task. You must use this time in its entirety. Press the spacebar to continue.”

**Soccer hooligan condition:**  
“imagine that you are a typical soccer hooligan.

Hooligans, as a group, tend to be young men who are fanatical sports fans, generally drink a lot in public, say offensive things to passersby, and sometimes provoke fights or destroy property. Take a moment to imagine being a typical soccer hooligan. Think about the following questions: What are you doing in your daily life as a soccer hooligan? What are your typical activities as a soccer hooligan? What are your typical personality characteristics or attributes as a soccer hooligan? What are your typical passions or hobbies as a soccer hooligan? Write your answers to these on the next page in the first person, as if you actually are a soccer hooligan. You will have 5 minutes to complete this task. You must use this time in its entirety. Press the spacebar to continue.”

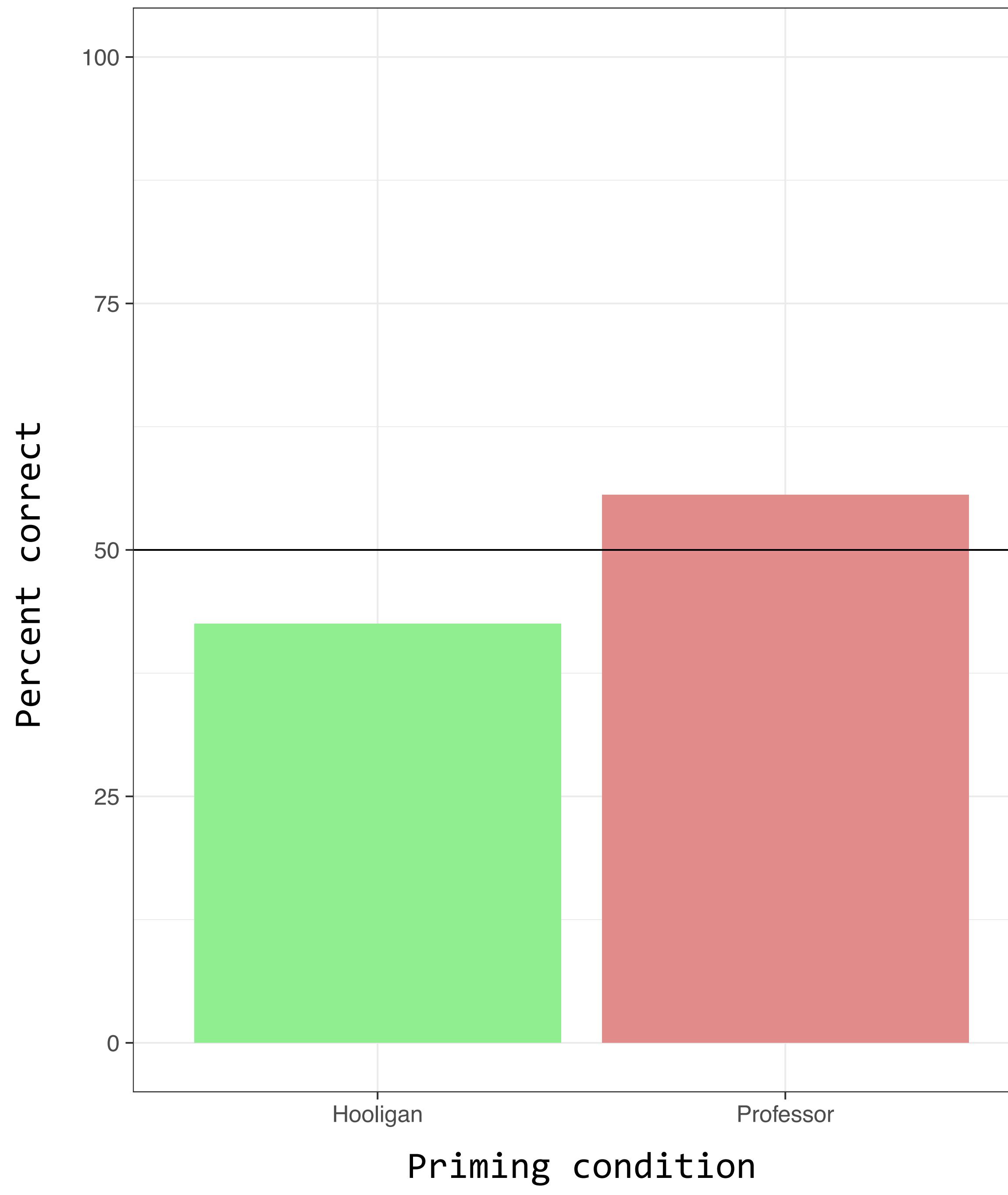
## Procedure

Write 5 minutes about [professor | hooligan]

Answer 30 trivial pursuit questions

In metrology what are lines with the same pressure?

- a. Cyclones
- b. Fronts
- c. Isotherms
- d. Isobars

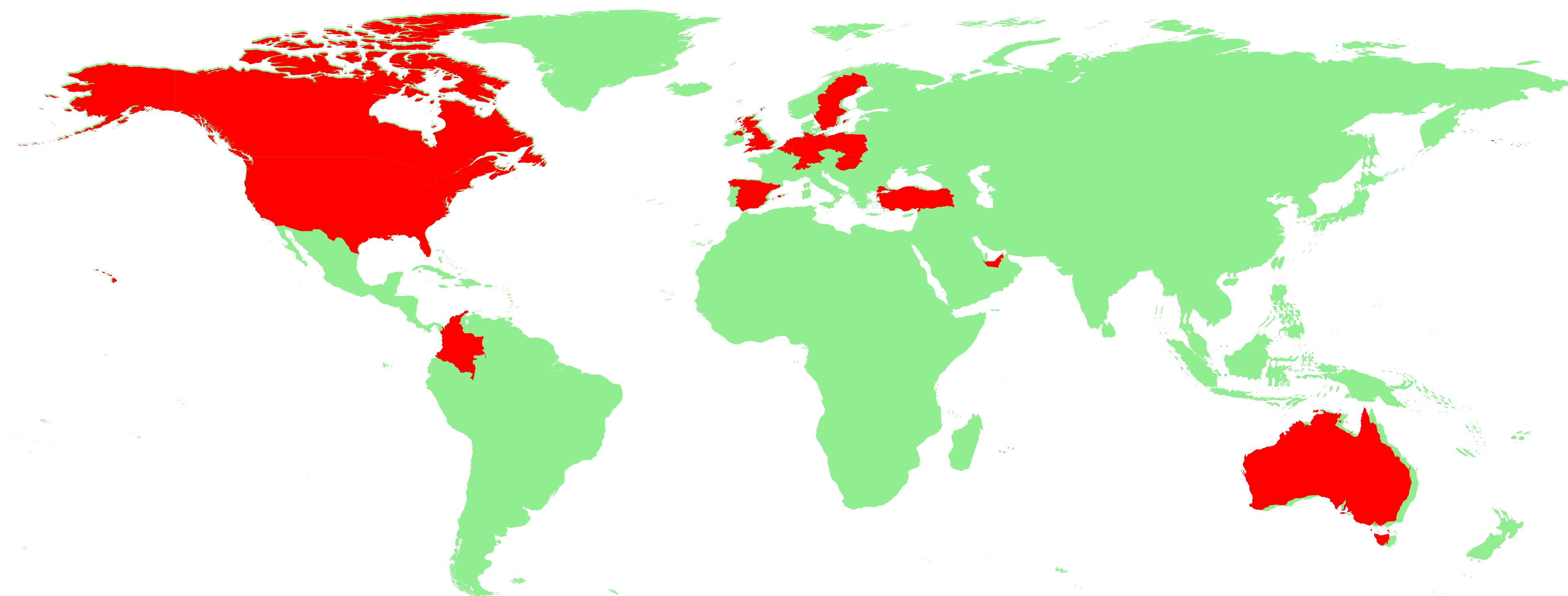


# How students at the Uni Bern see their teachers

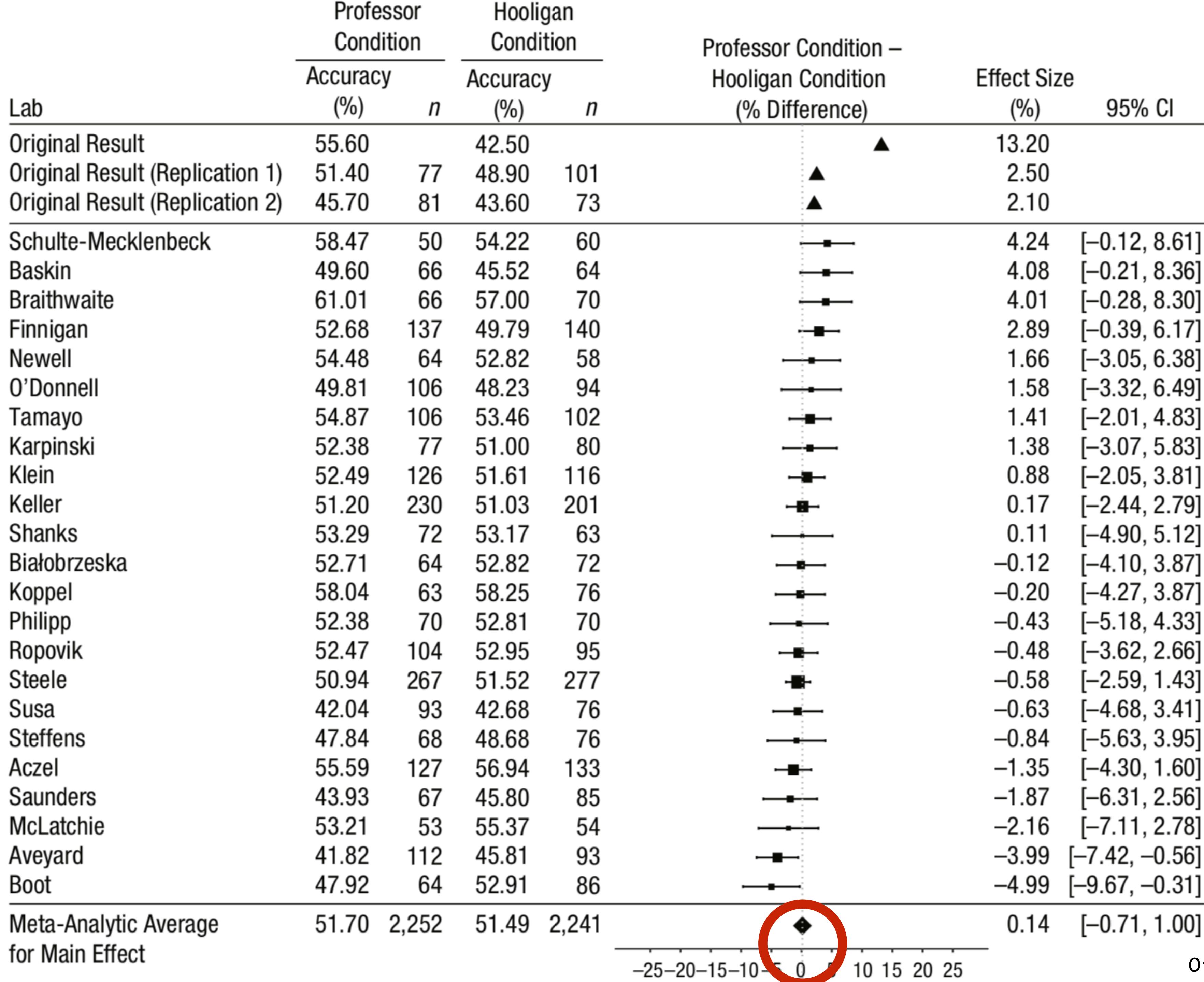
“... habe zwei Kinder, bin gegenüber anderen freundlich, habe keine Zeit für Bachelorstudenten, bin teilweise ein wenig zerstreut, ...”

