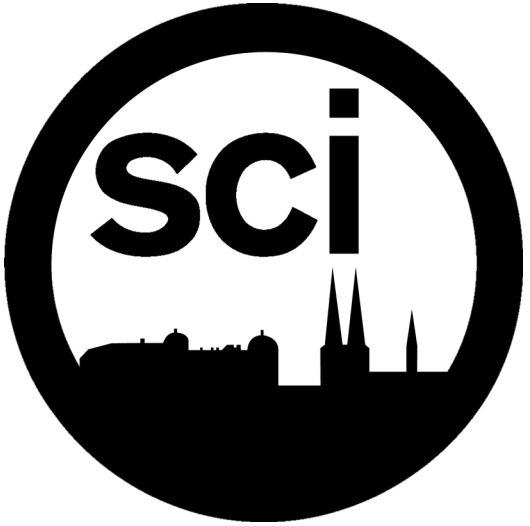
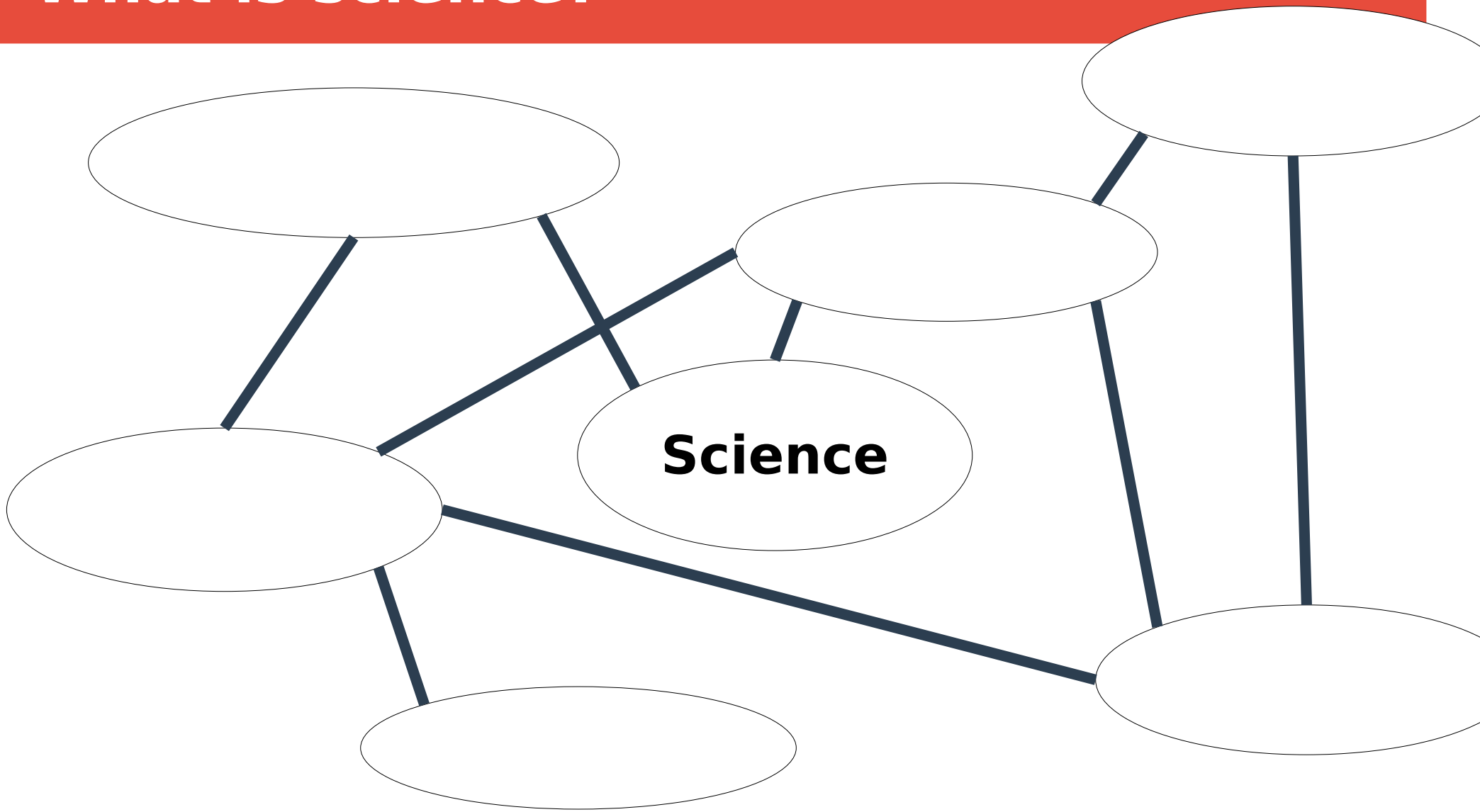
Open Science and some of its problems

Richèl Bilderbeek
2023-04-14



https://github.com/richelbilderbeek/osu_talk_20230414

What is science?



