



SLUB

Wir führen Wissen.

Lessons in Open Science

Preregistration and Registered Reports

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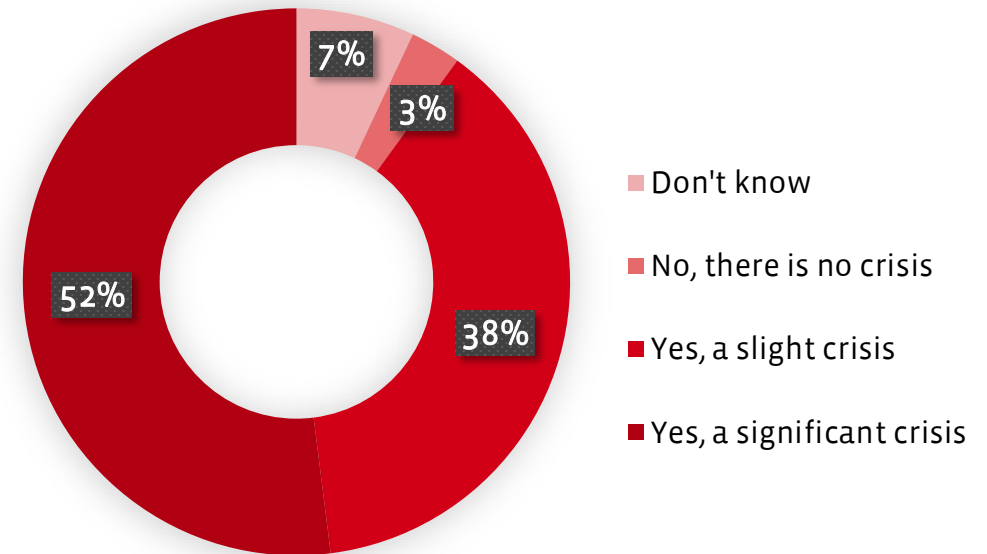
Agenda

- **Current Issues in Science**
 - *Credibility and trust*
 - *Prediction vs. postdiction*
 - *File Drawer, p-Hacking, HARKing, multiverse*
- **Definition and Merits**
 - *Benefits to science in general*
 - *Personal benefits*
 - *Adopting preregistration*
- **Process of Preregistration**
 - *Different methods*
 - *Registered Reports*
- **Common Obstacles and Concerns**

Credibility of Science?

- Neither laypersons nor professional scientists **trust** in the majority of published results in the life sciences
- Average statistical power is much **too low** (20-50%) considering the published positive rate (>90%) (*Nosek, 2018*)