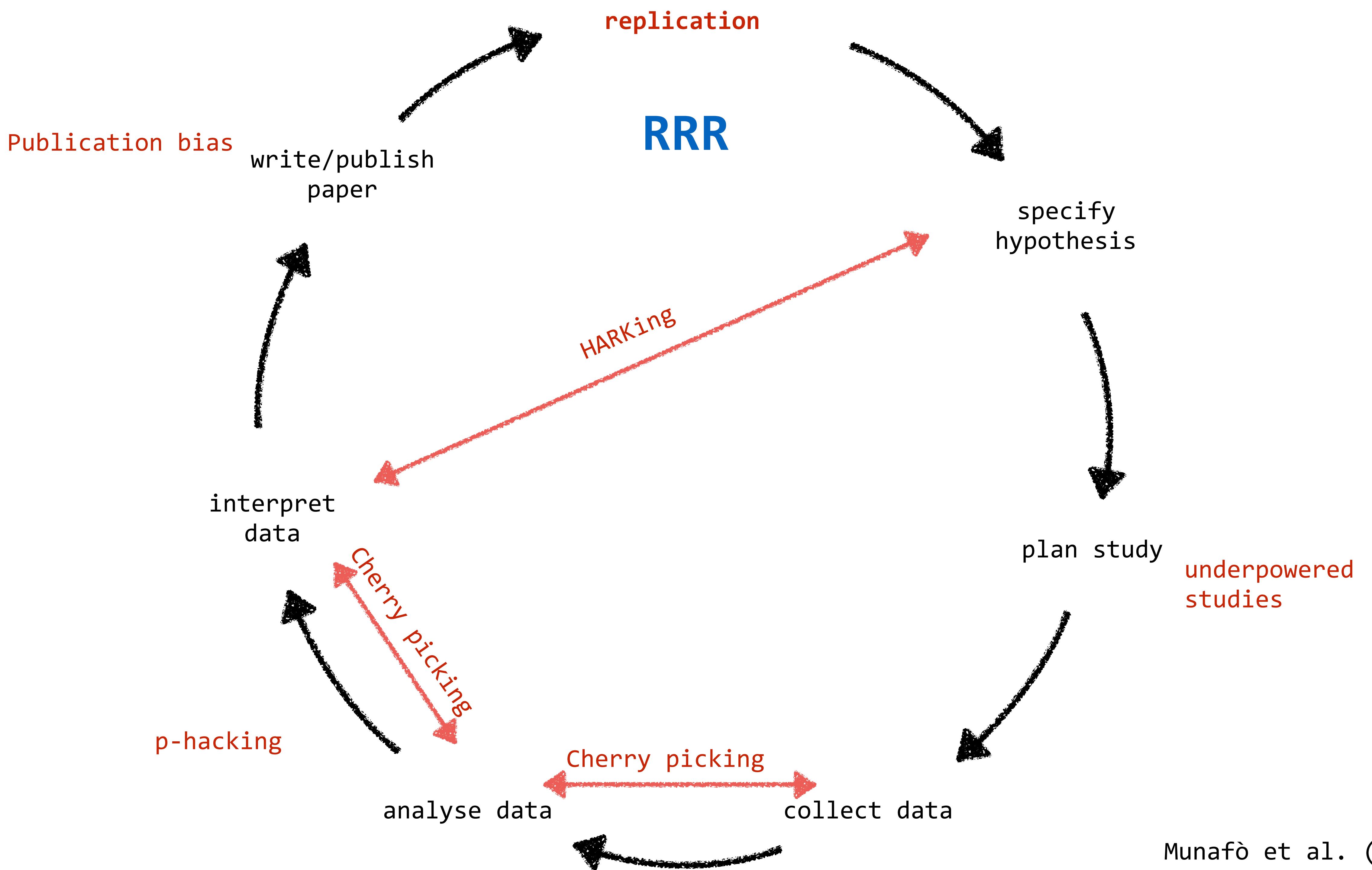
“Ich trage eine Hornbrille. Ich bin ca dreissig Jahre alt und sehe ziemlich gut aus. Leider hatte ich noch nie eine Freundin.”

“Ich bin ein pflichtbewusster Herr im mittlerem Alter, belesen, gehe meinen eigenen Weg, gekleidet wie es mir gerade passt.”



23 Labs





osf.io

The screenshot shows the Open Science Framework (OSF) homepage with a dark blue background featuring a network graph of nodes and connections. At the top left is the OSF logo and "OSF HOME ▾". Top right buttons include "Search", "Support", "Donate", "Sign Up" (in green), and "Sign In" (in blue). The main title "Open Science Framework" is prominently displayed in large white letters, with the subtitle "A scholarly commons to connect the entire research cycle" below it. A large white circular icon composed of smaller circles is centered on the page. On the left, a screenshot of a web browser shows the OSF dashboard with a "Projects" section listing "Relativity" and "Theory of General Relativity" by Einstein, and a "Create a project" form. An orange play button icon covers the middle of the screenshot. To the right is a sign-up form with fields for "Full name", "Contact email", "Confirm email", and "Password". Below these is a checkbox for accepting the "Terms of Use and Privacy Policy". A reCAPTCHA box with "I'm not a robot" and a "Sign up" button are at the bottom.

OSF HOME ▾

Search Support Donate Sign Up Sign In

# Open Science Framework

A scholarly commons to connect the entire research cycle

FREE AND OPEN SOURCE. START NOW.

Full name

Contact email

Confirm email

Password

I have read and agree to the [Terms of Use](#) and [Privacy Policy](#).

I'm not a robot

reCAPTCHA  
Privacy - Terms

Sign up

# GSERM Demo Project

osf.io

Contributors: Michael Schulte-Mecklenbeck

Date created: 2019-05-16 04:22 PM | Last Updated: 2019-05-16 04:33 PM

Category: Project

Description:

This project serves as a demo for the GSERM workshop - it wants to be forked!

License: CC-By Attribution 4.0 International

## Wiki

### GSERM

In the Wiki you can easily edit (together) and share information about your project with your project team and others.

### Subheader

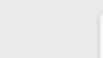
You can add lists:

1. List item 1
2. List item 2
3. ...

Code:

## Files

Click on a storage provider or drag and drop to upload



Filter



Name ▾ ▾

Modified ▾ ▾

GSERM Demo Project

- OSF Storage (Germany - Frankfurt)

## Citation

## Components

Add Component Link Projects

Add components to organize your project.

## Tags

demo x GSERM x pre-registration x Add a tag

## Recent Activity

Michael Schulte-Mecklenbeck added tag pre-registration to GSERM Demo Project

2019-05-16 04:33 PM

Michael Schulte-Mecklenbeck added tag demo to GSERM Demo Project

2019-05-16 04:33 PM

Michael Schulte-Mecklenbeck added tag GSERM to GSERM Demo Project

2019-05-16 04:33 PM

Michael Schulte-Mecklenbeck updated wiki page Home to version 1 of GSERM Demo Project

2019-05-16 04:32 PM

Michael Schulte-Mecklenbeck updated the license of GSERM Demo Project to CC-By Attribution 4.0 International

2019-05-16 04:24 PM

Michael Schulte-Mecklenbeck created GSERM Demo Project

2019-05-16 04:22 PM

# OSF as a project management tool

Toggle view: [View](#) [Edit](#) [Compare](#)

[View](#)      Wiki Version: [Preview](#)

## GSERM

In the Wiki you can easily edit (together) and share information about your project with your project team and others.