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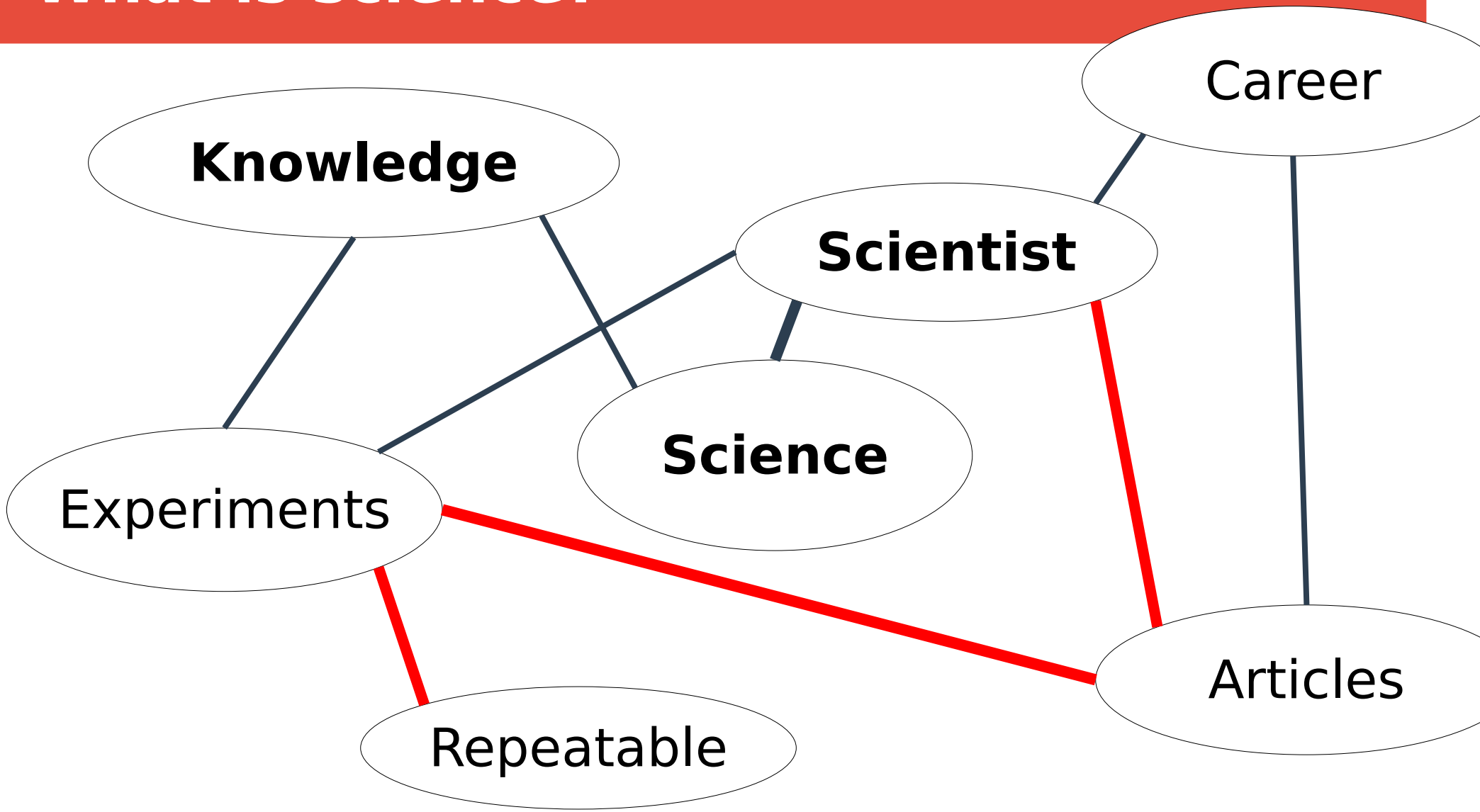
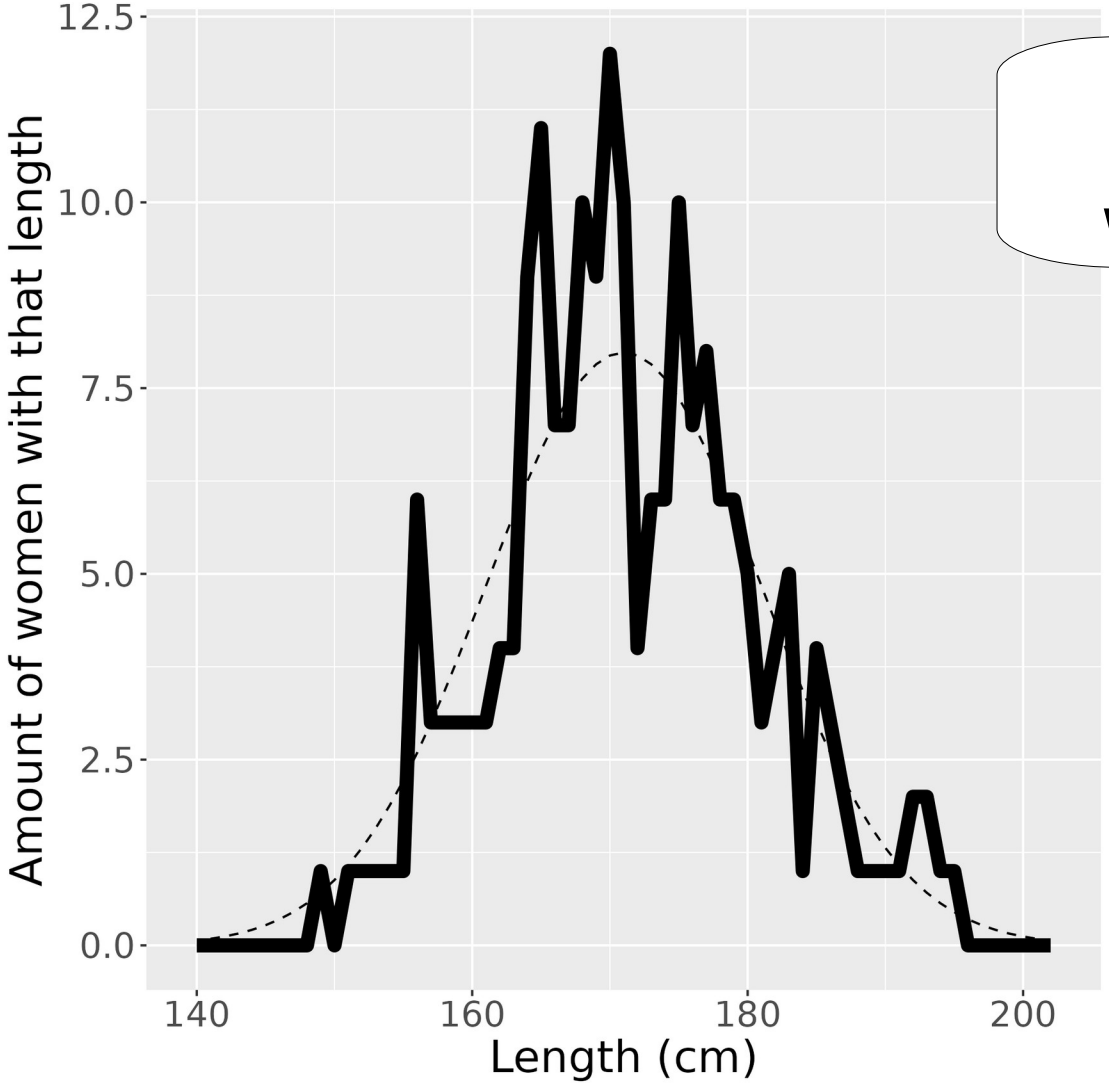
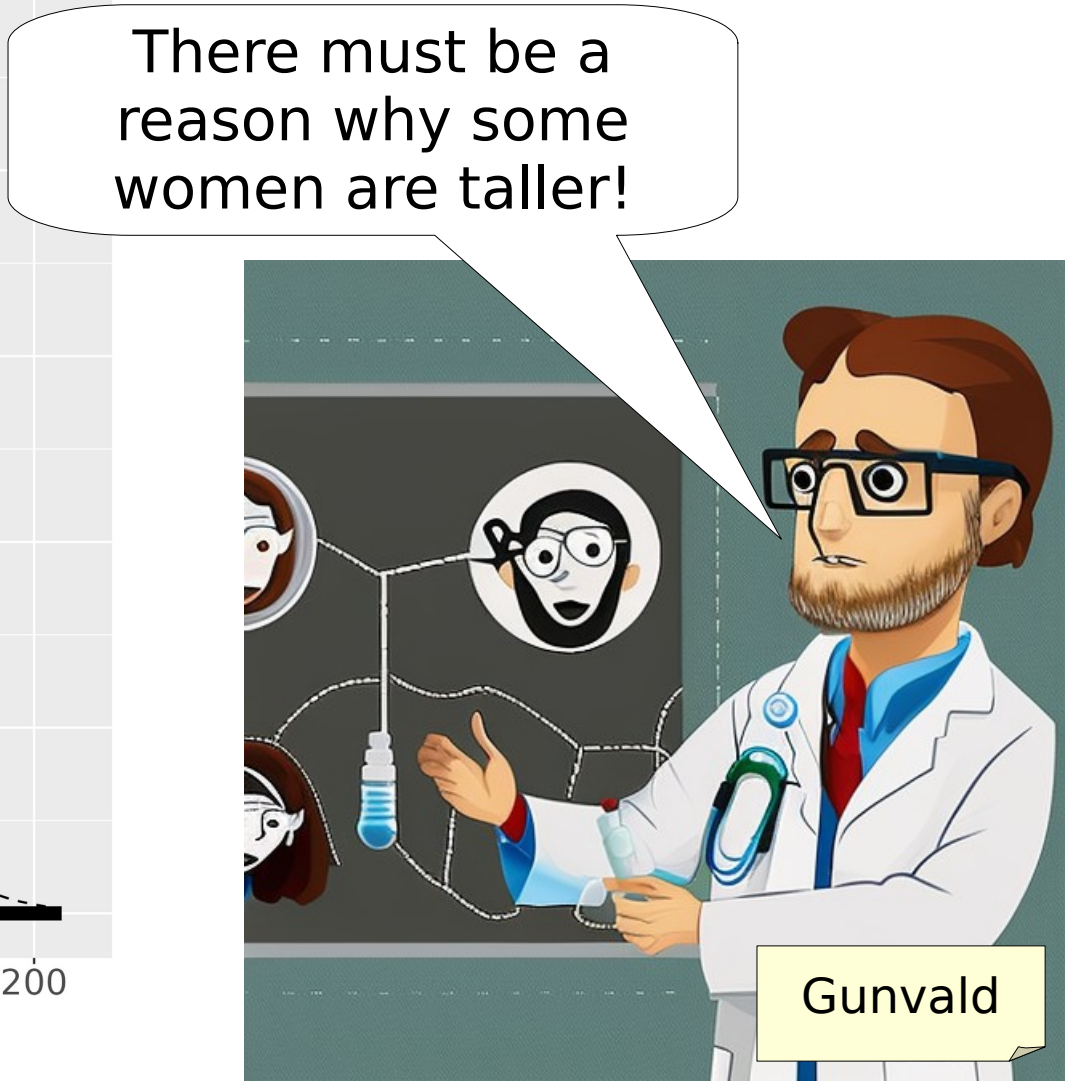


Exploratory research question





Example inspired by Simmons, Joseph P., Leif D. Nelson, and Uri Simonsohn. "False-positive psychology: undisclosed flexibility in data collection and analysis allows presenting anything as significant." (2016).

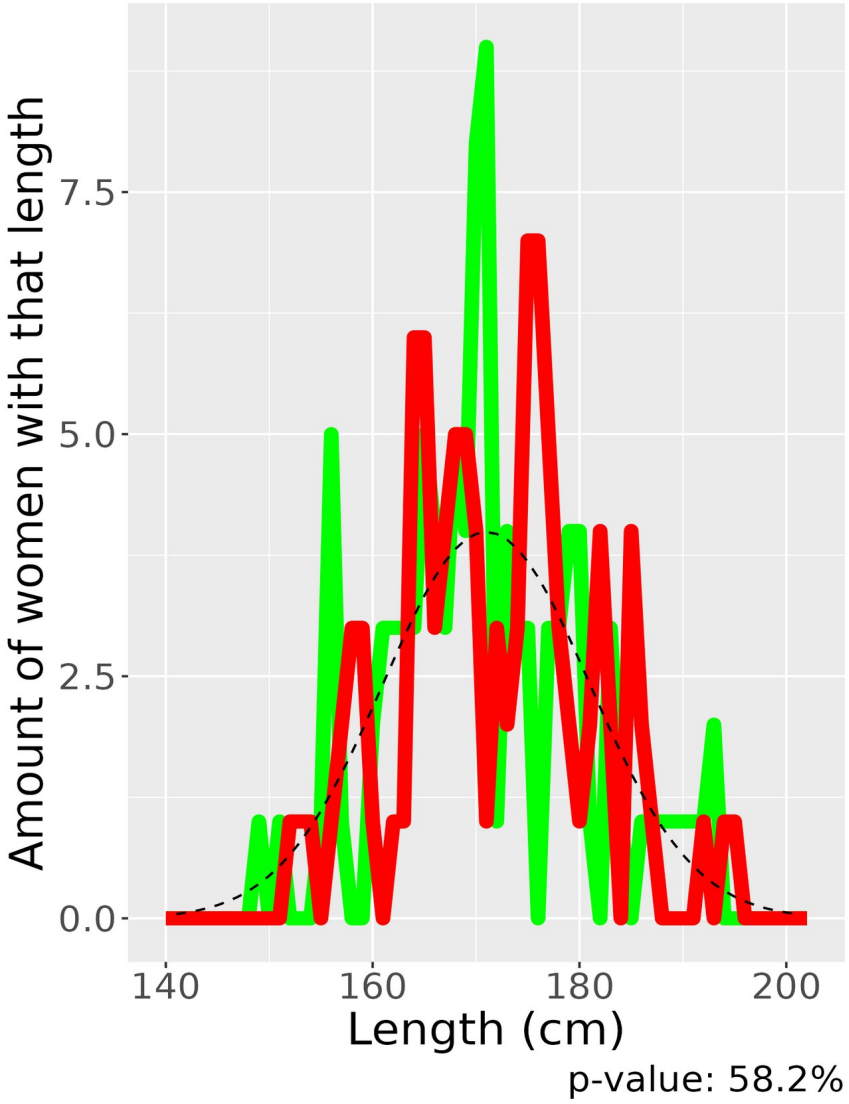
Survey for women

How tall are you?	
Do you prefer red over green?	
Is your phone number an even number?	
… 18 other yes/no questions ...	

