# Reproducibility – a workshop

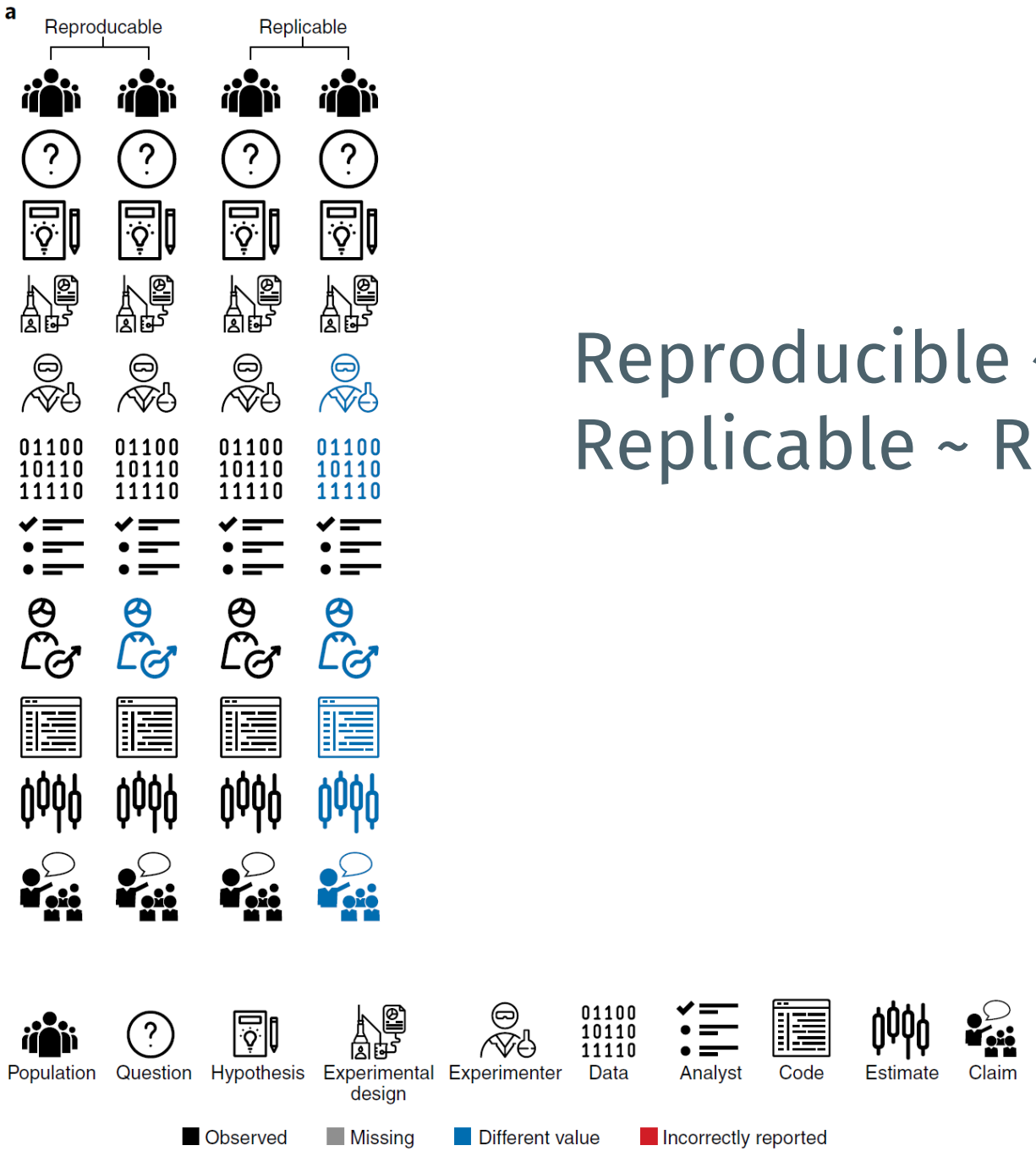
**Ulf Toelch**

BIH QUEST
Center for Responsible Research

BIH Berlin Institute of Health @Charité

# What to expect...

1. **Reproducibility: Definitions.**
2. **The standard test for truth**
3. **Questionable Research Practices and their effects**
4. **Preregistrations and registered reports.**
5. **Can everything be reproducible?**




# Reproducible ~ Methods Reproducibility
# Replicable ~ Results Reproducibility

Patil, P., Peng, R.D. & Leek, J.T. A visual tool for defining reproducibility and replicability. *Nat Hum Behav* **3,** 650–652 (2019). https://doi.org/10.1038/s41562-019-0629-z

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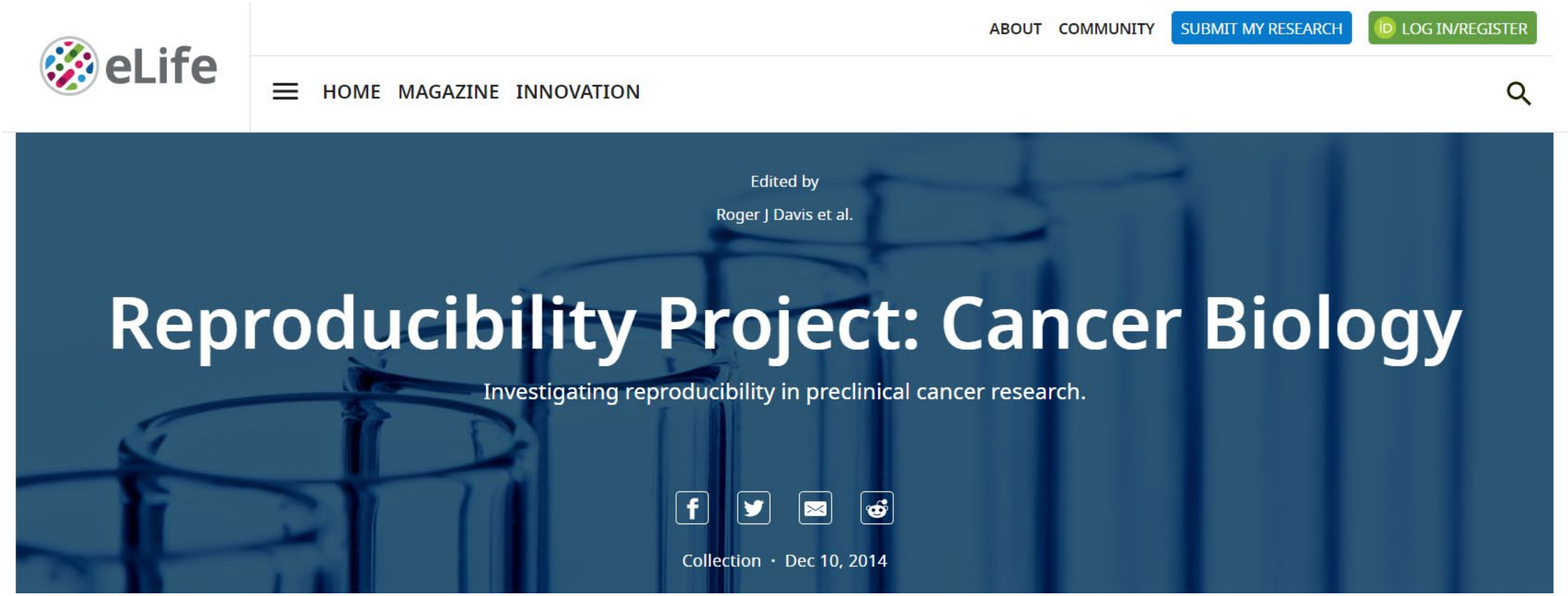
# Reproducibility Initiatives