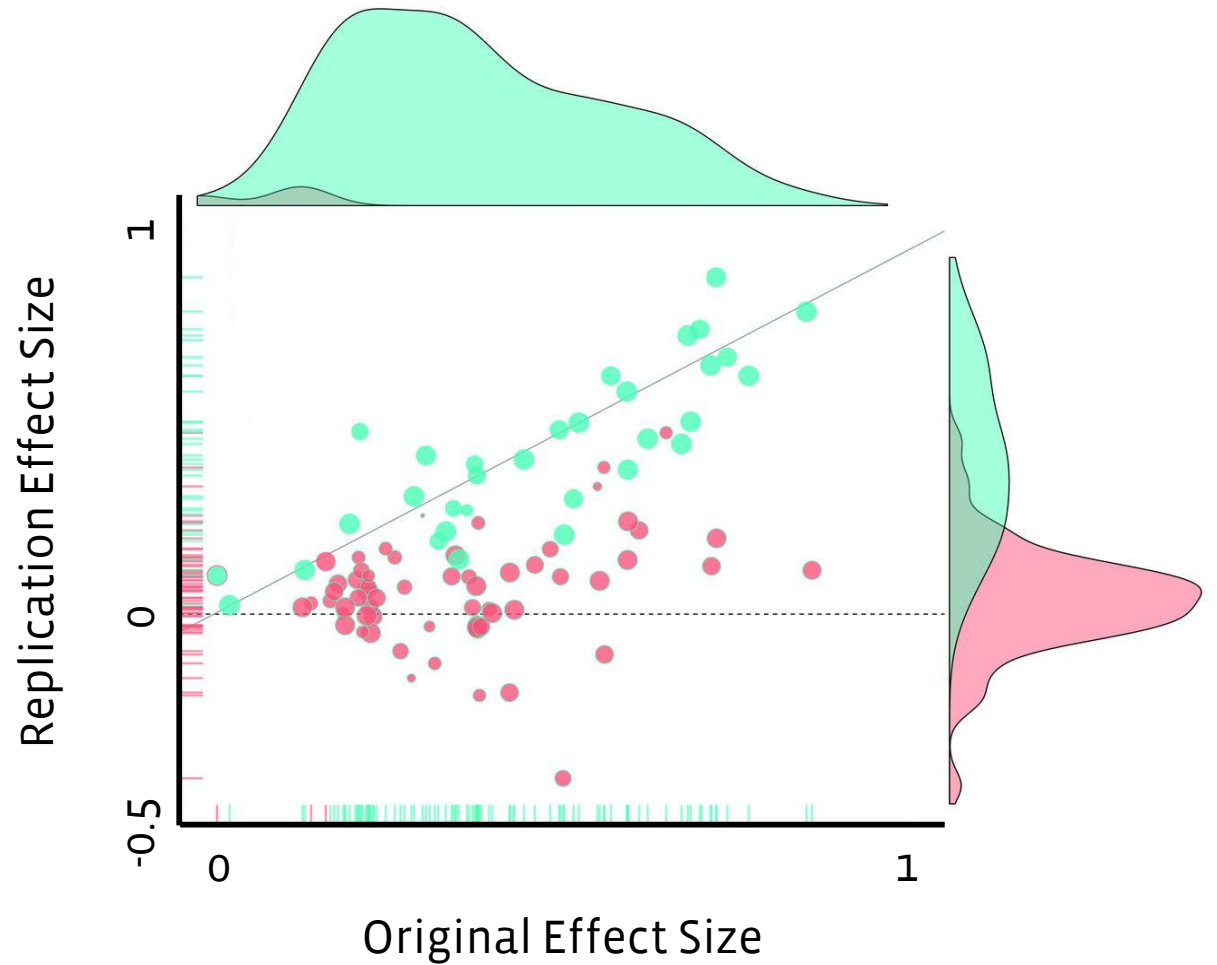
Is there a reproducibility crisis?
- 1576 Researchers surveyed -



Adapted from Baker, 2016

Replication Crisis in Psychology

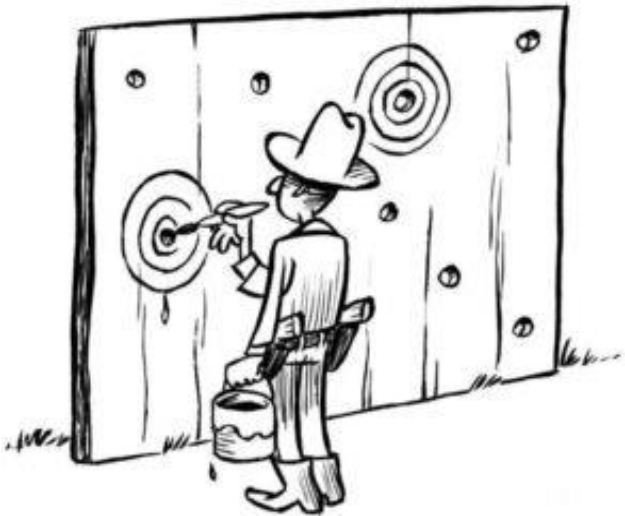
- Replication of 100 studies
- Significant results **decreased** from 97% to 36%
- Reasons: coincidence/error, biases, **questionable research practices**