Response variable

'Explanatory' variables

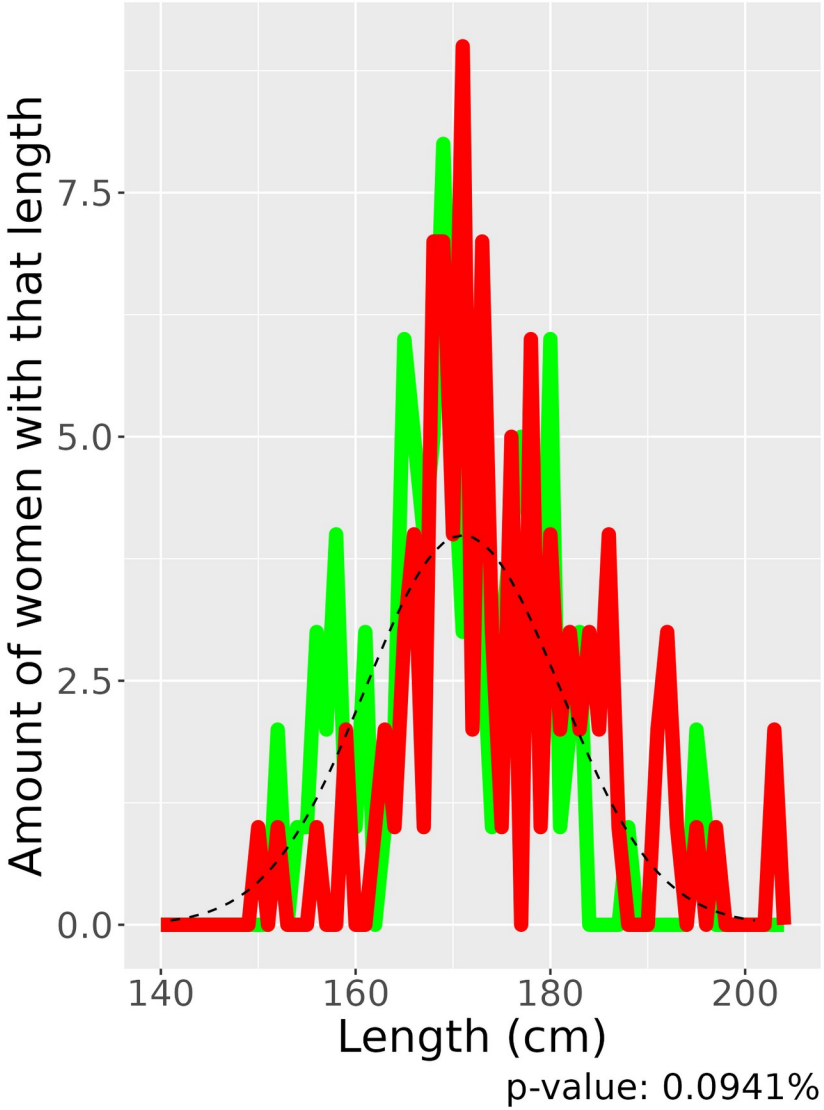
Gunvald is unlucky



Chance is 95% if there is no effect

Too bad, no significant finding

Gunvald is lucky



Chance is 5% if there is no effect

Eureka! A significant finding!

Problem

Tip 1: measure 20 things!

Problem

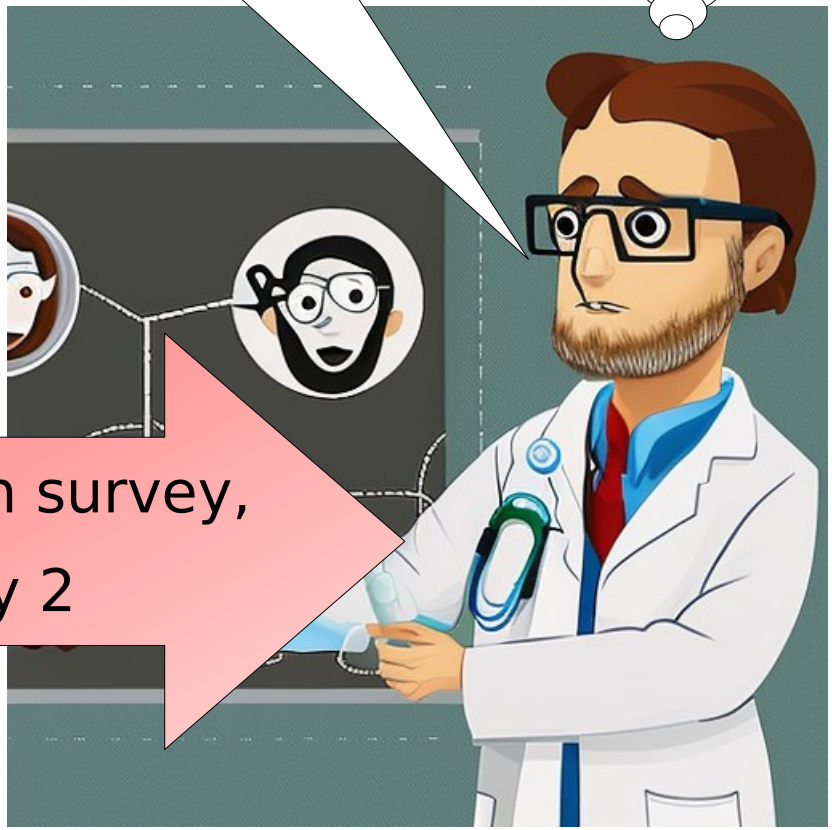
The chance to find something significant when there is **no effect** when using 2 things is at least around 20%

Tip 2: there are 36 ways to tweak an experiment [1]

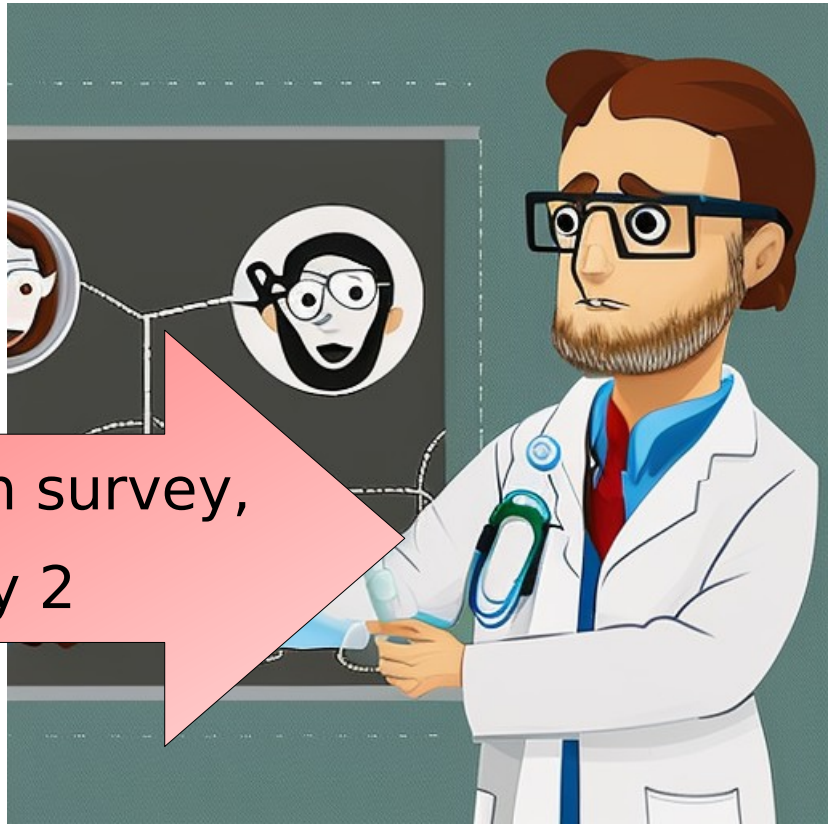
[1] Wicherts, Jelte M., et al. "Degrees of freedom in planning, running, analyzing, and reporting psychological studies: A checklist to avoid p-hacking." Frontiers in psychology 7 (2016): 1832.

A publication!

Asked 20 things in survey,
Reports only 2



Is Gunvald evil?



Why do scientists do this?

	Linear regression model[††] coefficient (95% CI)
Work pressure	0.02 (0.00, 0.04)
Publication pressure	**0.10 (0.08, 0.12)**
Funding pressure	0.01 (-0.01, 0.03)
Mentoring *	0.02 (0.01, 0.04)
Competitiveness	0.02 (0.00, 0.04)
Scientific norm	**-0.12 (-0.13, -0.10)**
Peer norms	-0.04 (-0.05, -0.02)
Organizational justice **	-0.04 (-0.06, -0.02)
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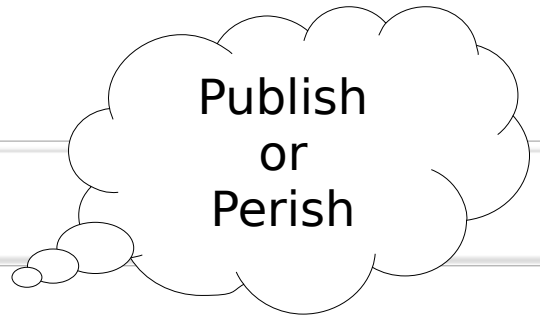
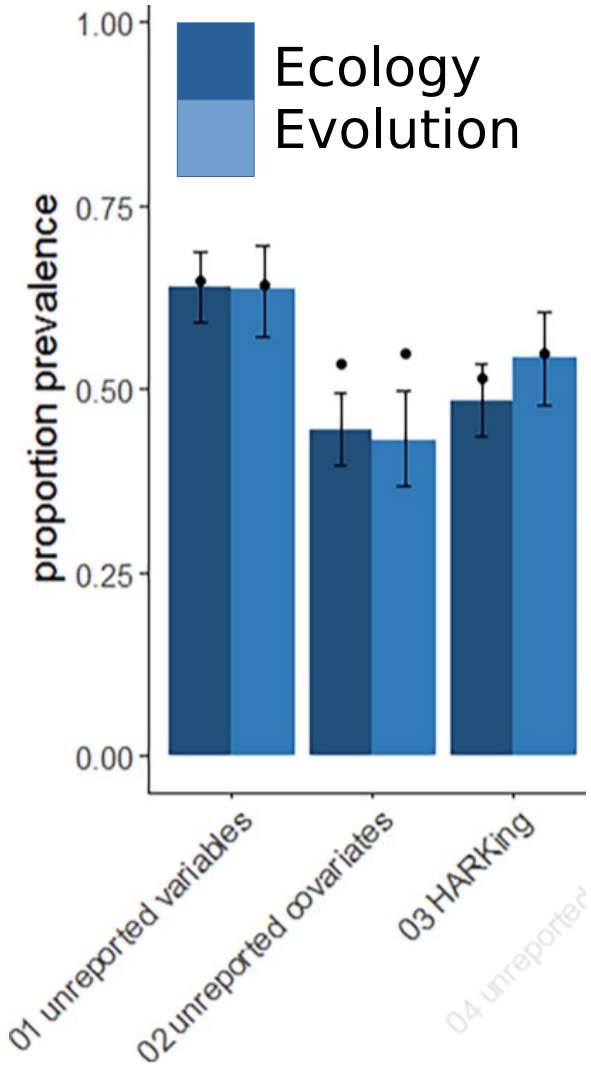
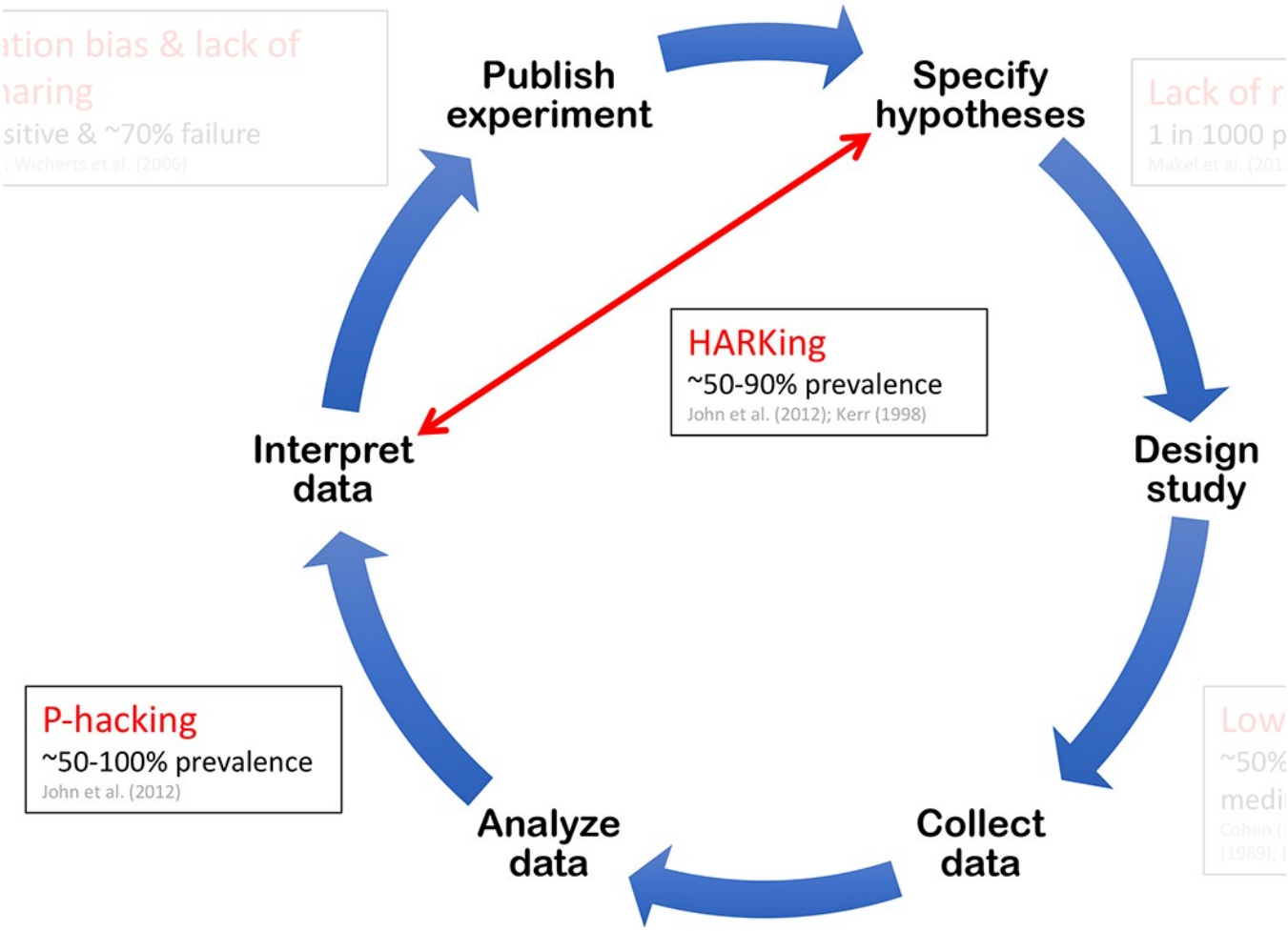