- Main findings from **50 high impact citations/publications** in cancer research



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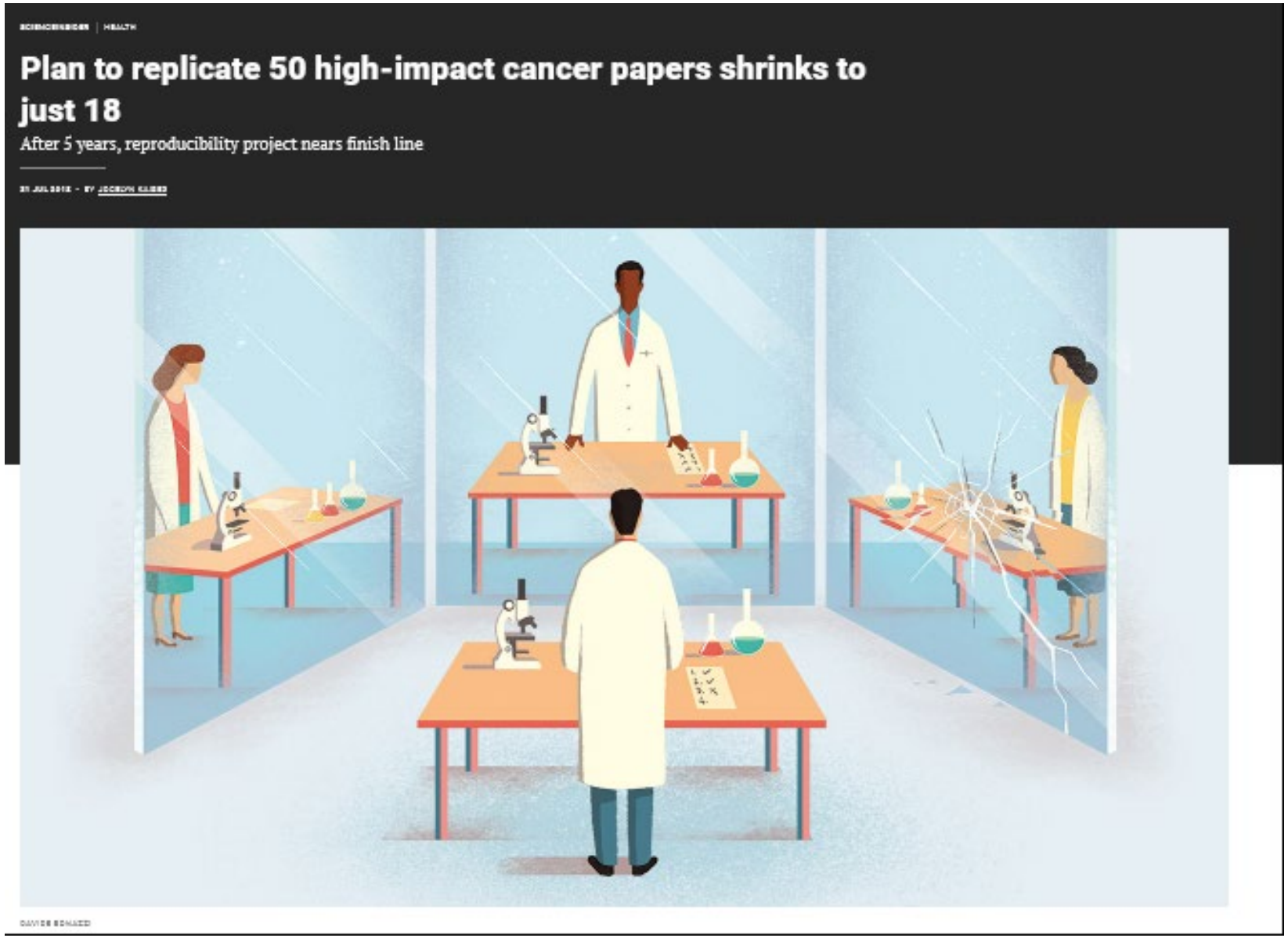
# Results of Reproducibility Project : Cancer Biology



SCIENCEMAG | HEALTH

## Plan to replicate 50 high-impact cancer papers shrinks to just 18

After 5 years, reproducibility project nears finish line

31 JUL 2018 · BY JOCELYN KAISER

DAVIDE BONAZZI

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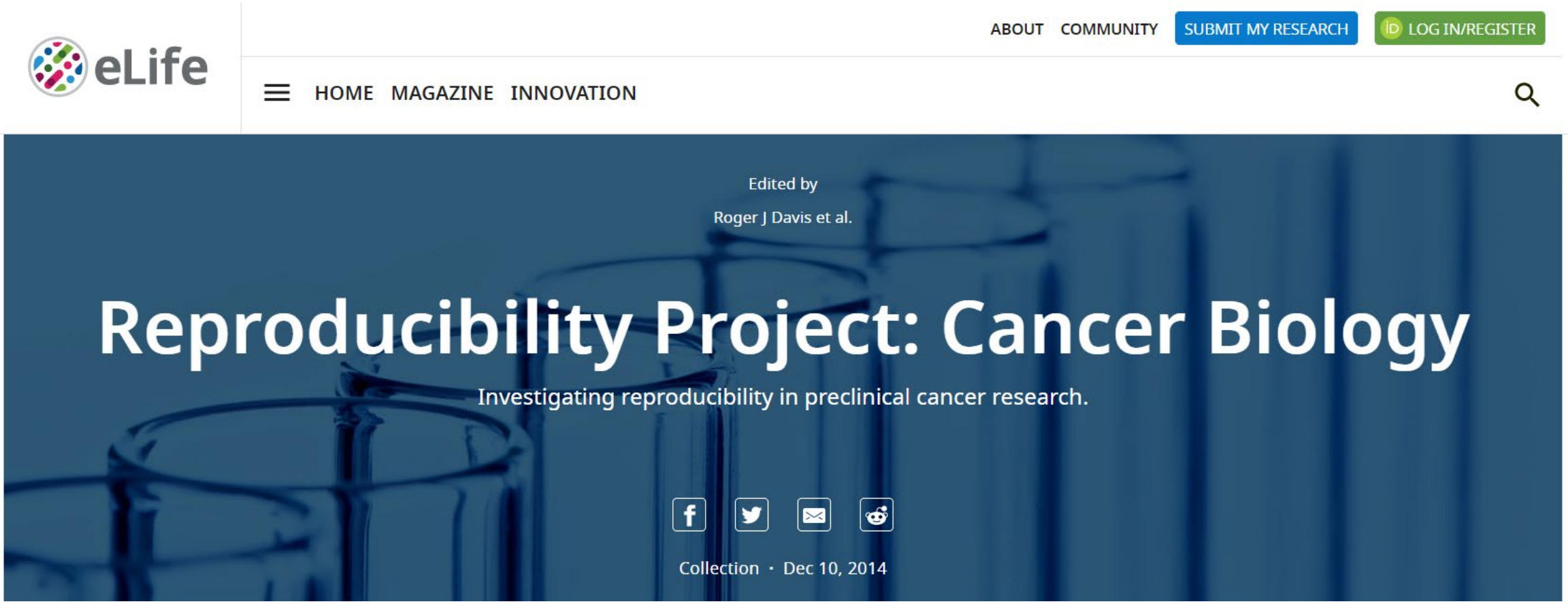
# Reproducibility Initiatives