### Subheader

You can add lists:

1. List item 1
2. List item 2
3. ...

Code:

```
x <- seq(1:5)
```

Formula:

$$X = \frac{n^2}{2n + 1}$$

[Edit](#)      [Live editing mode ?](#)

**B** *I* ABC | 🌐 “ “ 101 010 | 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 | Autocomplete | ?

```
1 # GSERM
2
3 In the Wiki you can easily edit (together) and share
4 information about your project with your project team and
5 others.
6
7 ## Subheader
8
9 You can add lists:
10
11 1. List item 1
12 2. List item 2
13 3. ...
14
15 Code:
16
17 x <- seq(1:5)
18
19 Formula:
20
21
22 $X = \frac{n^2}{2n+1}
23
24 ### SubSubHeader
```

# Example from replication class

## Bessere Forschung machen - Replikationen, Reproduzierbarkeit und Open Science

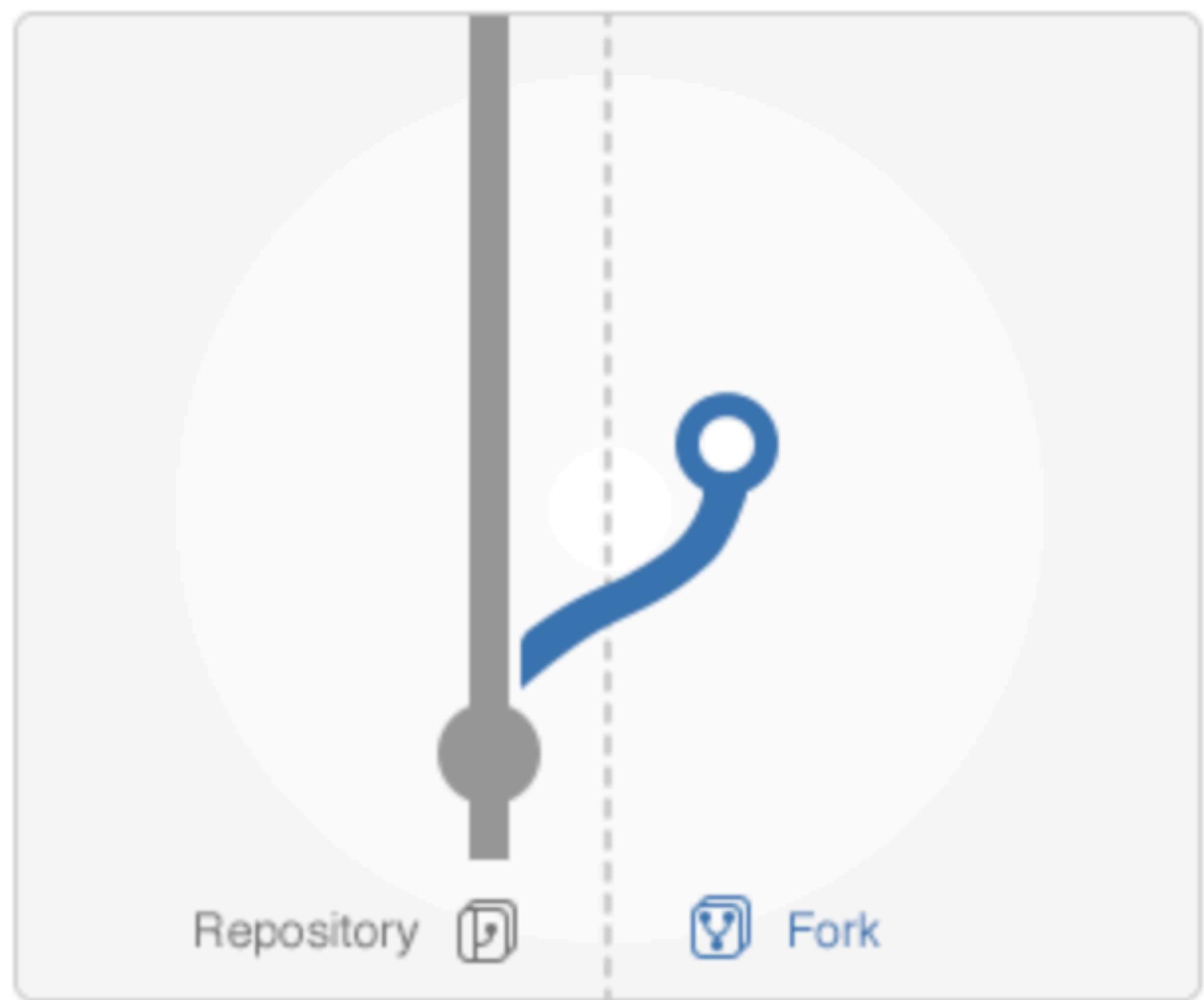
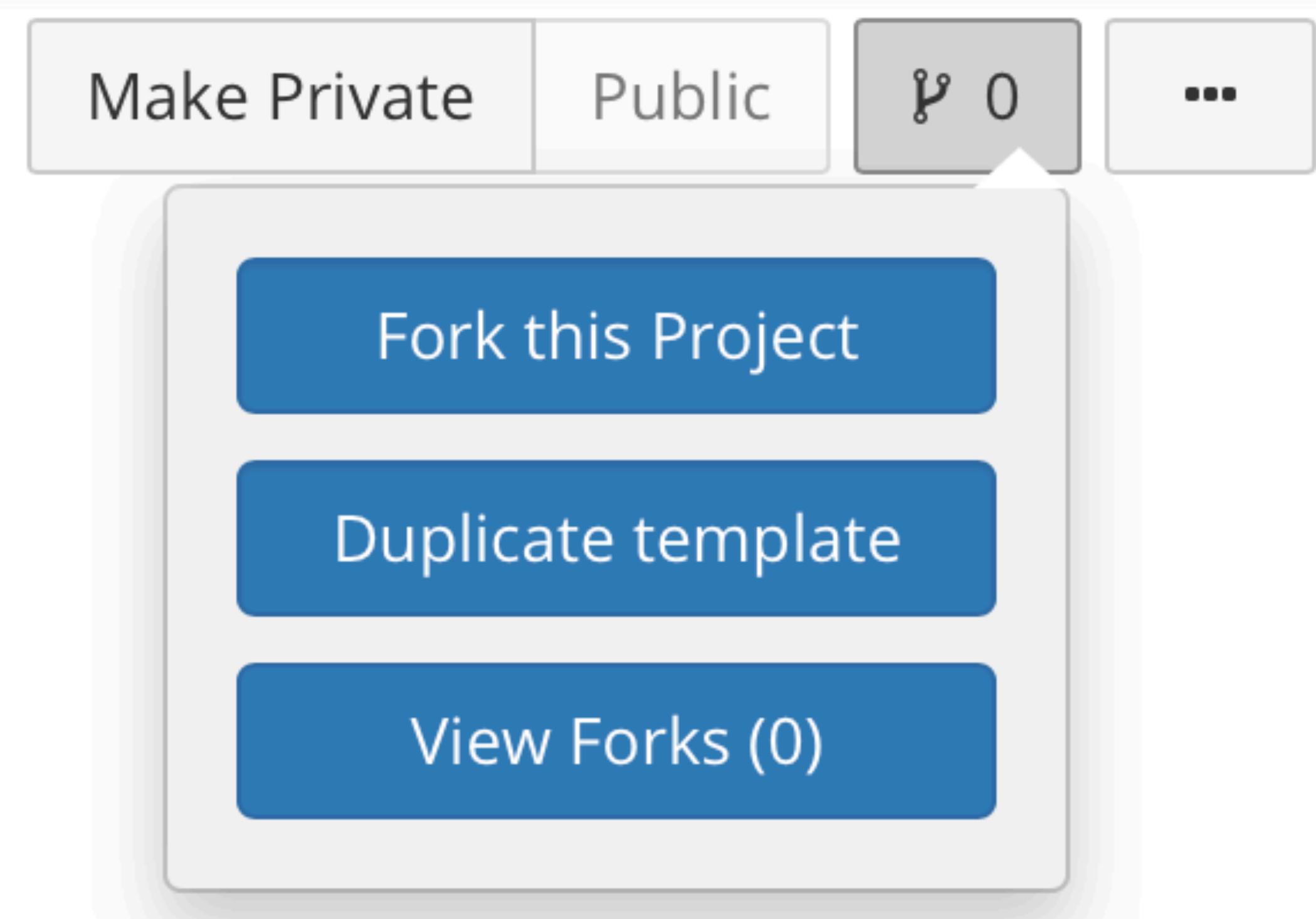
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 Boris Mayer	removed file SessionSlides/Session1_Schulte.pdf from OSF Storage in <a href="#">Bessere Forschung machen - Replikationen, Reproduzierbarkeit und Open Science</a>
	2018-12-17 04:22 PM
 Boris Mayer	added file <a href="#">SessionSlides/Session1.pdf</a> to OSF Storage in <a href="#">Bessere Forschung machen - Replikationen, Reproduzierbarkeit und Open Science</a>
	2018-12-17 04:22 PM
 Michael Schulte-Mecklenbeck	made <a href="#">Bessere Forschung machen - Replikationen, Reproduzierbarkeit und Open Science</a> public
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 Michael Schulte-Mecklenbeck	added file <a href="#">Replication_Seminar_Bern_2018.pdf</a> to OSF Storage in <a href="#">Bessere Forschung machen - Replikationen, Reproduzierbarkeit und Open Science</a>
	2018-12-14 11:55 AM
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	2018-12-14 11:10 AM

< 1 2 3 4 ... 102 >

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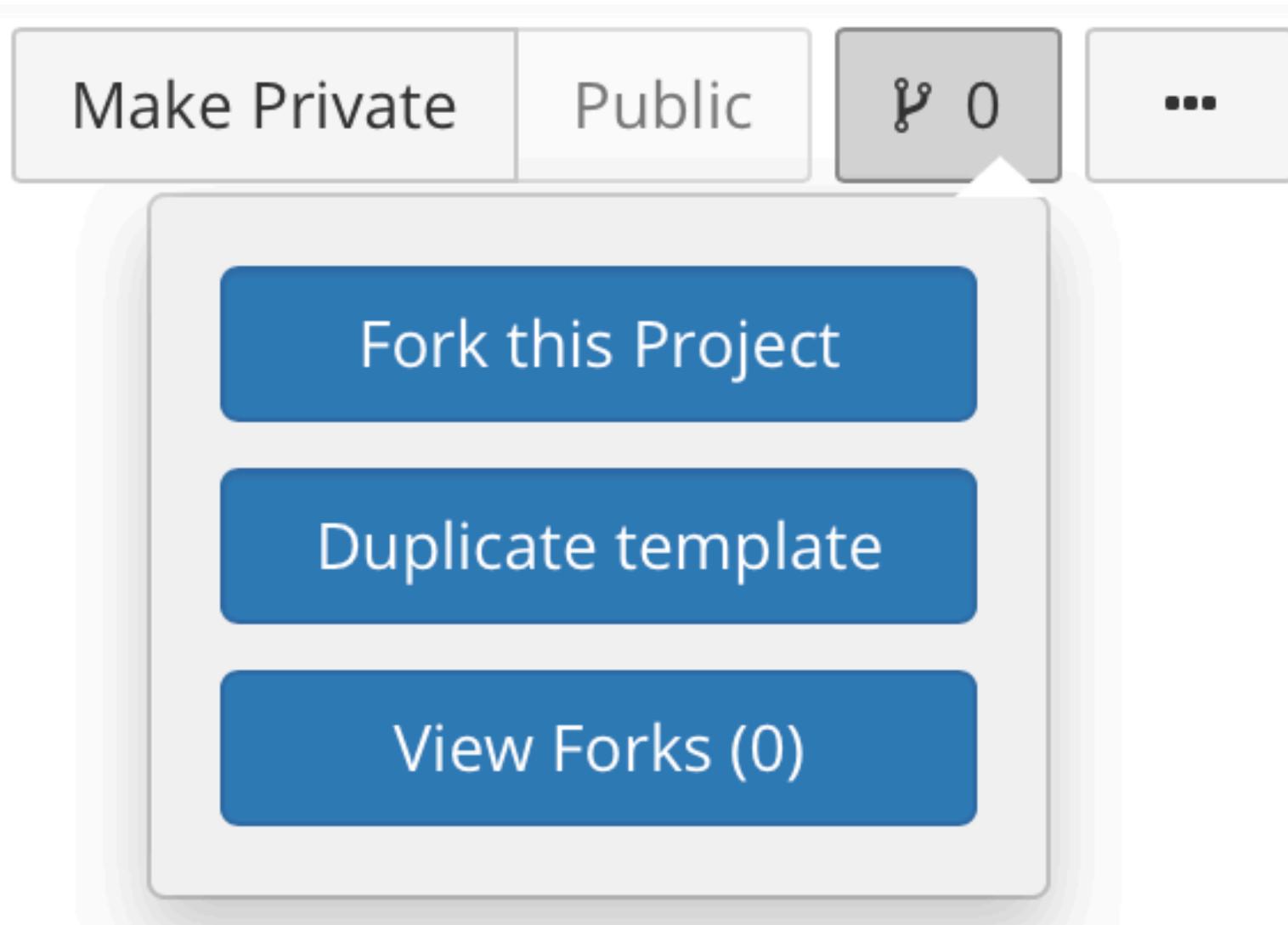
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# Forking a project