Gopalakrishna, Gowri, et al. "Prevalence of questionable research practices, research misconduct and their potential explanatory factors: a survey among academic researchers in The Netherlands." (2021).

How often do people do this?





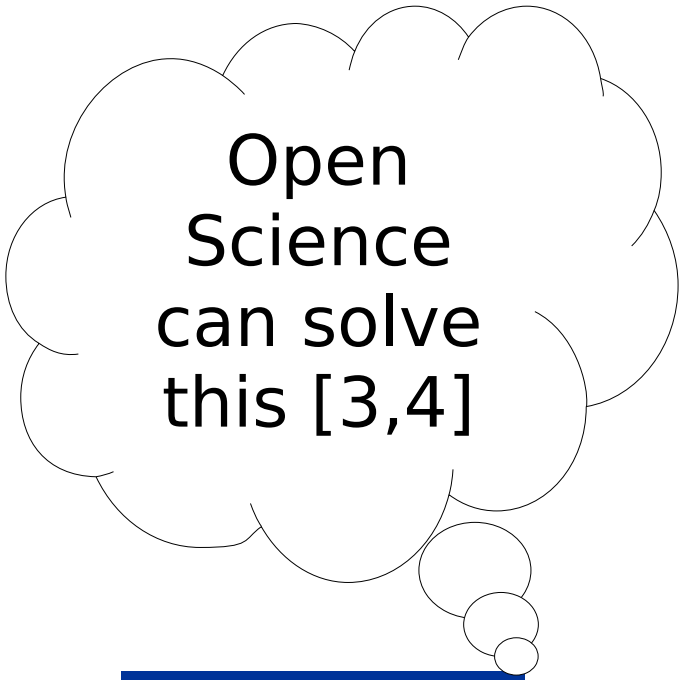
Fraser, Hannah, et al. "Questionable research practices in ecology and evolution." PloS one 13.7 (2018): e0200303.
Image from https://sarneckalab.blogspot.com/2018/05, which is adapted from
Munafò, Marcus R., et al. "A manifesto for reproducible science." Nature human behaviour 1.1 (2017): 1-9.

Is that a problem?

Reproducibility Crisis

50% cannot reproduce their own work [1]

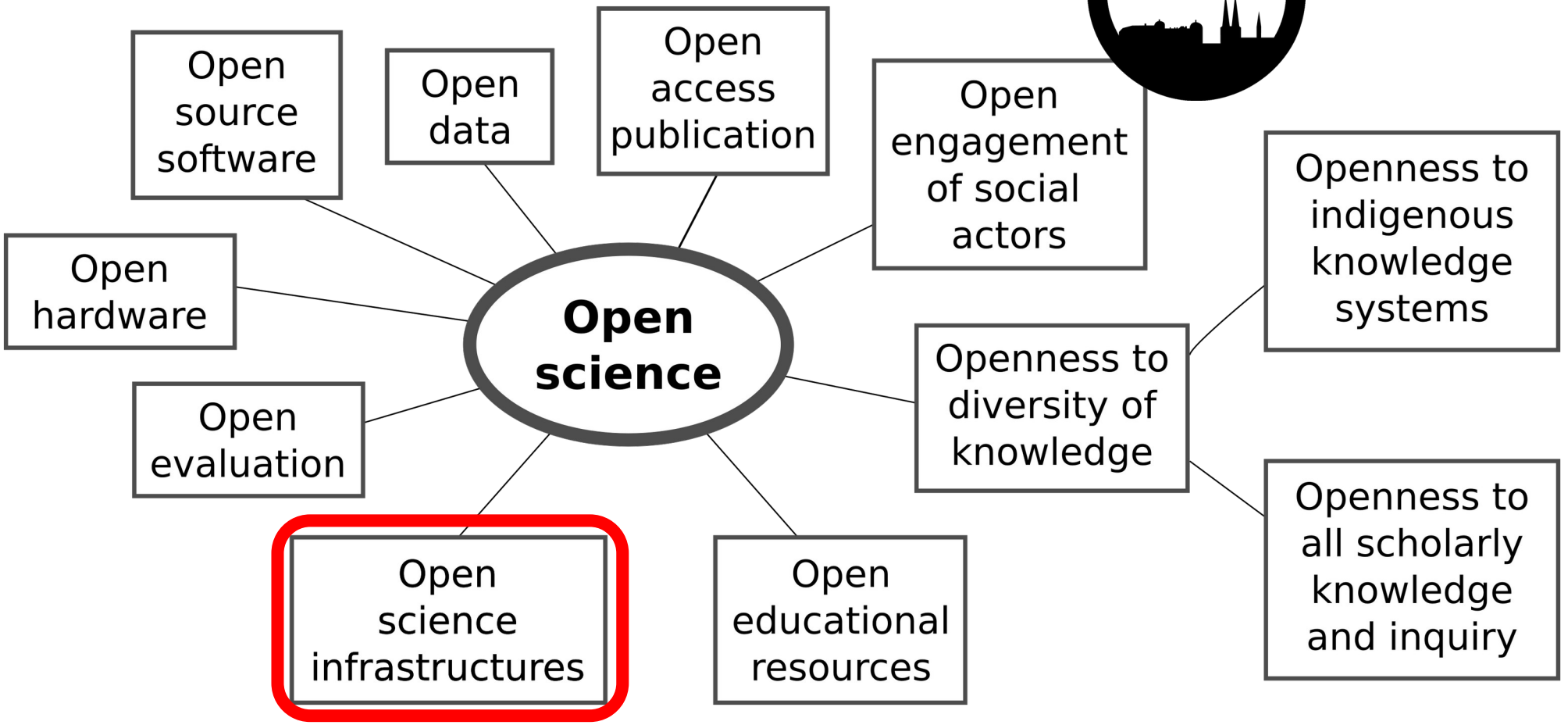
11% of pre-clinical cancer studies could be replicated [2]



United Nations Educational, Scientific and Cultural Organization

[1] Baker, Monya. "1,500 scientists lift the lid on reproducibility." Nature News 533.7604 (2016): 452.
[2] Begley, C. Glenn, and Lee M. Ellis. "Raise standards for preclinical cancer research." Nature 483.7391 (2012): 531-533.
[3] https://en.unesco.org/science-sustainable-future/open-science
[4] https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/our-digital-future/open-science_en

What is Open Science?