- Main findings from **50 high impact citations/publications** in cancer research

**5 replicated most results**

**6 replicated parts but not all results**

**6 were not able to reproduce results**



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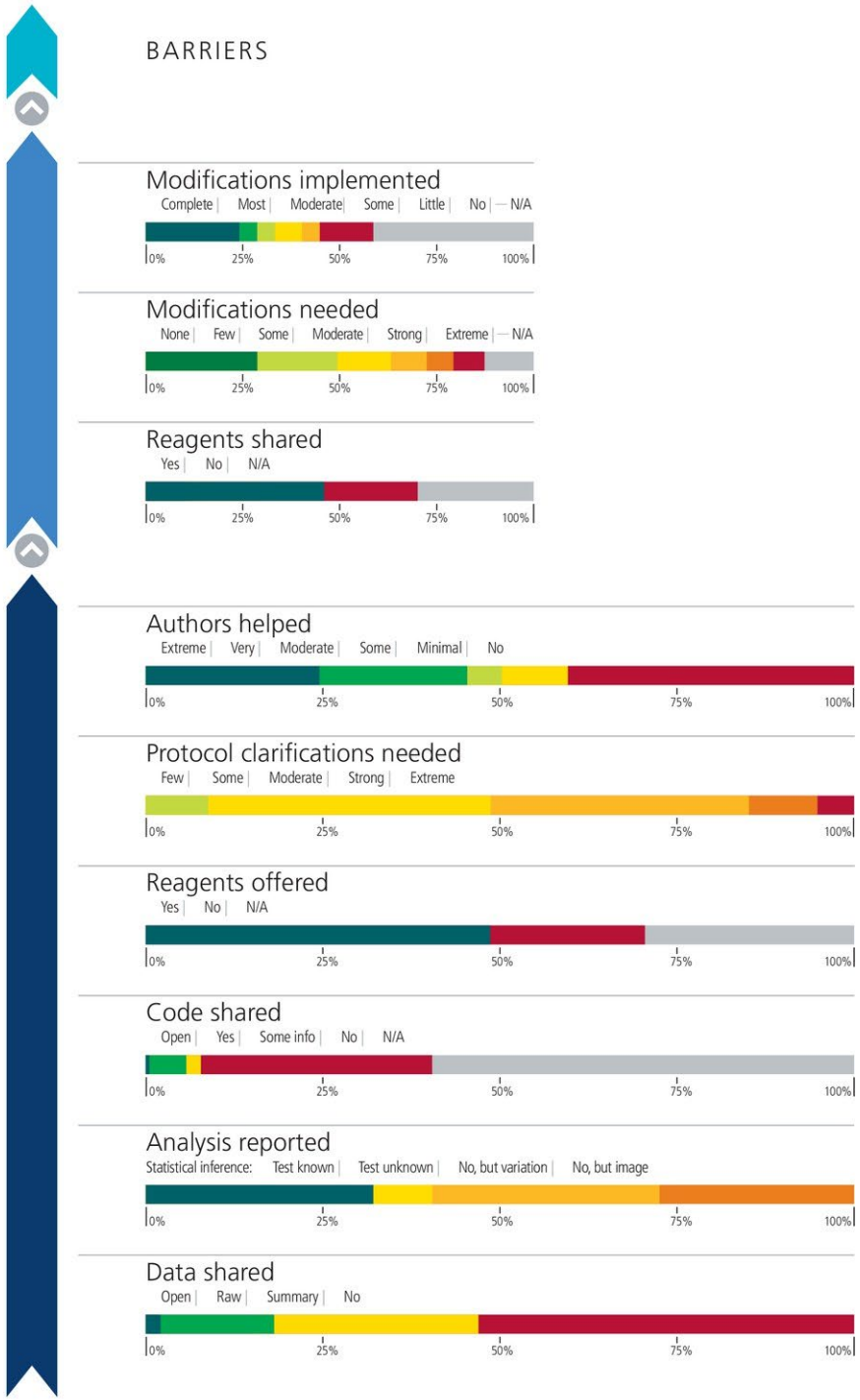
# Roadblocks to Replication