Open Science Collaboration, 2015

HARKing and p-Hacking

Hypothesizing **A**fter
Results are **K**nown



<https://ispgr.org/open-science-and-the-power-of-pre-registration/>

p-Hacking

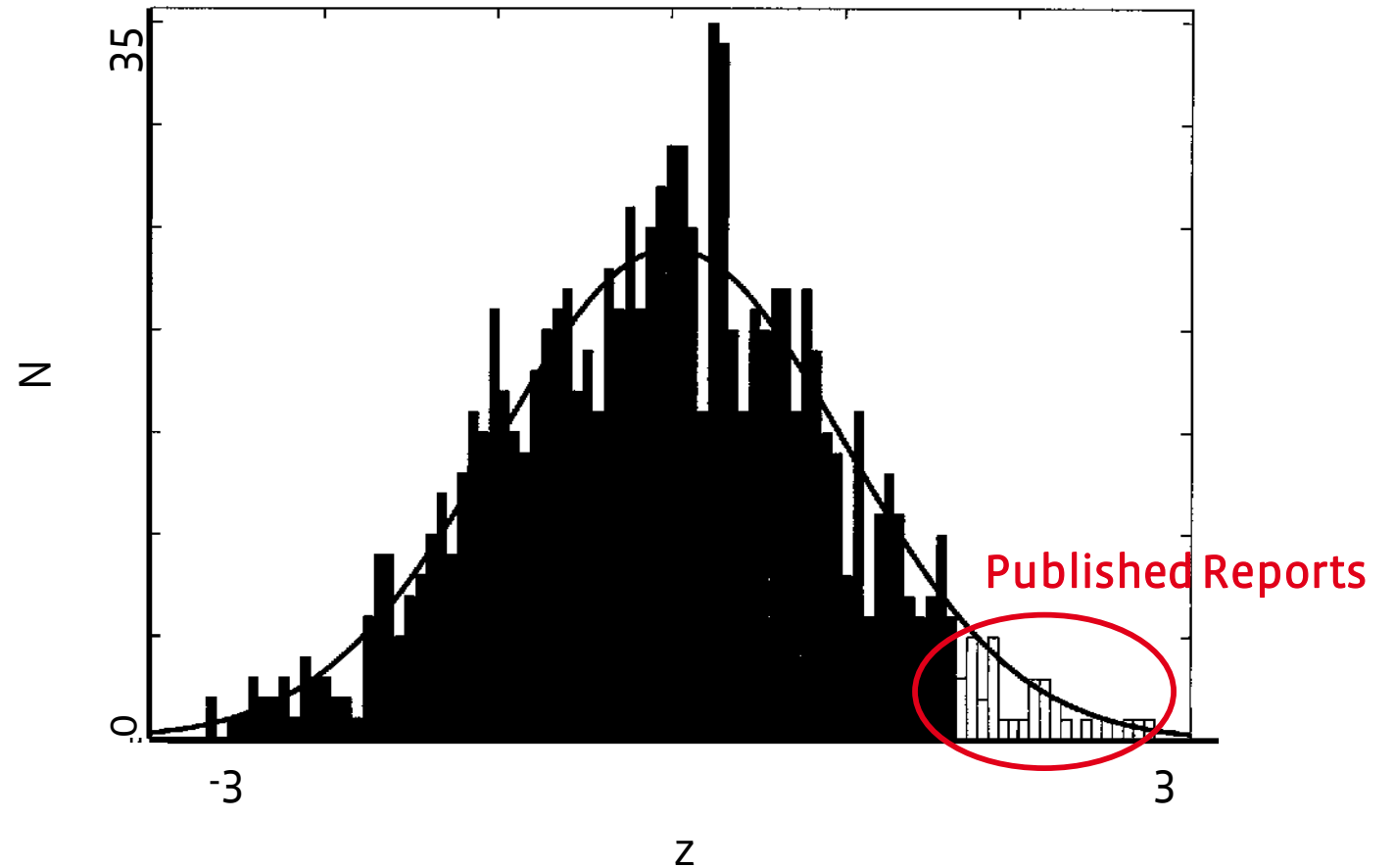


“If you don't reveal some insights soon, I'm going to be forced to slice, dice, and drill!”