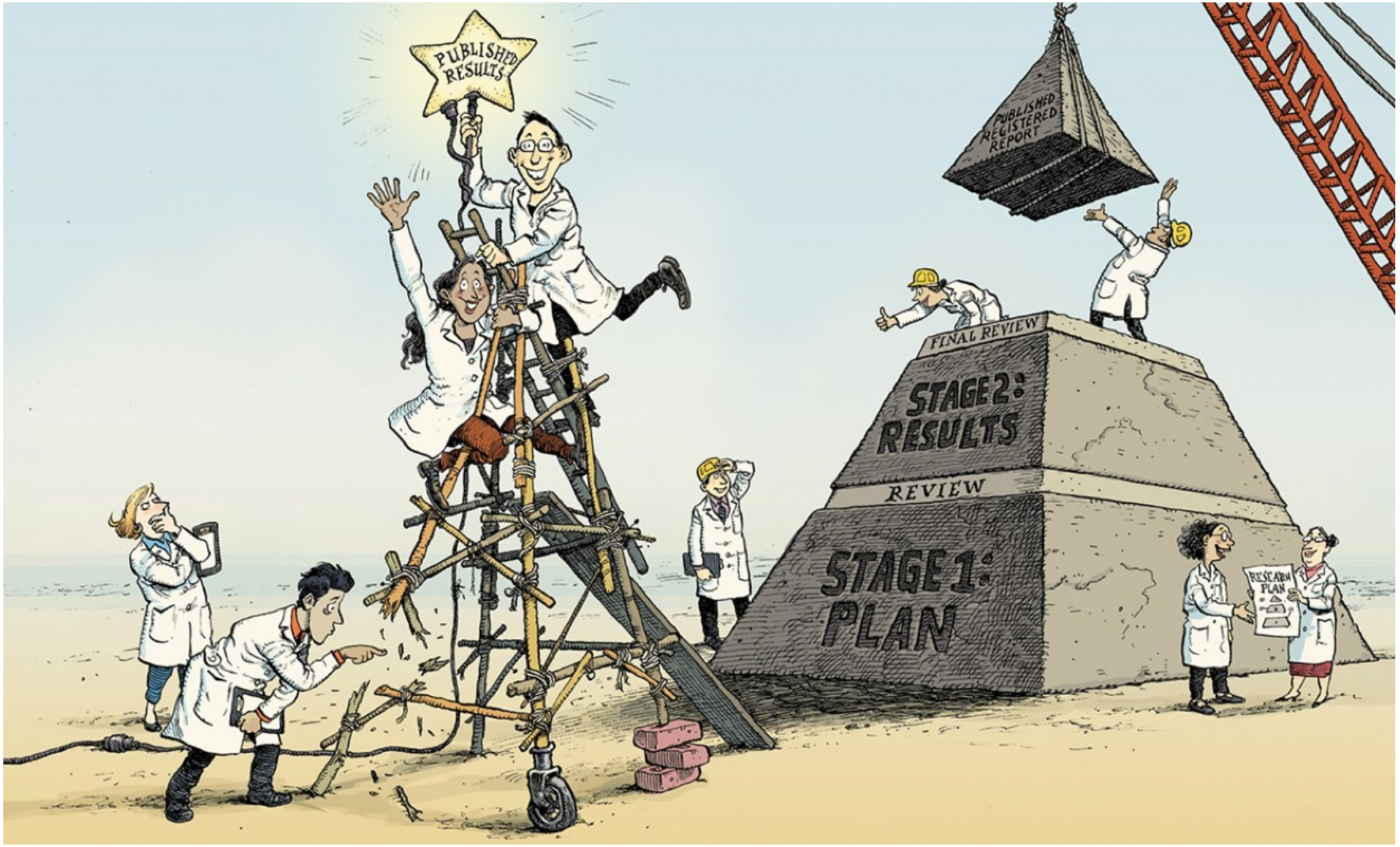
https://en.unesco.org/science-sustainable-future/open-science

Solutions

Theme	Proposal	Examples of initiatives/potential solutions (extent of current adoption)
Methods	Protecting against cognitive biases	All of the initiatives listed below (* to ****) Blinding (**)
	Improving methodological training	Rigorous training in statistics and research methods for future researchers (*) Rigorous continuing education in statistics and methods for researchers (*)
	Independent methodological support	Involvement of methodologists in research (**) Independent oversight (*)
	Collaboration and team science	Multi-site studies/distributed data collection (*) Team-science consortia (*)
Reporting and dissemination	Promoting study pre-registration	Registered Reports (*) Open Science Framework (*)
	Improving the quality of reporting	Use of reporting checklists (**) Protocol checklists (*)
	Protecting against conflicts of interest	Disclosure of conflicts of interest (***) Exclusion/containment of financial and non-financial conflicts of interest (*)
Reproducibility	Encouraging transparency and open science	Open data, materials, software and so on (* to **) Pre-registration (**** for clinical trials, * for other studies)
Evaluation	Diversifying peer review	Preprints (* in biomedical/behavioural sciences, **** in physical sciences) Pre- and post-publication peer review, for example, Publons, PubMed Commons (*)
Incentives	Rewarding open and reproducible practices	Badges (*) Registered Reports (*) Transparency and Openness Promotion guidelines (*) Funding replication studies (*) Open science practices in hiring and promotion (*)

Munafò, Marcus R., et al. "A manifesto for reproducible science." Nature human behaviour 1.1 (2017): 1-9.

The Registered Report



Chambers, What's next for Registered Reports?, https://www.nature.com/articles/d41586-019-02674-6:

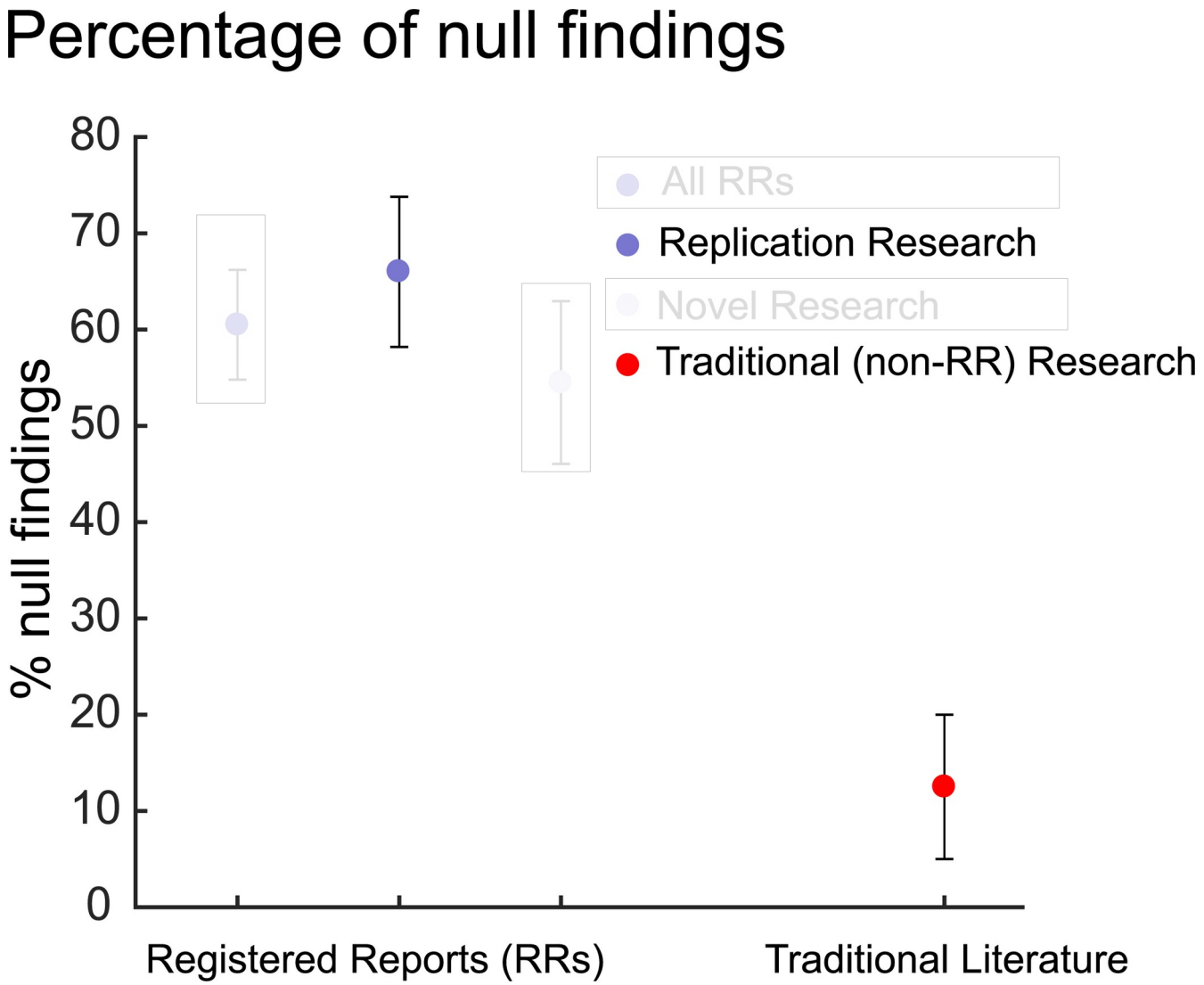
Workflow

Registered report

Pre-registration

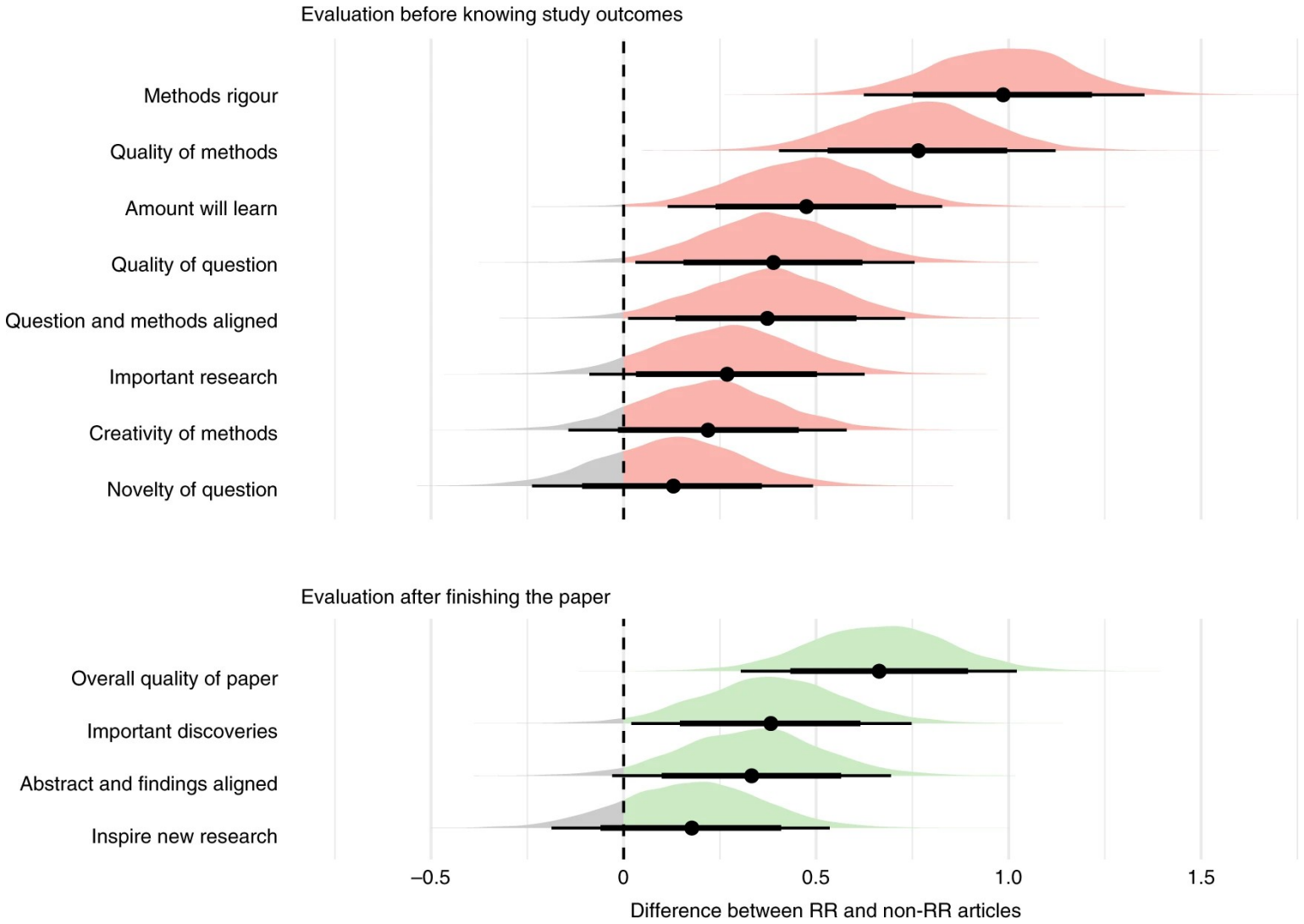
https://www.elsevier.com/connect/editors-update/cortexs-registered-reports
https://help.osf.io/hc/en-us/articles/360019930913-Submit-a-Registered-Report