**COMPLETED**
50 experiments

**INITIATED**
87 experiments

**DESIGNED**
193 experiments

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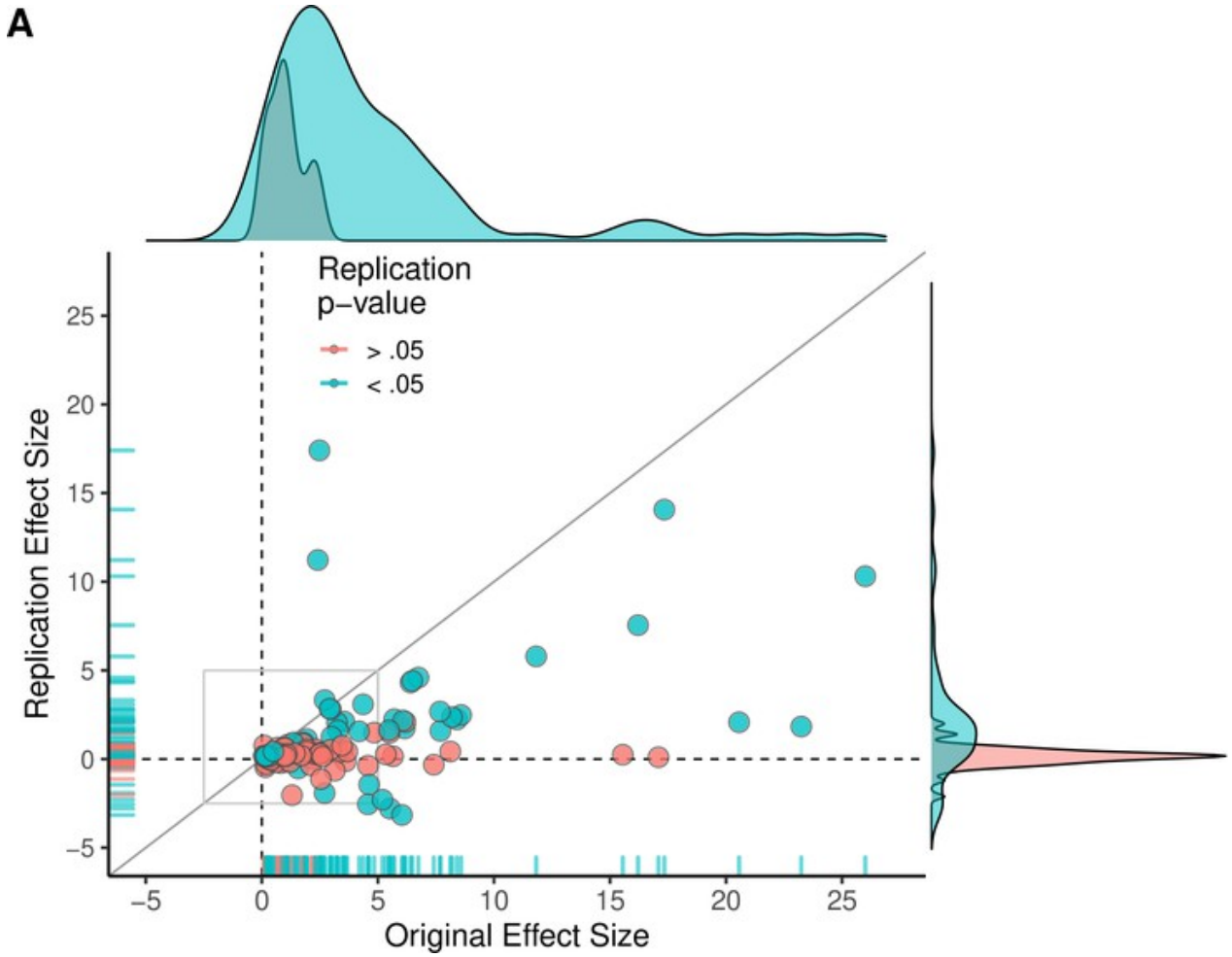
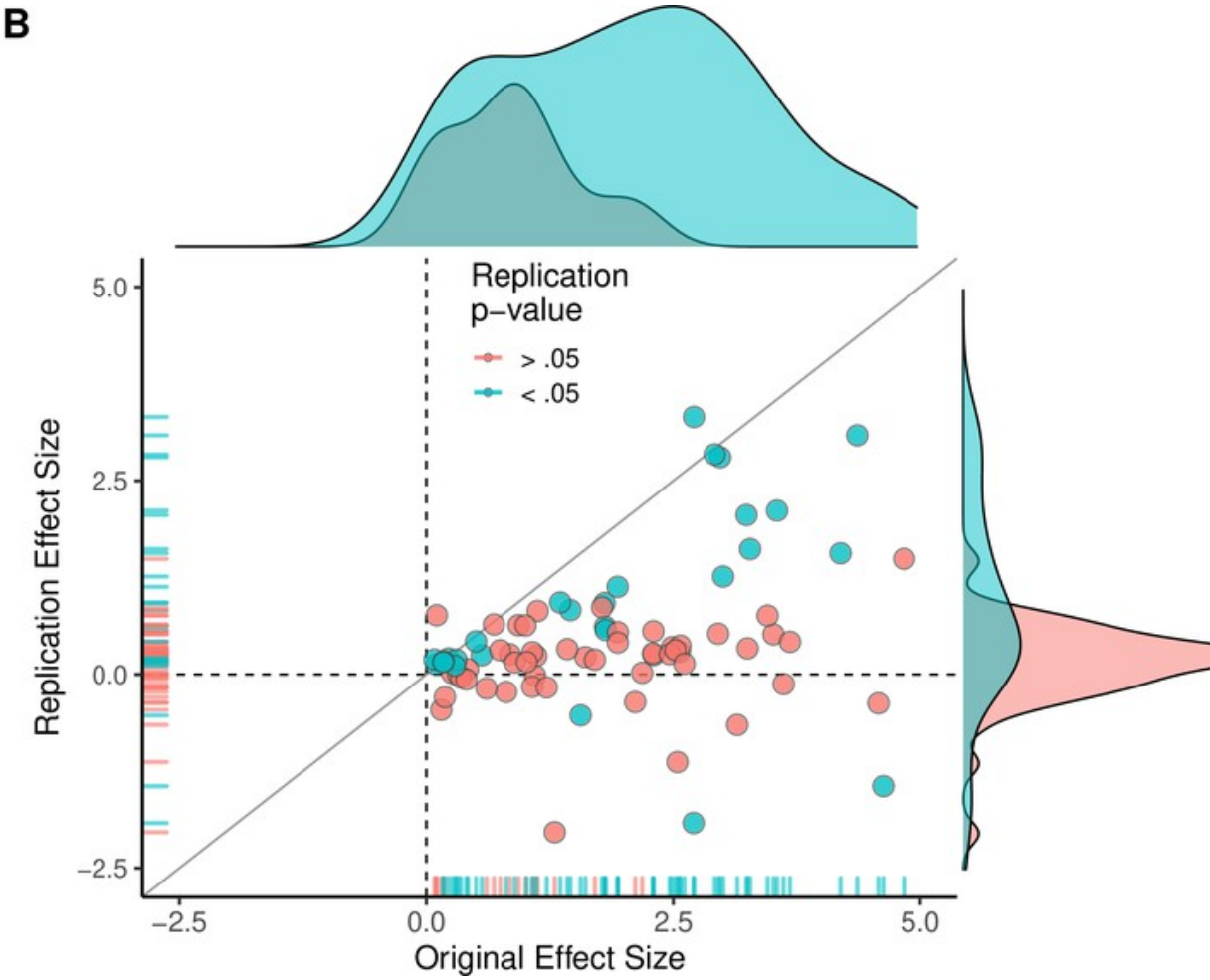
# Replication success limited



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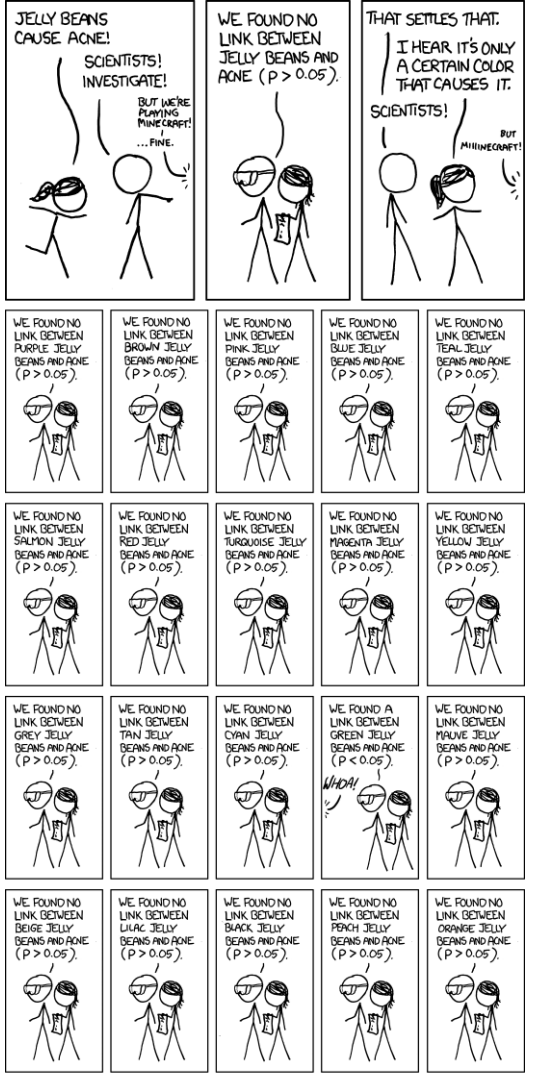
# Science: How to search for the truth...