# Fork the DEMO GSERM project

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Contributors: Michael Schulte-Mecklenbeck

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Date created: 2019-06-03 09:08 AM | Last Updated: 2019-06-03 09:08 AM

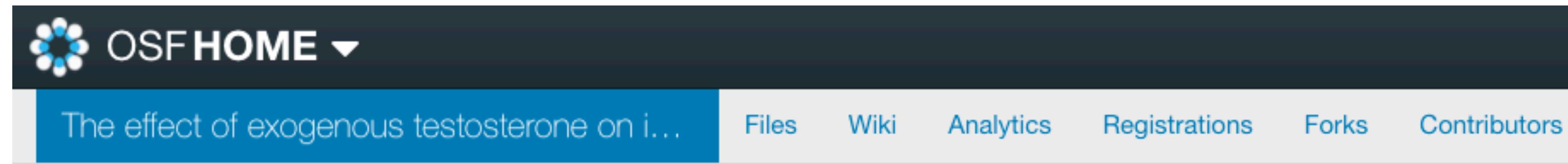
Category: Project

Description:

This project serves as a demo for the GSERM workshop - it wants to be forked!

License: CC-BY Attribution 4.0 International

# Pre-Registration



The effect of exogenous testosterone on i...

OSF HOME ▾

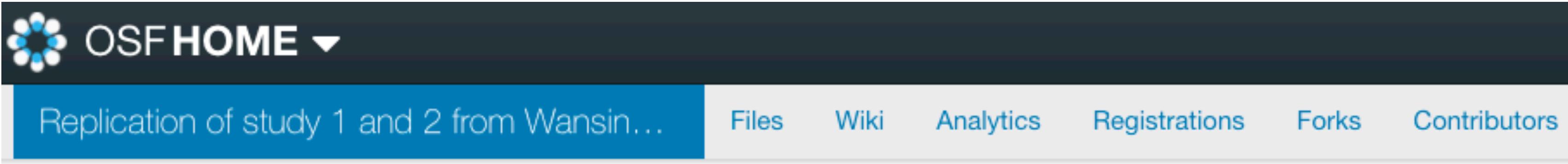
Files Wiki Analytics Registrations Forks Contributors

The effect of exogenous testosterone on intertemporal choices and its underlying mechanisms

Contributors: Iris Ikink, Isabel Woyke, Vivian Heuvelmans, Michael Schulte-Mecklenbeck, Bernd Figner, Karin Roelofs

Date created: 2016-12-23 03:21 PM | Last Updated: 2017-07-11 03:57 PM

Category: Project 



Replication of study 1 and 2 from Wansin...

OSF HOME ▾

Files Wiki Analytics Registrations Forks Contributors

Replication of study 1 and 2 from Wansink 2006

Contributors: Florian Fankhauser, Michael Schulte-Mecklenbeck

Date created: 2017-03-14 02:45 PM | Last Updated: 2017-05-19 08:58 AM

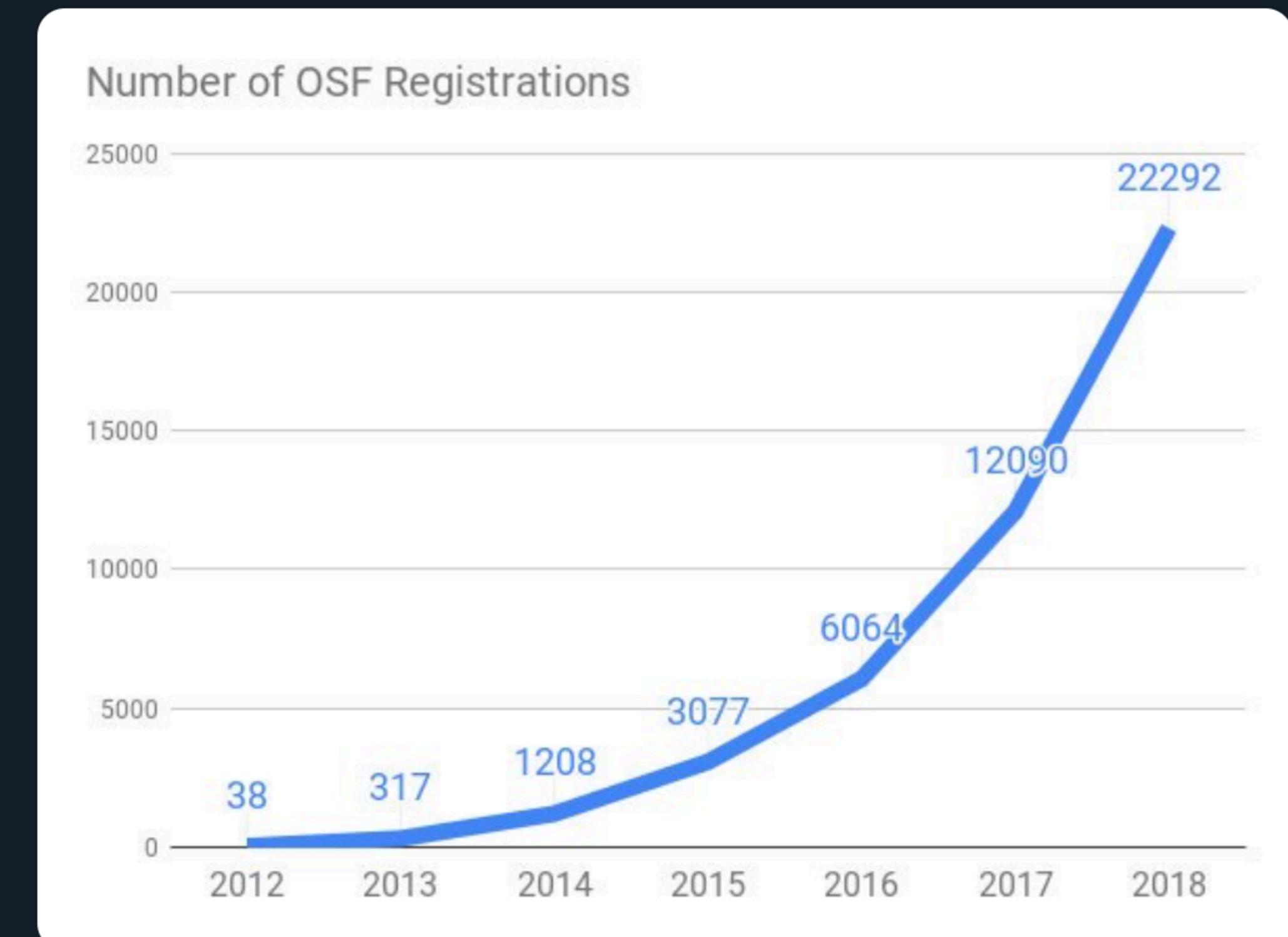
Category: Project 



Brian Nosek  
@BrianNosek

Following

The growth of study registration in basic and preclinical research has been excellent, but there is a lot more to do to realize the potential for study registration. Short thread for what's on deck for improvements to OSF registration...



# Register

Registration creates a frozen version of the project. Your original project remains editable and will have the registration linked.

Things to know about registration:

- **Registrations cannot be edited or deleted.**
- Withdrawing a registration removes its contents, but leaves behind basic metadata: title, contributors, date registered, date withdrawn, and justification (if provided).
- Registrations can be public or embargoed for up to four years. Embargoed registrations will be made public automatically when the embargo expires.