Open Science reports more honestly



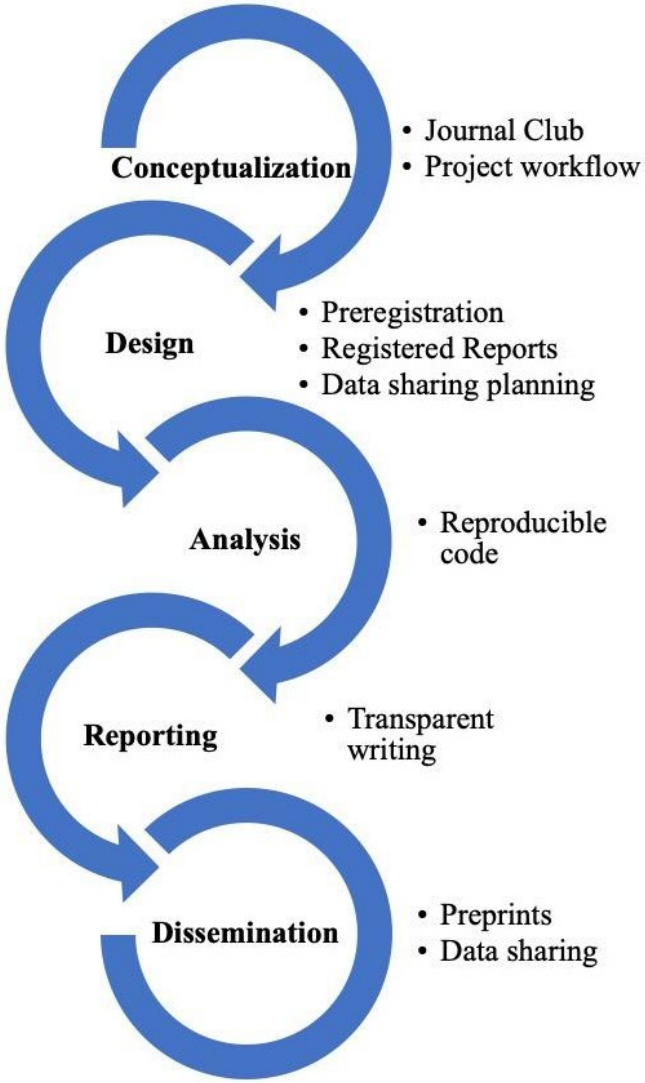
Allen, Christopher, and David MA Mehler. "Open science challenges, benefits and tips in early career and beyond." PLoS biology 17.5 (2019): e3000246.

Open Science gives better papers



Soderberg, Courtney K., et al. "Initial evidence of research quality of registered reports compared with the standard publishing model." Nature Human Behaviour 5.8 (2021): 990-997.

Easing into Open Science: A guide for graduate students and their advisors



We emphasize that engaging in open science behaviors need not be an all or nothing approach, but rather graduate students can engage with any number of the behaviors outlined.

Kathawalla, Ummul-Kiram, Priya Silverstein, and Moin Syed. "Easing into open science: A guide for graduate students and their advisors." Collabra: Psychology 7.1 (2021).

Conclusions

Open Science helps ...

to find true/reproducible knowledge

to report ‘no effect’ more honestly

is easy to get into

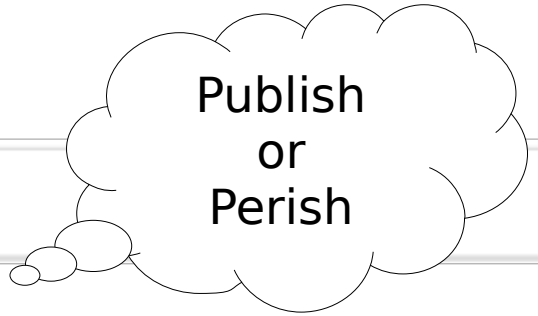

I ♥ Open Science!

Proposition 1

In any presentation [1], it is hard to be critical when one enjoys the outcome.

[1] including an Open Science presentation for an audience of people that are interested in Open Science

Why do scientists do this?



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[...] a standard deviation increase on the publication pressure scale is associated with an increase of 0.10 in the overall QRP mean score

Gopalakrishna, Gowri, et al. "Prevalence of questionable research practices, research misconduct and their potential explanatory factors: a survey among academic researchers in The Netherlands." (2021).

Why do scientists do this?

So, a person that in the top 0.000028% in feeling publication pressure does 1 more QRP (out of 11) than a person at the bottom 0.000028%

Unimpressed

[...] a standard deviation increase on the publication pressure scale is associated with an increase of 0.10 in the overall QRP mean score

Gopalakrishna, Gowri, et al. "Prevalence of questionable research practices, research misconduct and their potential explanatory factors: a survey among academic researchers in The Netherlands." (2021).

Why do scientists do this?

Scientists are complex

There is no single clear cause for them to do questionable research

Unimpressed

Gopalakrishna, Gowri, et al. "Prevalence of questionable research practices, research misconduct and their potential explanatory factors: a survey among academic researchers in The Netherlands." (2021).

Proposition 2

Doing Open Science is easier said than done,

and we prefer to say it is easy

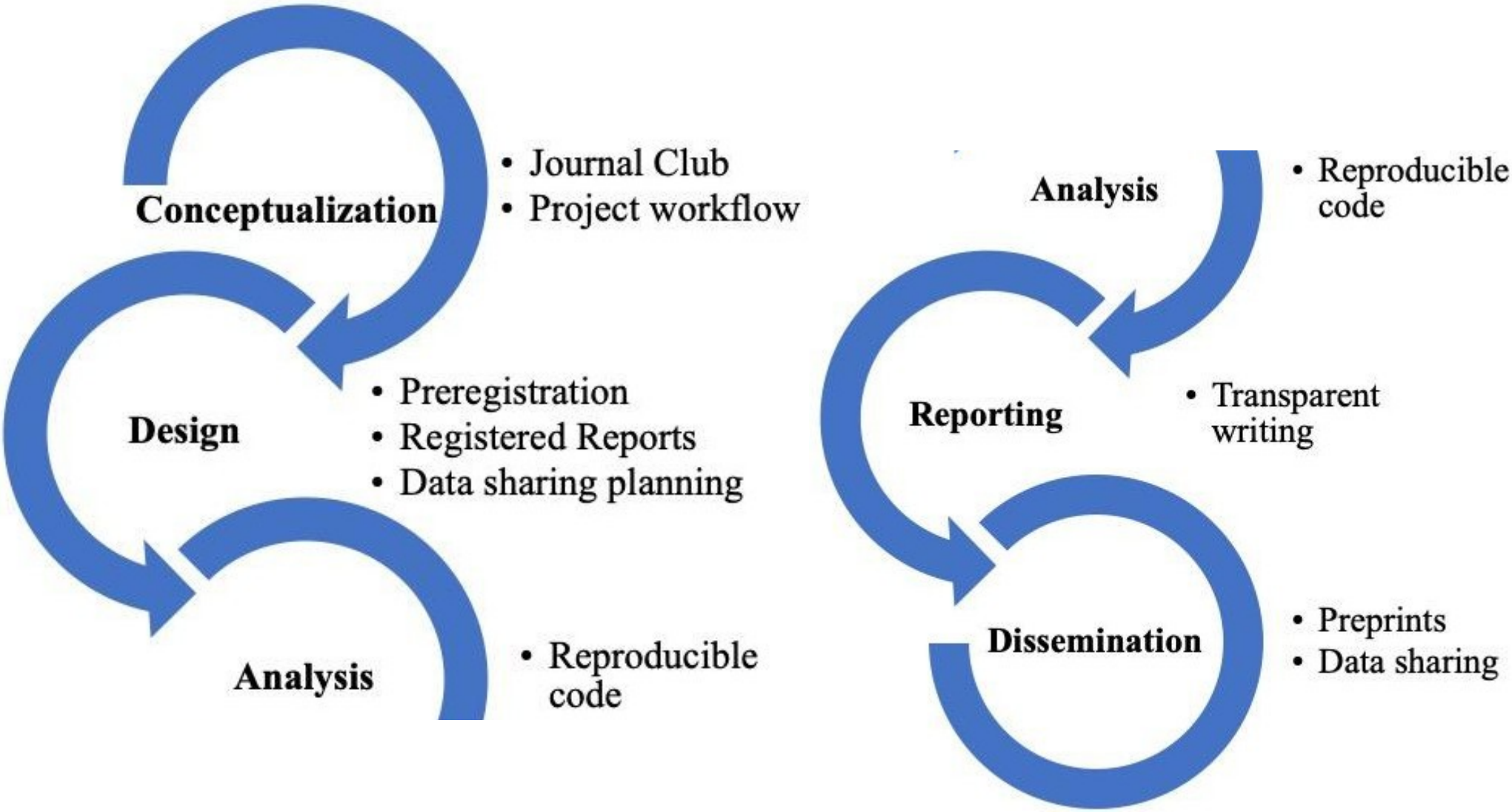
Easing into Open Science?