https://xkcd.com/882/



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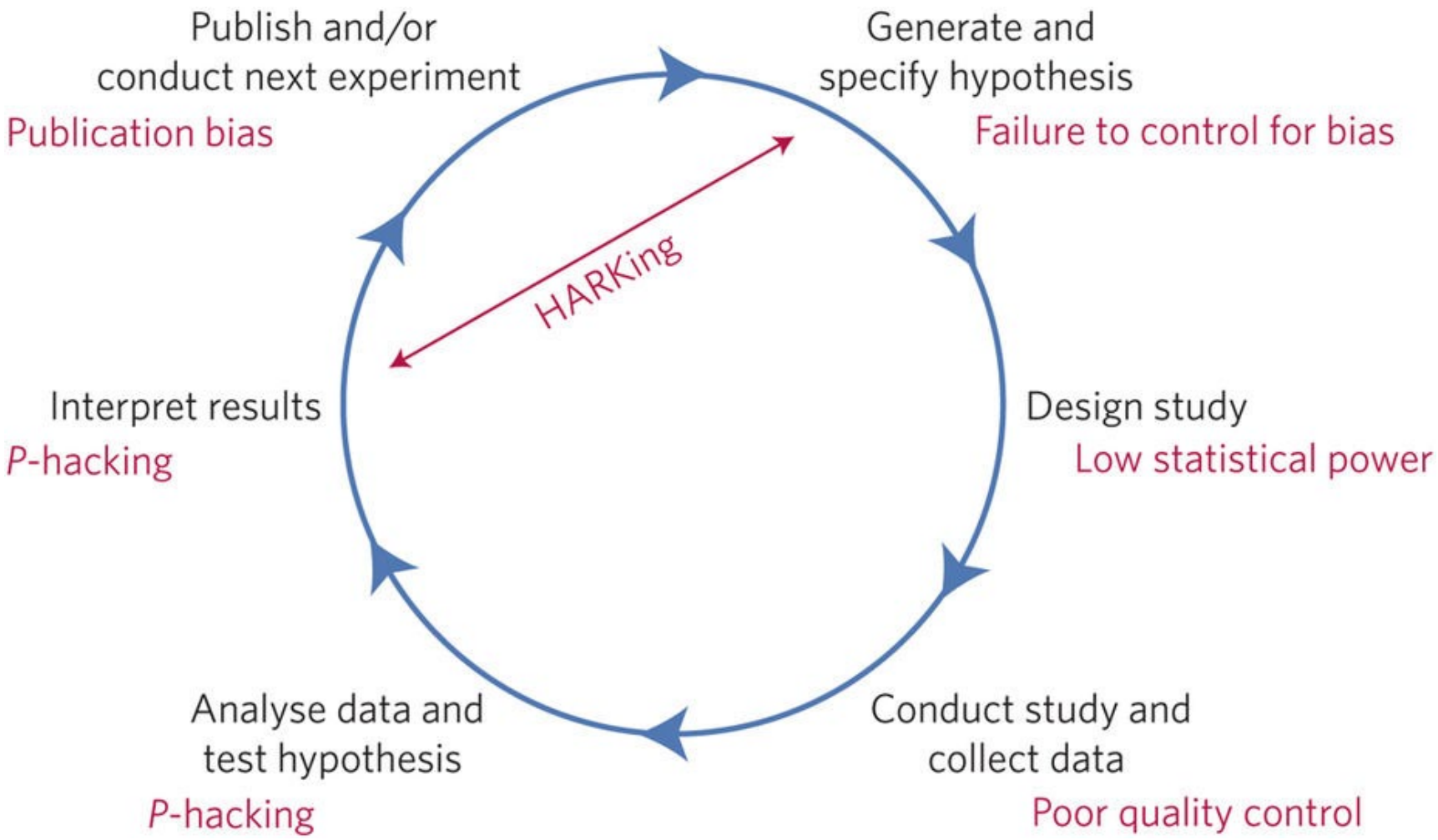
# Threats to reproducibility

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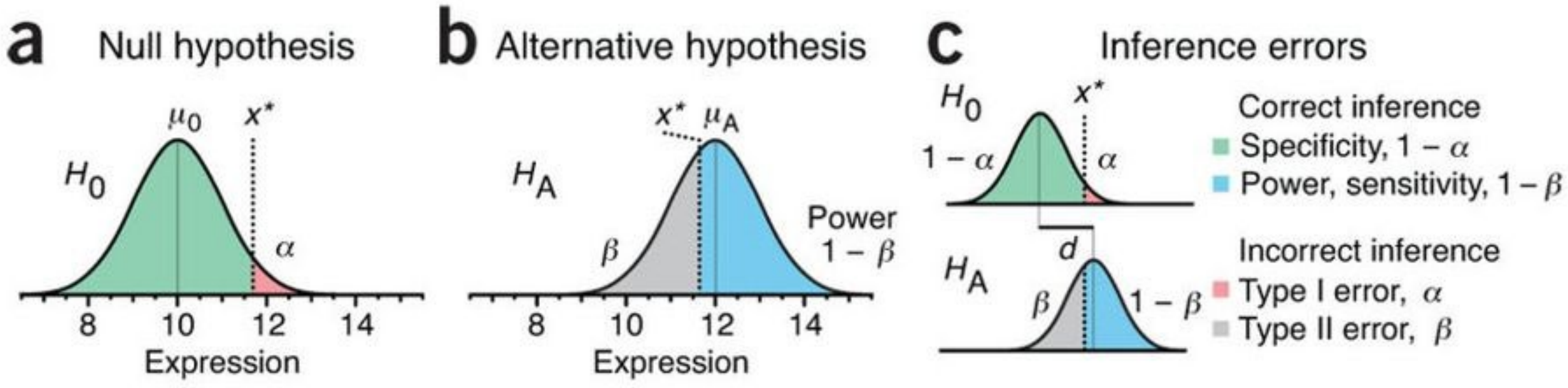
# Standard test for the „truth“




https://rpsychologist.com/pvalue/

Krzywinski, M., & Altman, N. (2013). Power and sample size. *Nature Methods*, *10*, 1139.