Continue your registration by selecting a registration form:

- OSF Preregistration ⓘ
- Open-Ended Registration ⓘ
- Registered Report Protocol Preregistration ⓘ
- Preregistration Template from AsPredicted.org ⓘ
- OSF-Standard Pre-Data Collection Registration ⓘ
- Replication Recipe (Brandt et al., 2013): Post-Completion ⓘ
- Replication Recipe (Brandt et al., 2013): Pre-Registration ⓘ
- Pre-Registration in Social Psychology (van 't Veer & Giner-Sorolla, 2016): Pre-Registration ⓘ

Cancel

Create draft

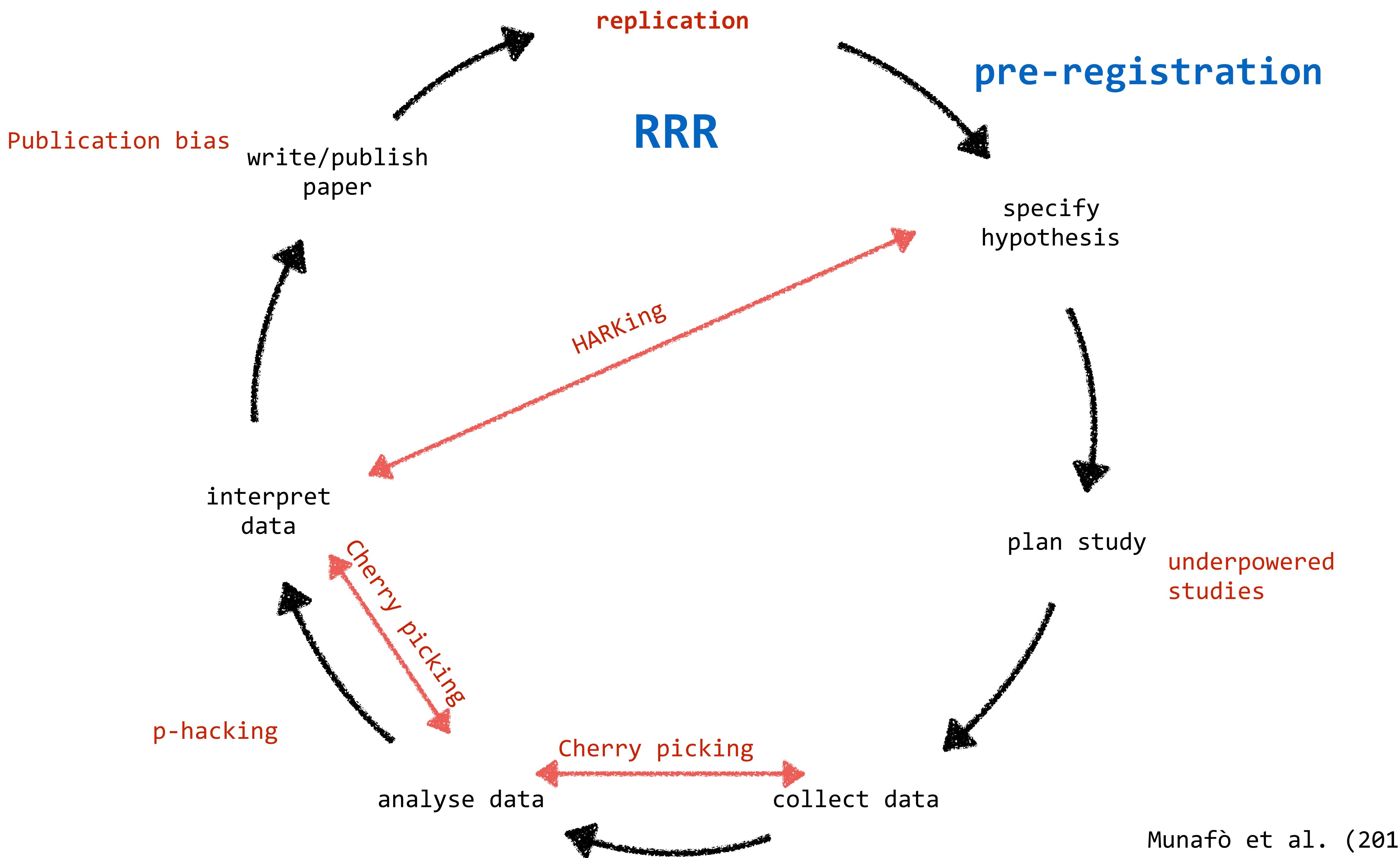
## 8 questions for pre-registration

1. Have any **data** been **collected** for this study already?
2. What's the **main question** being asked or hypothesis being tested in this study?
3. Describe the **key dependent variable(s)** specifying how they will be measured.
4. How many and which **conditions** will participants be assigned to?
5. Specify exactly which **analyses** you will conduct to examine the main question/hypothesis.
6. Any secondary analyses?
7. How many **observations** will be collected or what will determine **sample size**?
8. Anything else you would like to pre-register? (e.g., data exclusions, variables collected for exploratory purposes, unusual analyses planned?)

Last auto-saved: Wed May 29 2019 17:25:47 GMT+0200 (CEST)

Save draft

Preview for submission



# Reproducible analysis and Standard operating procedures (SOPs)

## LEARN TO CODE !

### Zurich Toolbox for Readymade Economic Experiments



z-Tree is a [widely used](#) software package for developing and carrying out economic experiments. The language used to define the experiments is simple and compact, meaning that experiments can be developed quickly, and programming experience is not necessary, though useful.



*PsychoPy<sup>3</sup>*



## GO OPEN SOURCE !

# ONE DATA SET, MANY ANALYSTS

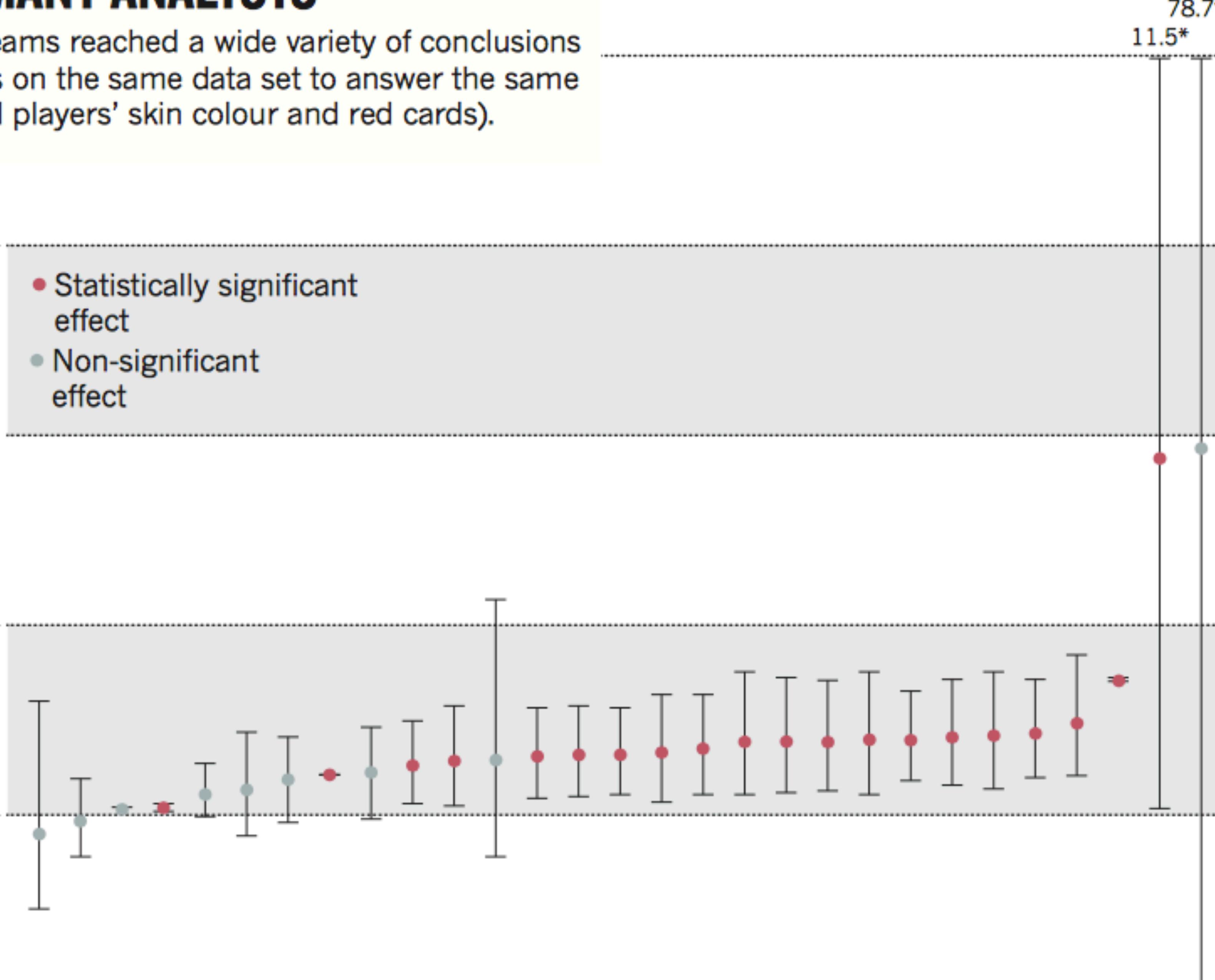
Twenty-nine research teams reached a wide variety of conclusions using different methods on the same data set to answer the same question (about football players' skin colour and red cards).

Dark-skinned players four times more likely than light-skinned players to be given a red card.

- Statistically significant effect
- Non-significant effect

Twice as likely

Equally likely



**Reproducible analysis**  
Standard operating procedures (SOPs)

**LEARN TO CODE !**

## Exercise: Motivating reproducibility

To Do...

This is a two-part exercise:

Part 1: Analyze + document

Part 2: Swap + discuss

## Part 1: Analyze + document (Group 1)

To Do...

Write instructions / documentation for your collaborator to reproduce your work starting with the original dataset (`gapminder-5060.csv`). You find the dataset in your forked GSREM OSF project.

1. **Visualize** life expectancy over time for Canada in the 1950s and 1960s using a **line plot**.
2. Something is clearly wrong with this plot! Turns out there's a data error in the data file: **life expectancy** for Canada in the year **1957** is coded as **999999**, it **should actually be 69.96**. Make this correction.
3. **Visualize** life expectancy over time for Canada again, with the corrected data.
4. If you find all this too easy: Add lines for Mexico and United States.

## Part 1: Analyze + document (Group 2)

To Do...

Write instructions / documentation for your collaborator to reproduce your work starting with the original dataset (`gapminder-7080.csv`). You find the dataset in your forked GSREM OSF project.

1. **Visualize** life expectancy over time for Austria in the 1970s and 1980s using a **line plot**.
2. Something is clearly wrong with this plot! Turns out there's data missing. **Life expectancy** for Austria in the year **1982 should actually be 73.18**. Make this correction.
3. **Visualize** life expectancy over time for Canada again, with the corrected data.
4. If you find all this too easy: Add lines for Afganistan and Switzerland.

## Part 2: Swap + discuss

To Do...

Introduce yourself to your neighbour and ...