[...] students may be worried, “Won’t it make it harder to publish my research?”

It is absolutely the case that some practices associated with open science [...] could result in some delays in publishing. However, some open science practices (e.g., posting preprints, Registered Reports) can speed up the process and make it easier

Kathawalla, Ummul-Kiram, Priya Silverstein, and Moin Syed. "Easing into open science: A guide for graduate students and their advisors." Collabra: Psychology 7.1 (2021).

Easing into Open Science?



Kathawalla, Ummul-Kiram, Priya Silverstein, and Moin Syed. "Easing into open science: A guide for graduate students and their advisors." Collabra: Psychology 7.1 (2021).

How easy was it?

This study was accepted as a Stage 1 Registered Report [...] and registered on the OSF Registered Report Registry

Kathawalla, Ummul-Kiram, and Moin Syed. "Discrimination, Life Stress, and Mental Health Among Muslims: A Preregistered Systematic Review and Meta-Analysis." Collabra: Psychology 7.1 (2021): 28248.

Even though we did not pre-register the study, we were purposefully very transparent on our “researcher choices”

Kathawalla, Ummul-Kiram, and Moin Syed. "Occupational and Sociocultural Temporal Identity Integration: Links to Overall Health for Muslim-Heritage Immigrants to the United States." Journal of Muslim Mental Health 16.1 (2022).

No aspects of this study were preregistered

Syed, Moin, et al. "Somali migration to the United States: Understanding adaptation through digital stories." Cultural Diversity and Ethnic Minority Psychology 28.3 (2022): 361.

Challenge

Find a scientist in Uppsala that actually does Open Science, or at least:

- Registered report
- Reproducible research
  - All code and data uploaded
  - For sensitive data, provide a testing data set

Proposition 3

Doing a pre-registration is easier said than done,

as we need to change our way of thinking

Number #1 pre-registration problem

I cannot know in advance how I am going to analyze my data in an exploratory study!

Yes, you do,

else it is OK

Measure things

We always do research for a reason.

We always compare groups or locations or (experimental) settings or sex or language, etc.

We assume there is a possible difference there

Unexpected findings

It is OK to go dig deeper in the data beyond what was preregistered: do report it as such!

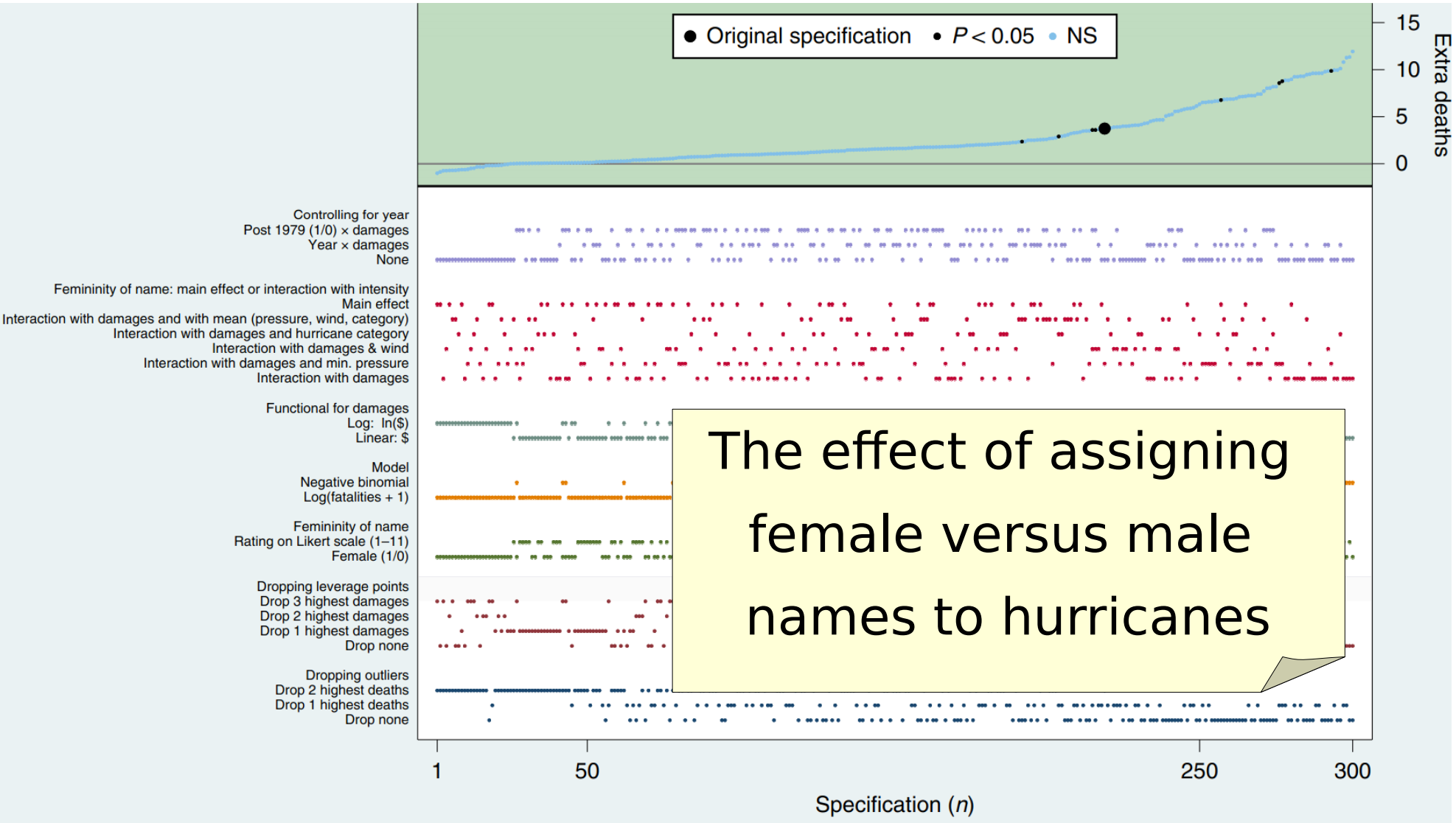
Picking the right statistical test

It is OK if you have no idea what to expect.

It is OK to do statistics that reflect this, such as a T-test or a Kolmogorov–Smirnov test.

Or consider specification curve analysis (on the next slide)

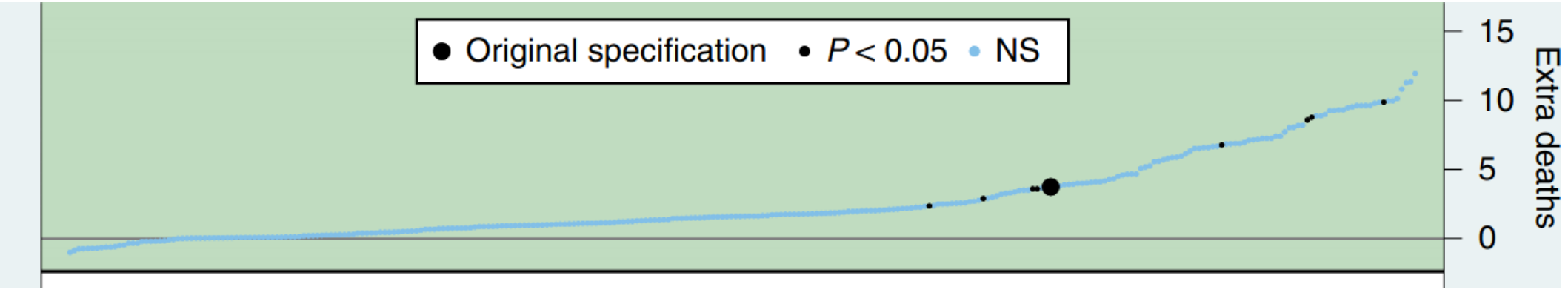
Specification curve analysis



The effect of assigning female versus male names to hurricanes

Simonsohn, Uri, Joseph P. Simmons, and Leif D. Nelson. "Specification curve analysis." Nature Human Behaviour 4.11 (2020): 1208-1214.

Specification curve analysis



The gender of the name of a hurricane has no effect on the number of extra deaths

Only a handful out of 300 tests show otherwise.

Simonsohn, Uri, Joseph P. Simmons, and Leif D. Nelson. "Specification curve analysis." Nature Human Behaviour 4.11 (2020): 1208-1214.

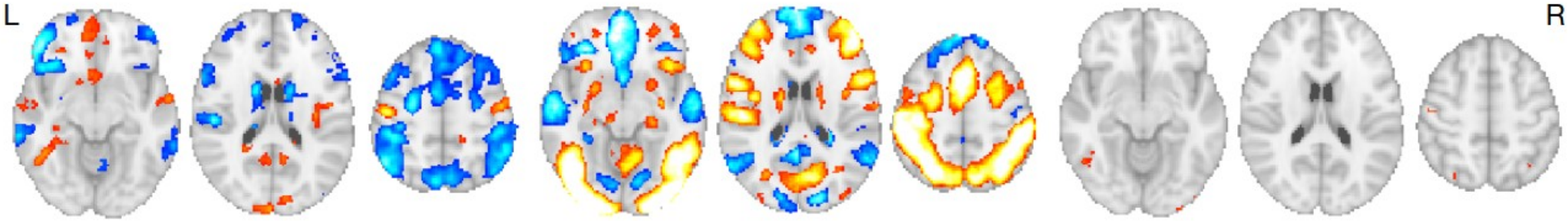
Proposition 4

Open Science gives rise to more complex conclusions, due to reproduced research

Different teams, different results

Research question: based on the same data, will different research groups accept/reject the same null-hypotheses?

‘There is [an effect] in [a brain area] between treatment A and B’



Botvinik-Nezer, Rotem, et al. "Variability in the analysis of a single neuroimaging dataset by many teams." Nature 582.7810 (2020): 84-88.