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# Standard test for the „truth“

1. Are we doing everything according to plan?
2. Can sound published research can be false?

# Are we doing everything according to plan? Questionable Research Practices

Questionable research practices (QRPs) are ways of producing, maintaining, sharing, analyzing, or interpreting data that are likely to produce misleading conclusions, typically in the interest of the researcher. QRPs are not normally considered to include research practices that are prohibited or proscribed in the researcher's field (e.g., fraud, research misconduct). Neither do they include random researcher error (e.g., data loss).

Nagy, T., Hergert, J., Elsherif, M., Wallrich, L., Schmidt, K., Waltzer, T., ... & Rubínová, E. (2024, May). *Bestiary of Questionable Research Practices in Psychology*. https://osf.io/fhk98/download

# Team up with your neighbour and find your „favourite“ QRP

https://nthun.github.io/qrp-bestiary/qrp_table_wide.html

# Explore the effects of some QRPs

https://shiny.psy.lmu.de/felix/ShinyPHack/

Nagy, T., Hergert, J., Elsherif, M., Wallrich, L., Schmidt, K., Waltzer, T., ... & Rubínová, E. (2024, May). *Bestiary of Questionable Research Practices in Psychology*. https://osf.io/fhk98/download



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# Parts of preregistrations

Time stamped, read-only version of your research plan

1. Research rationale
2. Hypotheses
3. Design
4. Analytic strategy (+)

http://www.apa.org/science/about/psa/2015/08/pre-registration.aspx

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# Benefits

Improved use of theory and stronger research methods

A decline in false-positive publications

Reduced File drawer effect

Reduced P-hacking

Reduced HARKing

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# Concerns

Pre-registration could lead to undervaluing exploratory research

Rely more on researcher prestige to make decisions about accepting articles for pre-registration.

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# Task

Think of benefits and concerns you personally see/have when thinking about pre-registration

Write down a list for both

Time: 10 min

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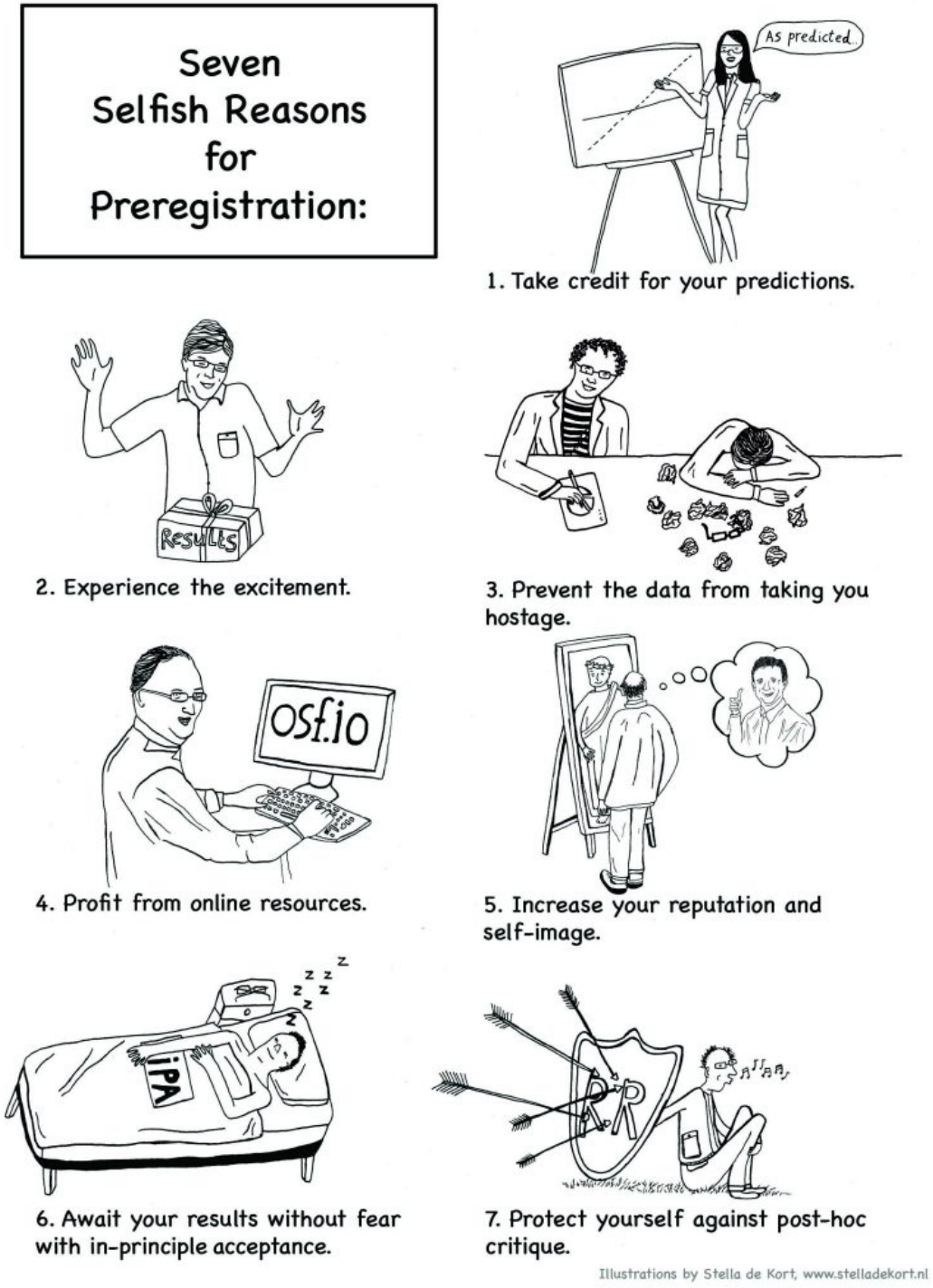

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# Confirmation vs Exploration

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## Preregistration: A Plan, Not a Prison