1. **Swap instructions** with your collaborator, and try to reproduce their work, first without talking to each other. If your collaborator does not have the software they need to reproduce your work, we encourage you to either help them install it or walk them through it on your computer in a way that would emulate the experience. (Remember, this could be part of the irreproducibility problem!)
2. Then, talk to each other about **challenges you faced** (or didn't face) or why you were or weren't able to reproduce their work.

## Reflection



What tools did you use (Excel / R / Python / Word / plain text etc.)?

Were you successful in reproducing each others' work?

What would happen if your collaborator is no longer available to walk you through their analysis?

What made it easy / hard for reproducing your partners' work?

# Four facets of reproducibility

**Documentation:** difference between binary files (e.g. docx) and text files and why text files are preferred for documentation

**Protip:** Use markdown to document your workflow so that anyone can pick up your data and follow what you are doing

**Organization:** tools to organize your projects so that you don't have a single folder with hundreds of files

**Automation:** the power of scripting to create automated data analyses

**Dissemination:** publishing is not the end of your analysis, rather it is a way station towards your future research and the future research of others

# Reproducible analysis

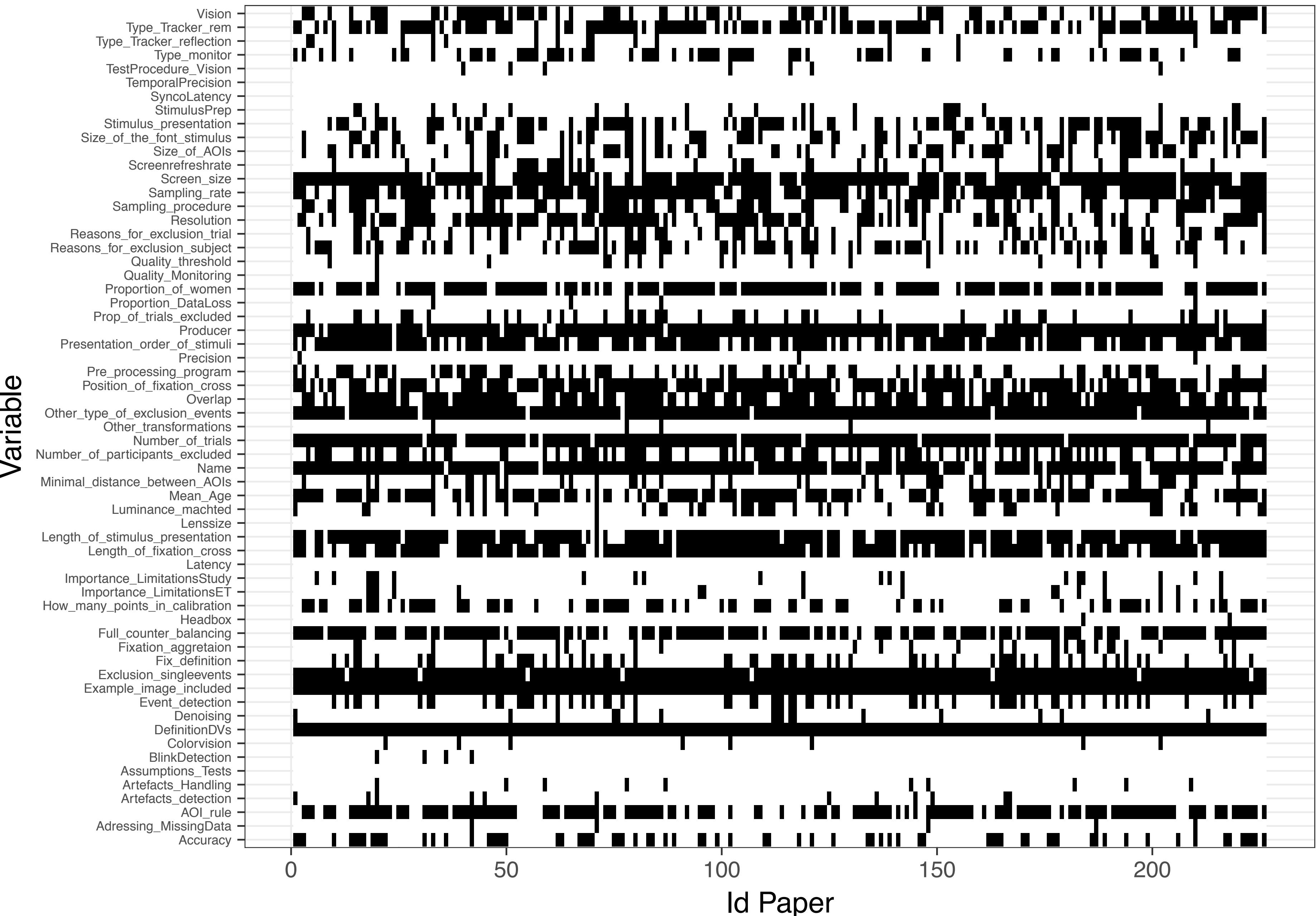
## Standard operating procedures (SOPs)

### Method

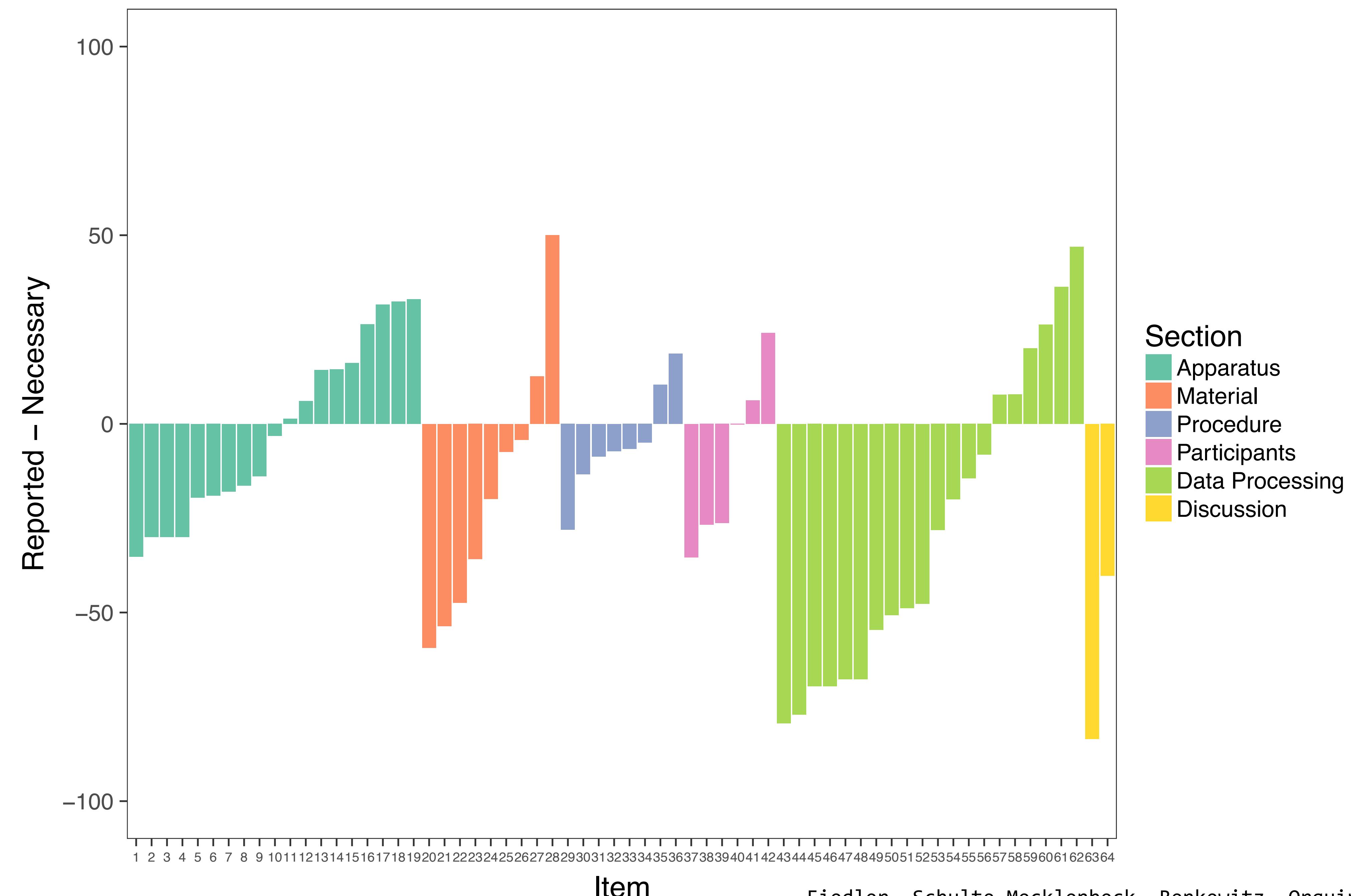
- The title **Method** (bolded) is centered above my method section.
- I use **Participants**, **Materials**, and **Procedure** as subheadings for different parts of my method section. These subheadings are left-justified.
- I use separate subheadings to denote separate parts of the materials and procedure. These subheadings are indented and begin the first line of the paragraph. They end with a period. Only the first word of the heading is capitalized unless it is the name of a specific test or measure (e.g., **Implicit Association Test (IAT)** vs. **Priming stimuli**).
- I describe the participants:
  - The number of participants [e.g., (52 men, 58 women)].
  - The participants' ages, including range (e.g., "from 18 to 22 years"), mean, and standard deviation. Note: mean age is rounded to one decimal place.
  - Other pertinent demographic characteristics (e.g., ethnicity, handedness, sexual orientation, etc. depending on the study).
  - Who the participants are or where they are from (e.g., undergraduates at a small liberal arts college, parents of 3-month-old children, etc.).
  - How I recruited the participants (e.g., "Participants were recruited through an online study sign-up system.").
  - How I compensated the participants for taking part in the study (e.g., "Participants were entered into a lottery to win \$100.").
- I describe the materials and/or apparatus:
  - I describe measures in detail (e.g., "I used a 12-item measure of anxiety ranging from 1 (never) to 7 (always) to evaluate participants' levels of anxiety on a day-to-day basis. Half of the items were reverse-scored to reduce response bias."). I also provide one or two sample items.
  - I describe any equipment used (e.g., eye tracker, Inquisit computer program), including the company name and model.
  - I do not list pen, paper, or other unimportant items as materials.
- I describe the procedure:
  - I describe what took place in chronological order, including informed consent and debriefing.
  - I do not describe any information explained previously in the Participants or Materials sections.
- Someone reading my method section would be able to replicate my study exactly.