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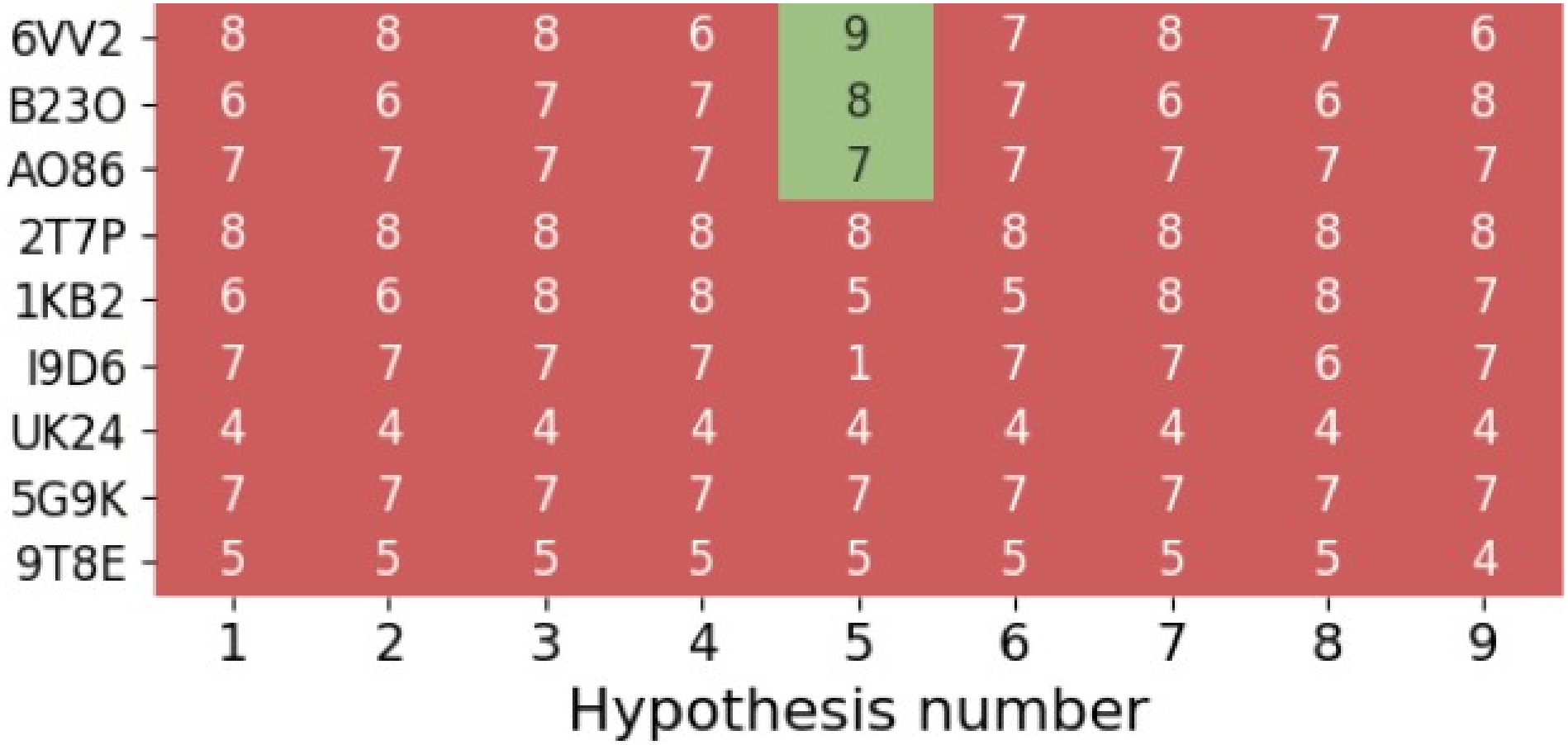

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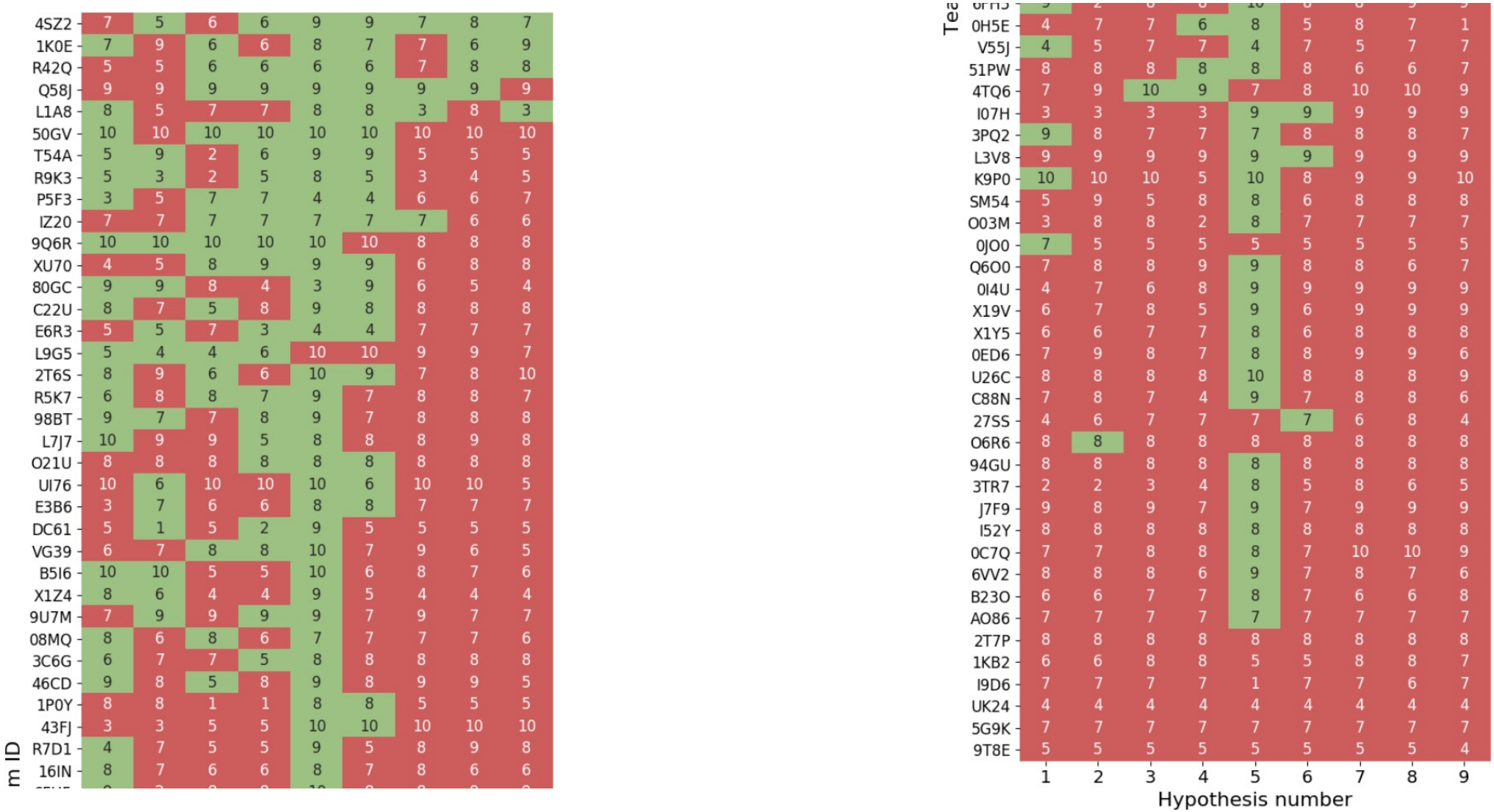


Botvinik-Nezer, Rotem, et al. "Variability in the analysis of a single neuroimaging dataset by many teams." Nature 582.7810 (2020): 84-88.

Conclusions

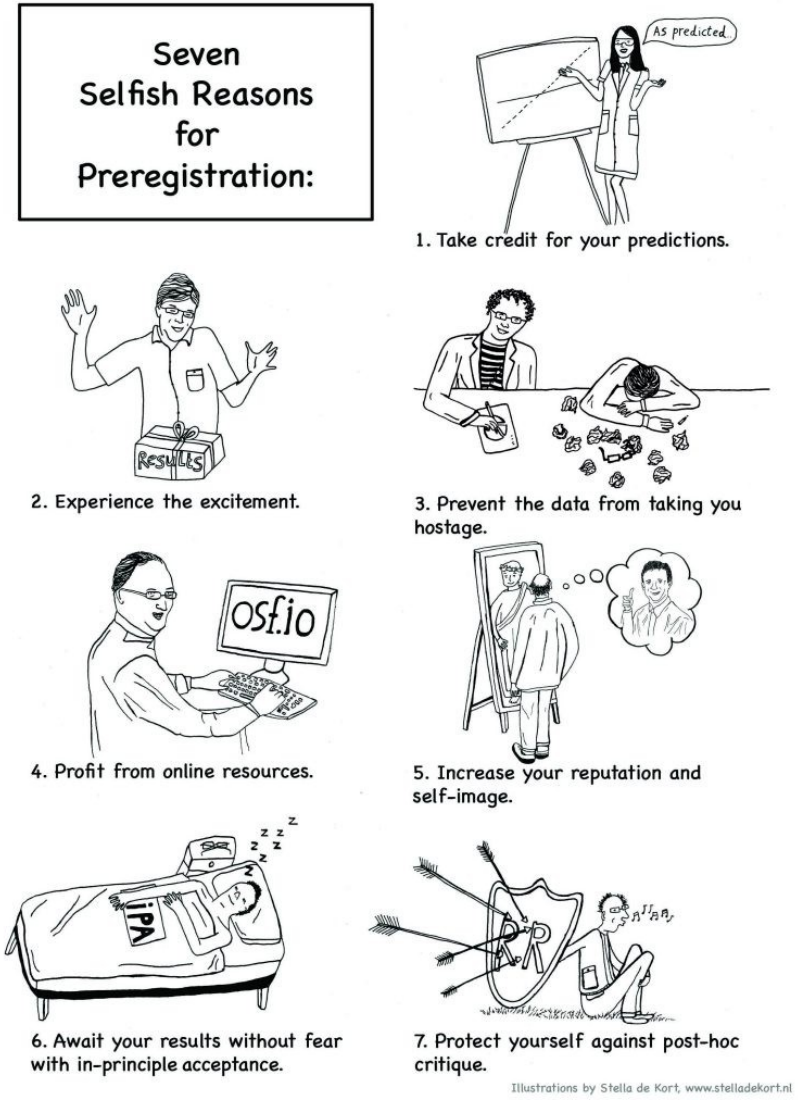
Open Science

- results in better science
- should not be hyped / should be criticized
- results in a more complex knowledge

Questions?

https://github.com/richelbilderbeek/osu_talk_20230414

Selfish reason for preregistration



Wagenmakers, Eric-Jan, and Gilles Dutilh. "Seven selfish reasons for preregistration." APS Observer 29 (2016).