May 23rd, 2017, Alexander DeHaven

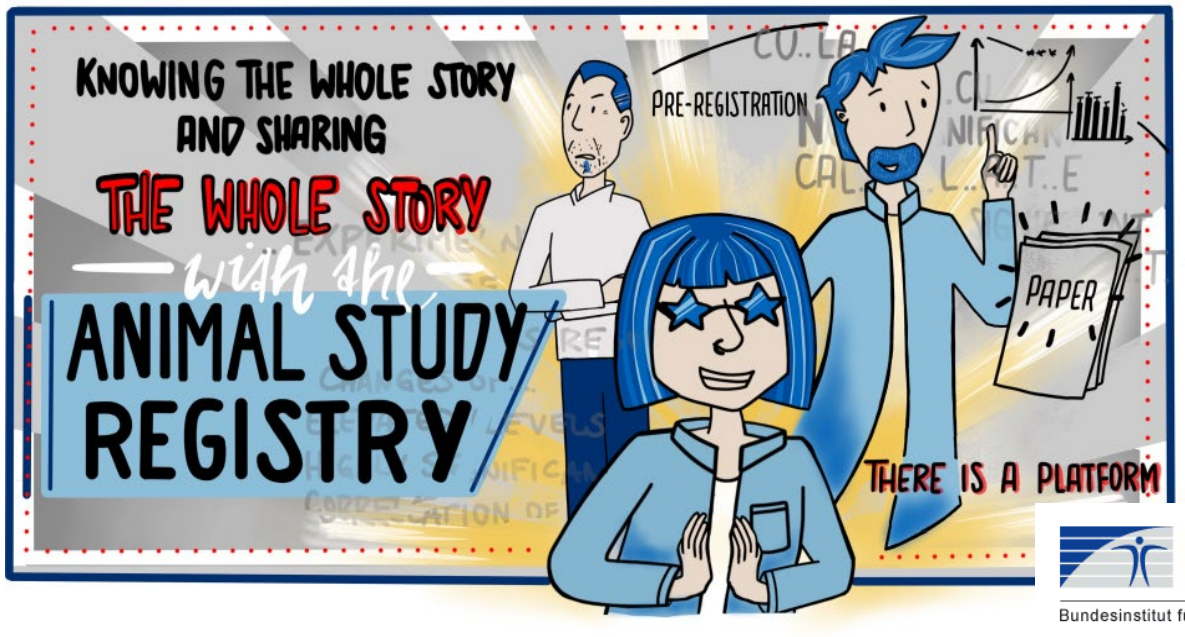
Posted in: Preregistration


https://www.cos.io/blog/preregistration-plan-not-prison

practical examples and solutions:
Nosek et al. 2018

- **pre-registration:**
  - OSF default template
  - OSF open-ended
  - PROSPERO
  - AsPredicted
  - animalstudyregistry

# Preregistration for animal experiments




BfR
Bundesinstitut für Risikobewertung

PRECLINICAL
TRIALS.EU

# Registered Reports


https://cos.io/rr/

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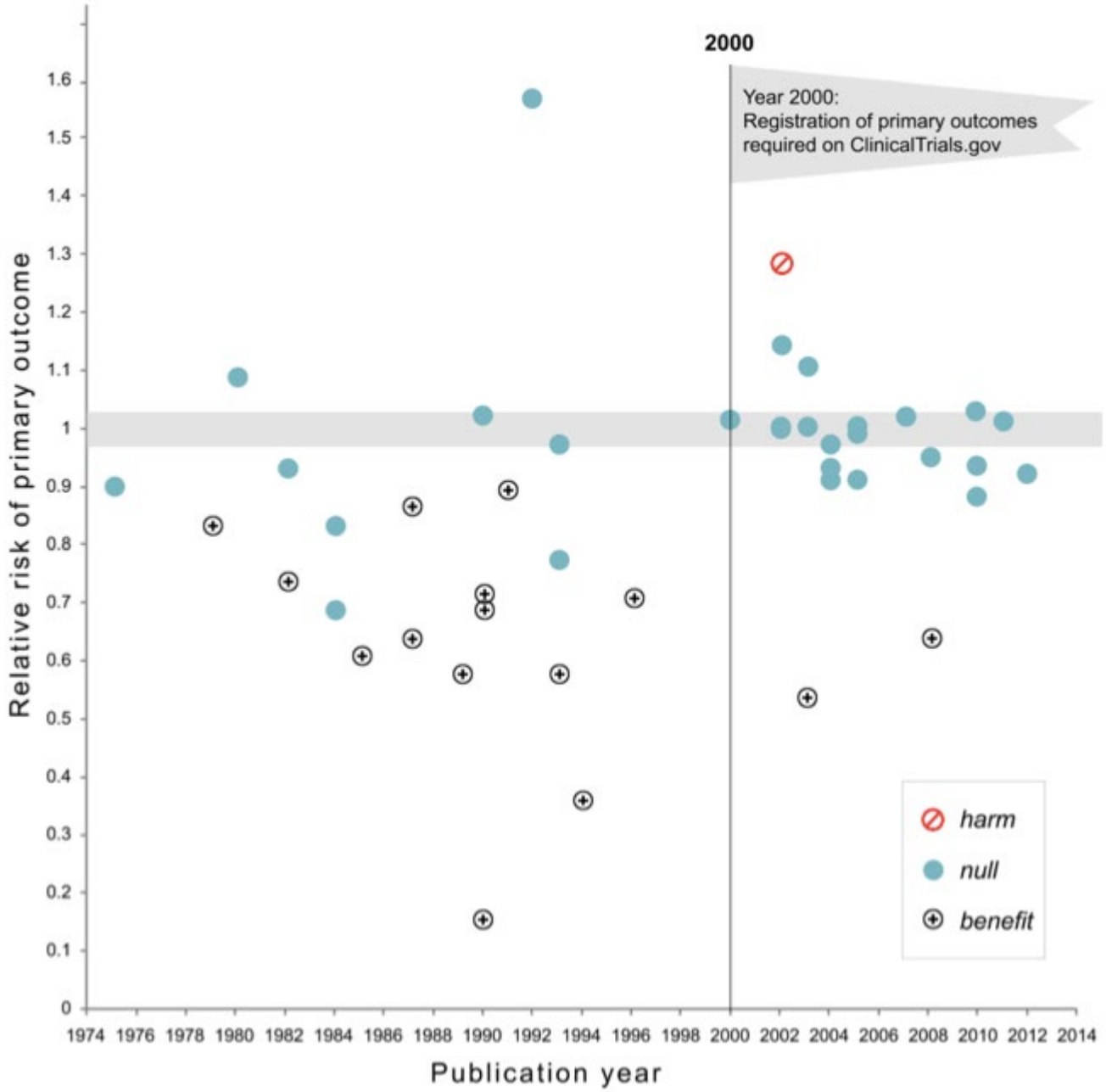


# Reduced positive findings after mandatory preregistration in clinical trials

Kaplan RM, Irvin VL (2015) Likelihood of Null Effects of Large NHLBI Clinical Trials Has Increased over Time. PLoS ONE 10(8): e0132382. https://doi.org/10.1371/journal.pone.0132382

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# How likely do you think scientific hypotheses are true?