Standard operating procedures (SOPs) are written instructions documenting how routine tasks should be done.

# What is reported in eye-tracking studies?



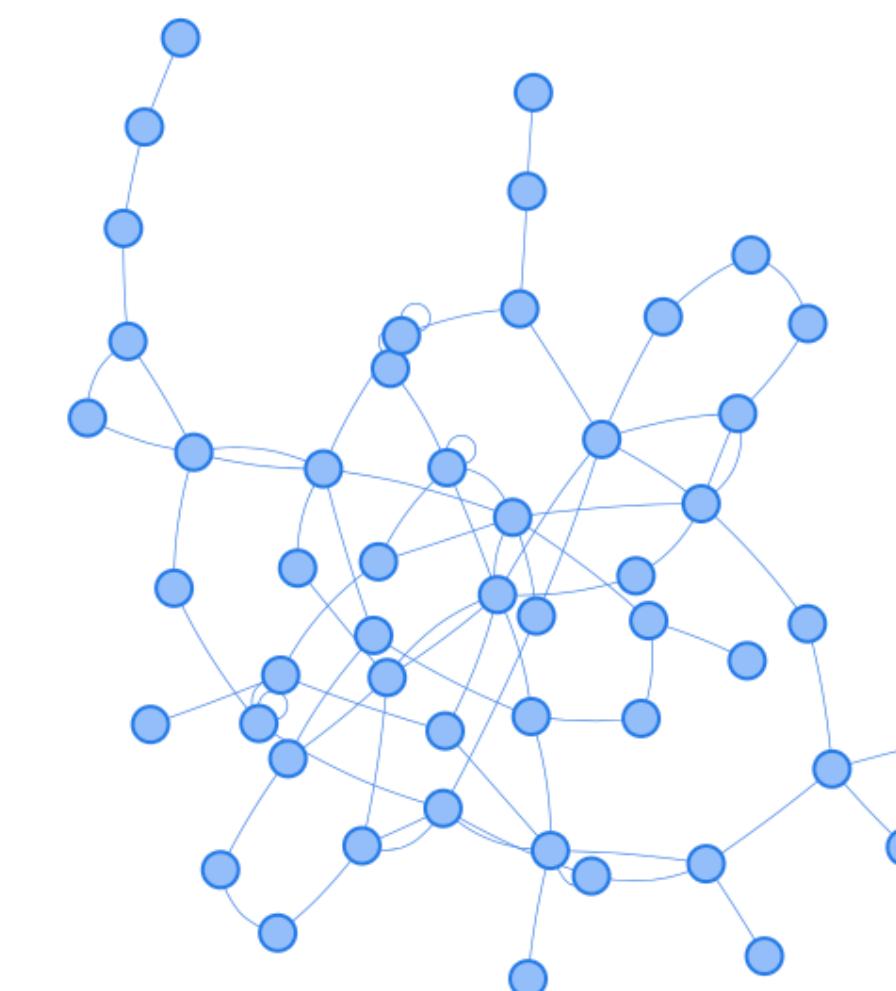
# The iGuideline



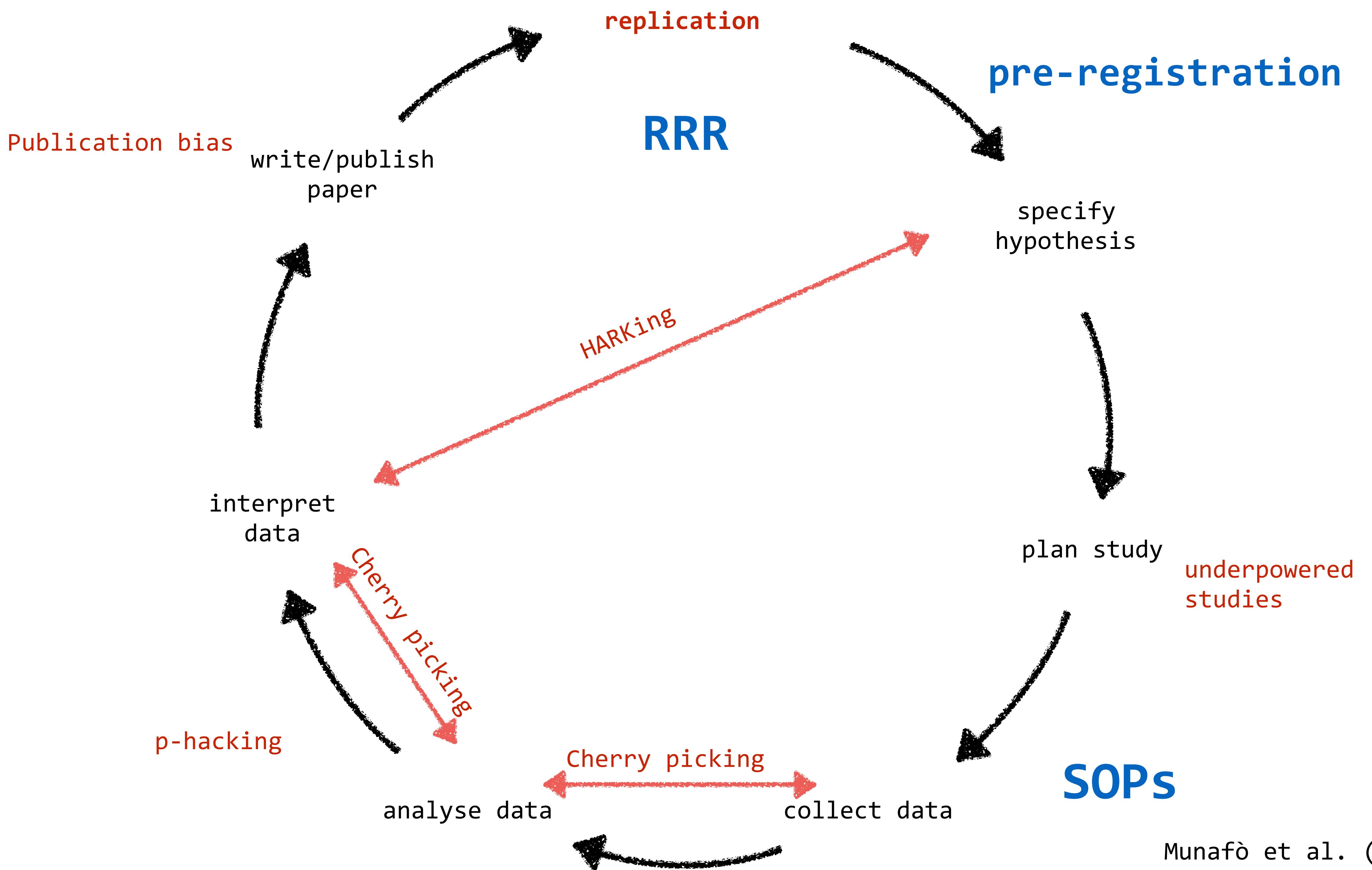
# EyeGuidelines

## Maximizing reproducibility of eyetracking studies.

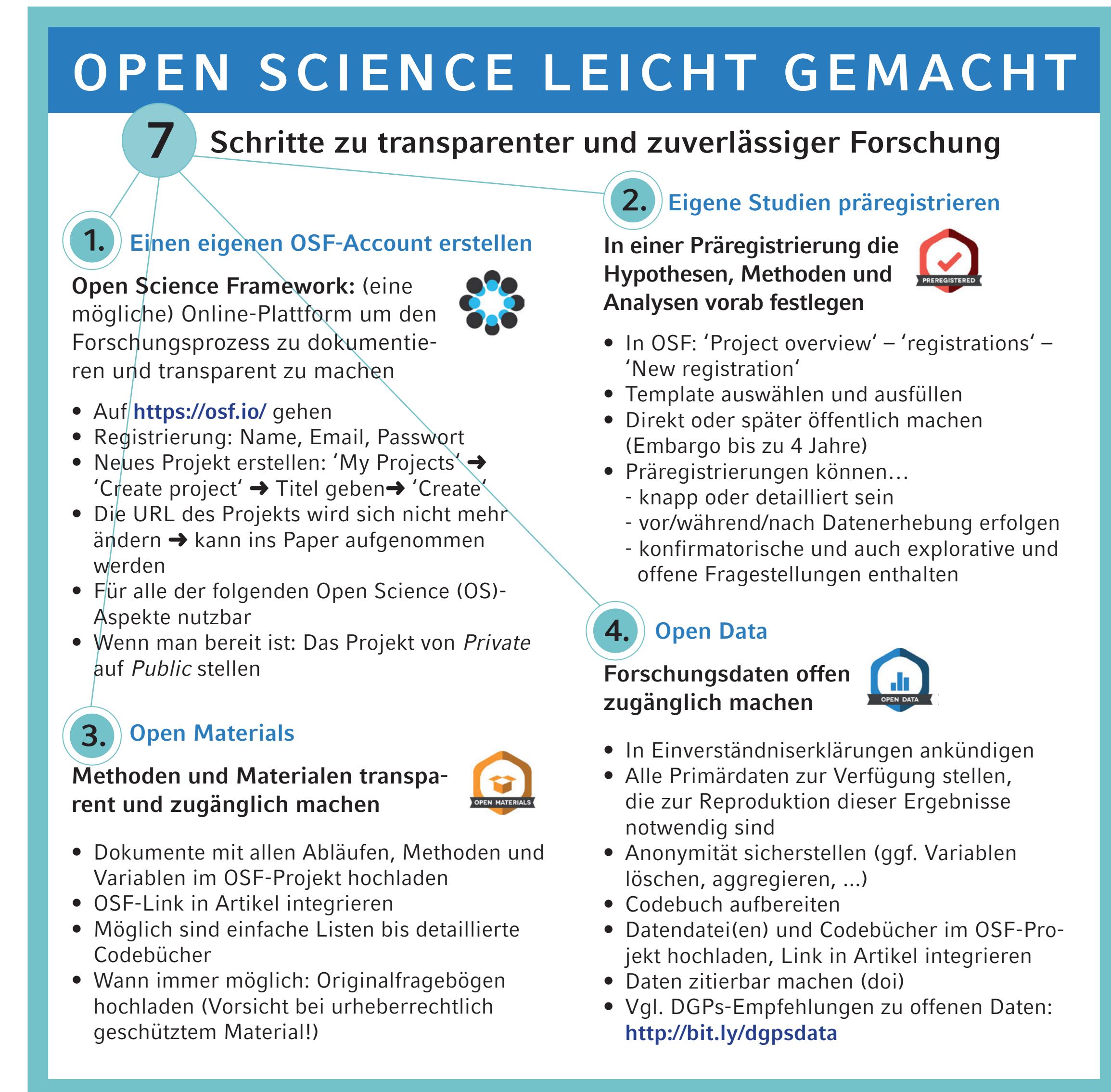
Susann Fiedler, Michael Schulte-Mecklenbeck, Jacob L. Orquin & Frank Renkewitz