# Conducting a power calculation and the Positive Predictive Value

# The cure for Alzheimer's

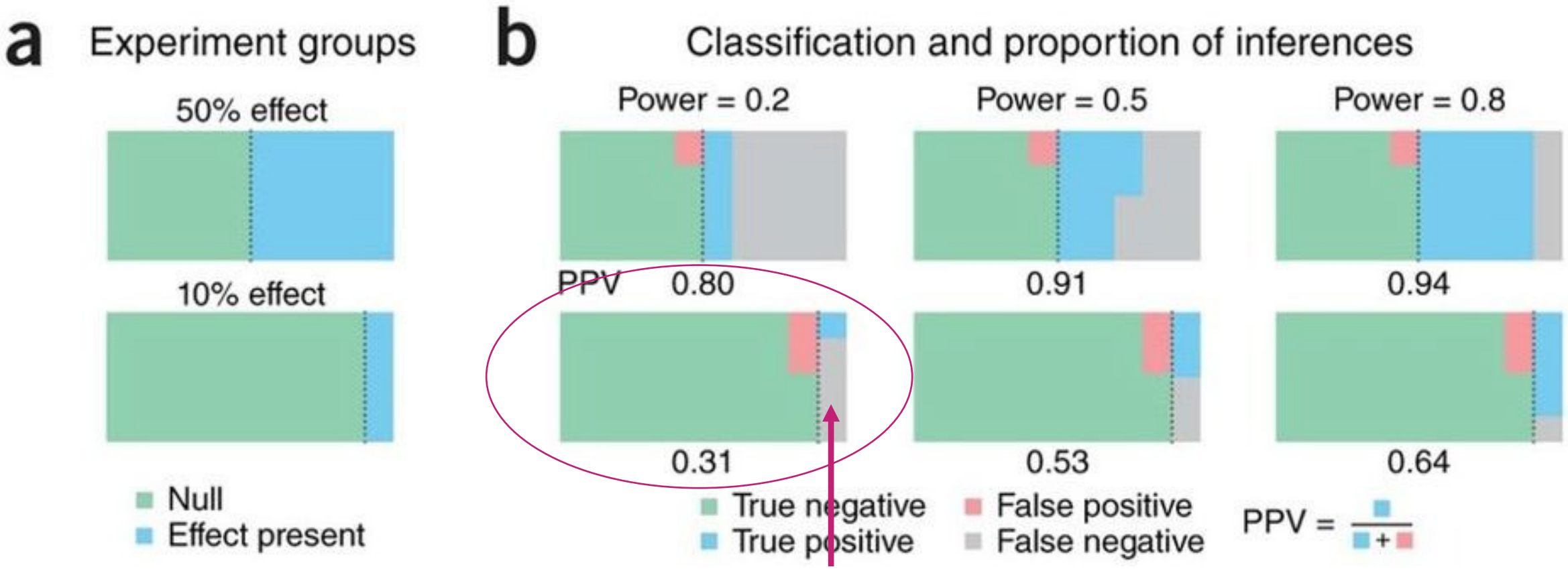
Difficult to understand mechanistically
Scientific progress slow

Assumption:
1. Low number of our hypotheses are true (<10%)
2. Effect sizes will not be overwhelmingly large (Median d=.5)

Typical study:
1 Treatment; 1 Control group
N=10 per group

What will be the positive predictive value* after 1000 experiments conducted on different hypotheses?

* Probability that a significant finding reflects a true effect




Krzywinski, M., & Altman, N. (2013). Power and sample size. *Nature Methods*, *10*, 1139.

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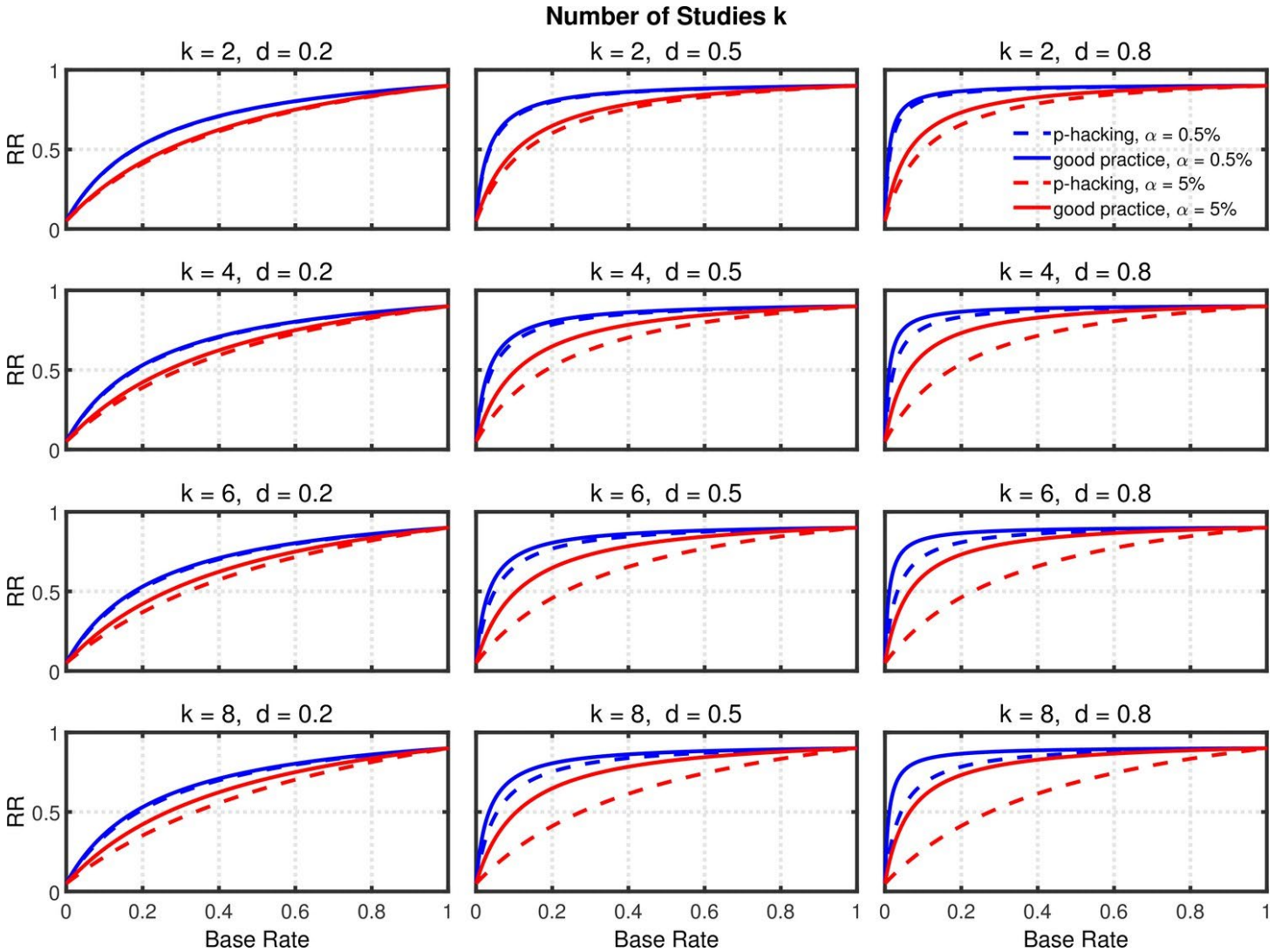
# The effect of selectively reporting significant studies




Ulrich, R., & Miller, J. (2020). Questionable research practices may have little effect on replicability. *eLife*, *9*, e58237. https://doi.org/10.7554/eLife.58237



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We engage in a replication!

We only have 65 studies to replicate. 45 false and 20 real effects

We power these properly at **alpha=.05 power=.8** for an **effect size of d=.5**

**PPV=~.9** but we need **64** animals per group!

We have 18 substances to go into clinic out of 1000.
But we have overlooked 80 substances that may work!

***How are your experiences with replications?***

# Thank you.

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