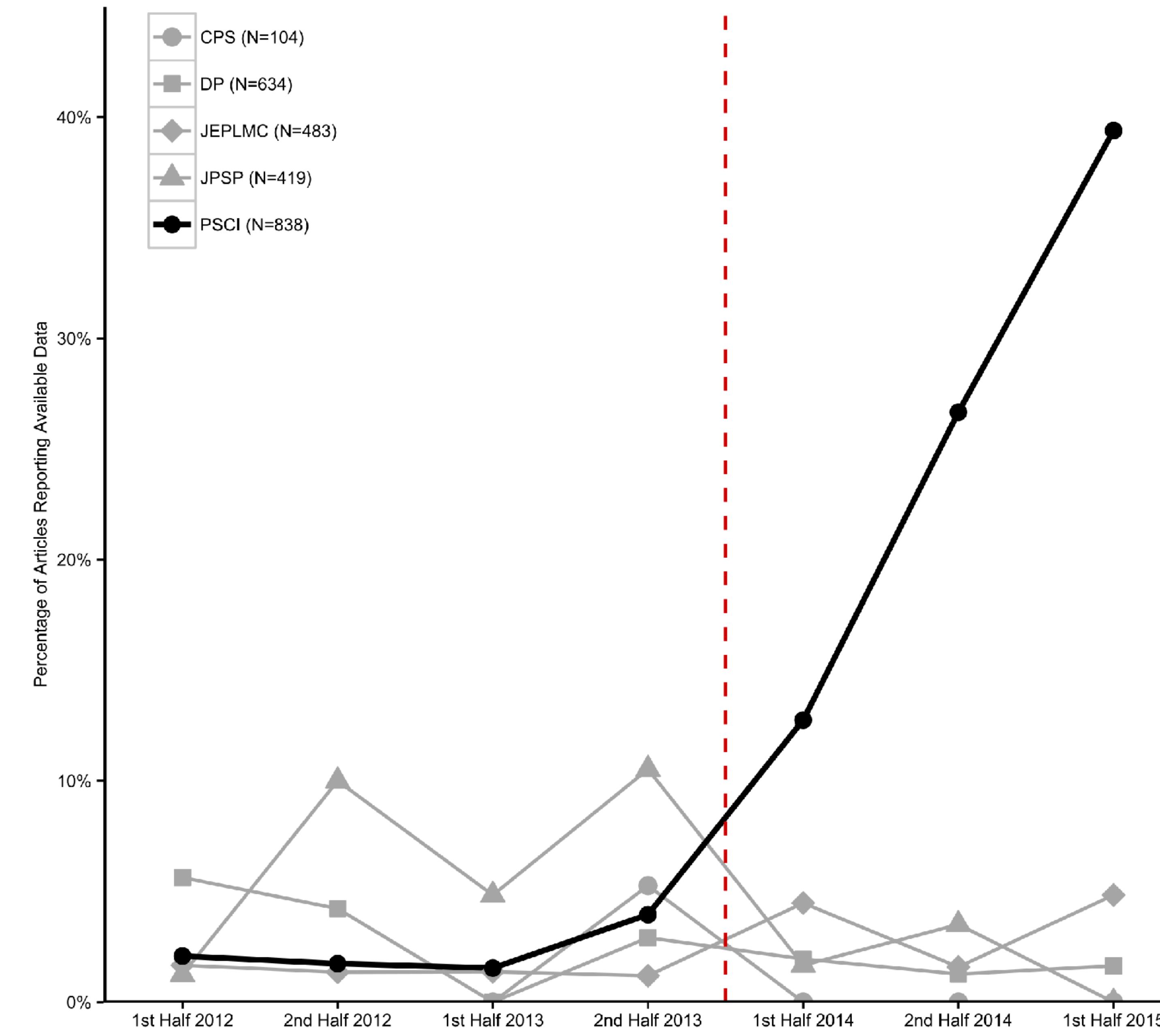
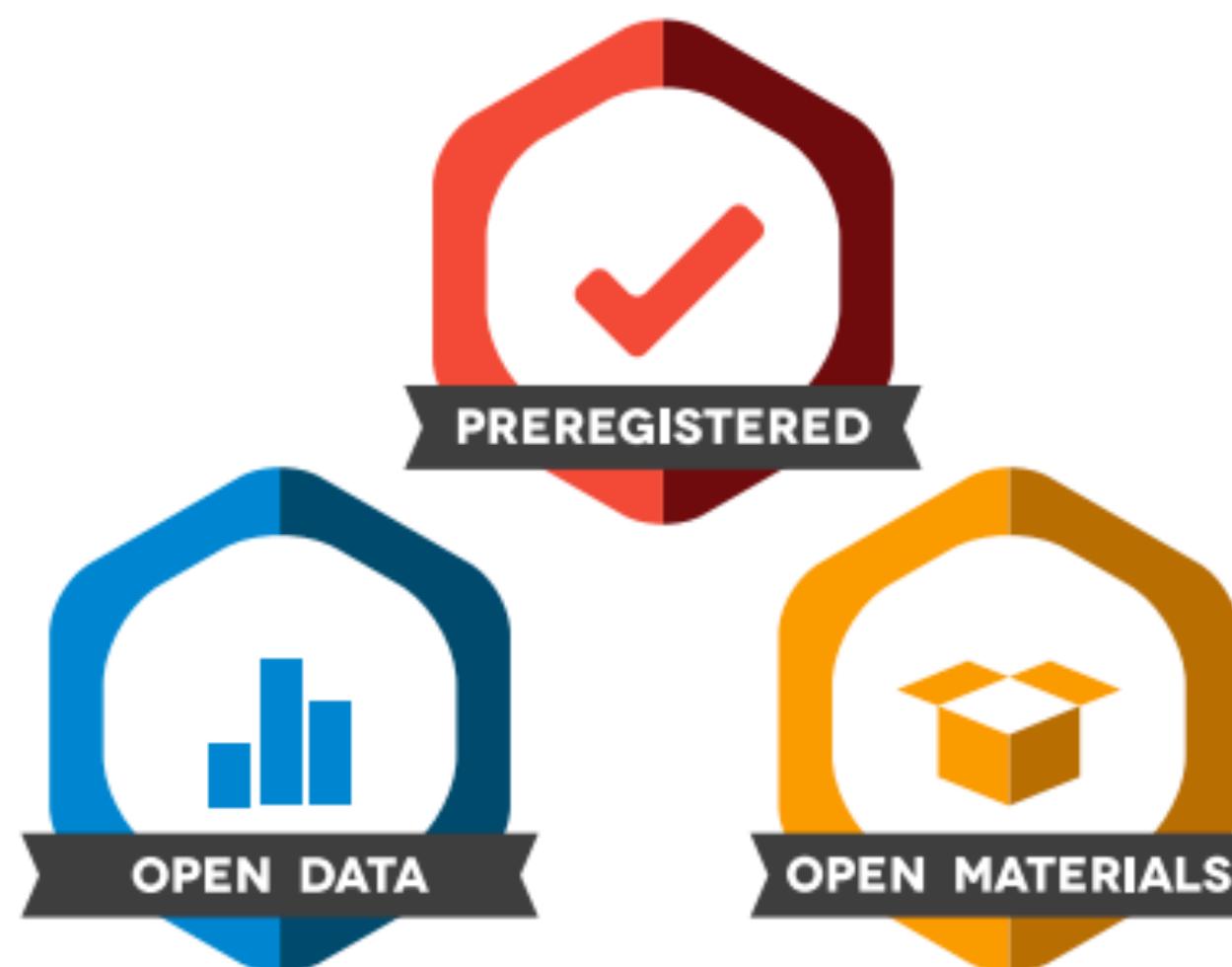
Standards are an essential part of the scientific method. They guarantee a commonly accepted approach for (reproducible) research, ensure agreement on how data should be collected and analyzed, and how reporting of the methods and results should be done. This last aspect of standards is central to the here introduced list of Minimal Reporting Standards that is meant to increase reproducibility of eye-tracking research in JDM.



# Open Science ([osf.io](https://osf.io))



# Do badges work?



**Fig 2. Reportedly available data.** Percentage of articles reporting open data by half year by journal. Darker line indicates *Psychological Science*, and dotted red line indicates when badges were introduced in *Psychological Science* and none of the comparison journals. Underlying data (<https://osf.io/a29bt/>) and scripts (<https://osf.io/bdtng/>) to reproduce this figure can be found on the Open Science Framework.

## Theory

## A problem in theory

Michael Muthukrishna  <sup>1\*</sup> and Joseph Henrich  <sup>2,3</sup>

Science is built up of facts, as a house is built of stones; but an accumulation of facts is no more a science than a heap of stones is a house. (Poincaré, 1905)

Some subfields of psychology [CB] have traditionally placed a premium on **slick studies with surprising results**. But ‘surprising’ should occur with reference to particular hypotheses derived from a broader general theory, **not based on folk intuitions** and theories derived from one’s own life experience.

Compounding the problem, most psychologists [CB-researchers] are **WEIRD**; their lives and intuitions often **differ in dramatic ways** from those of people in most societies, undercutting our efforts to accumulate knowledge ... [italics added]

# Overview

- **The problem**  
Why most of published research findings are false.
- **The catalysts**  
Questionable Research Practices  
Fraud
- **More bad news: replication failures**  
Business  
Psychology
- **The solutions**  
Registered Replication Report  
Pre-Registration  
Standards  
Open Science ([osf.io](https://osf.io))  
Theory

Thanks  
for your  
attention!



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@SchulteMi



# Overview

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