<https://atozmarkets.com/news/untold-reality-of-p-hacking-in-finance/>

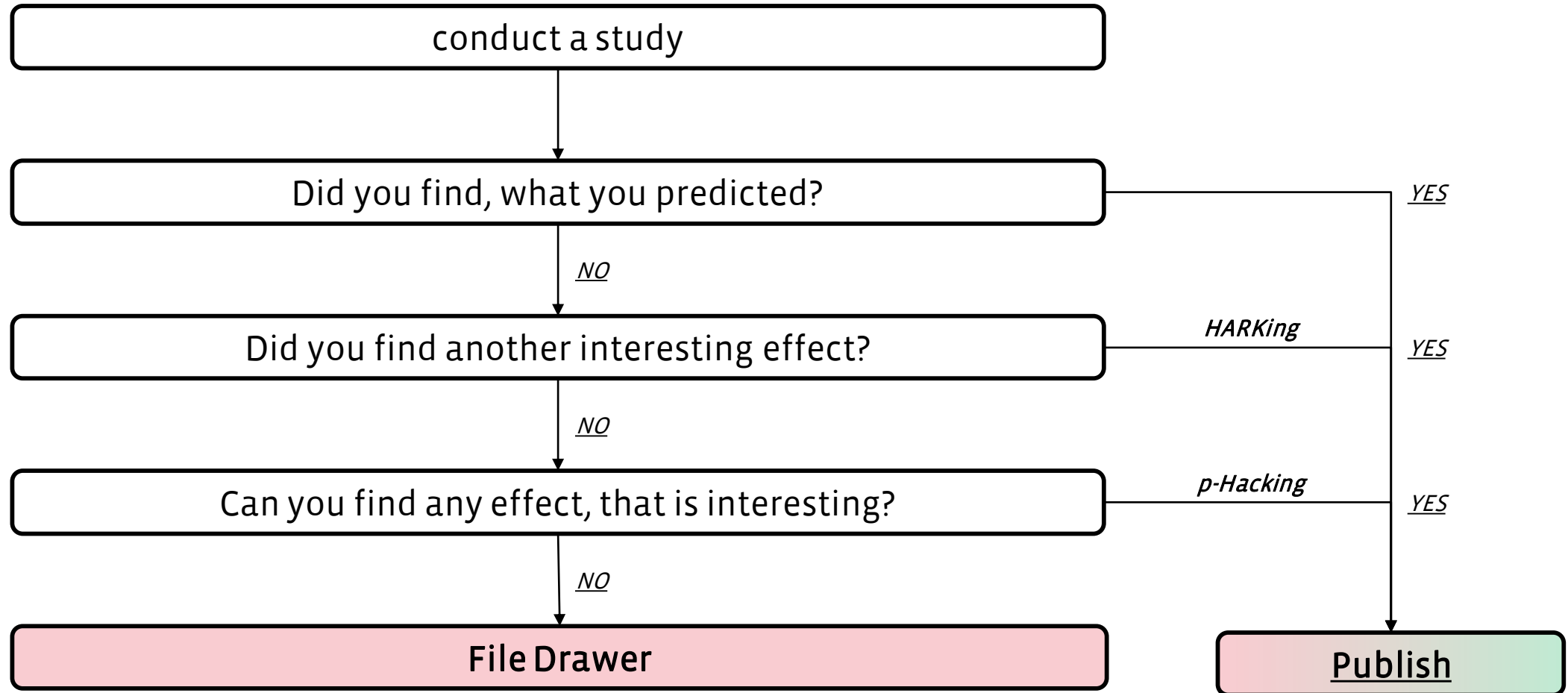
File Drawer

“A publication bias exists if the **probability** that a study reaches the literature [...] depends on the **results** of the study.”



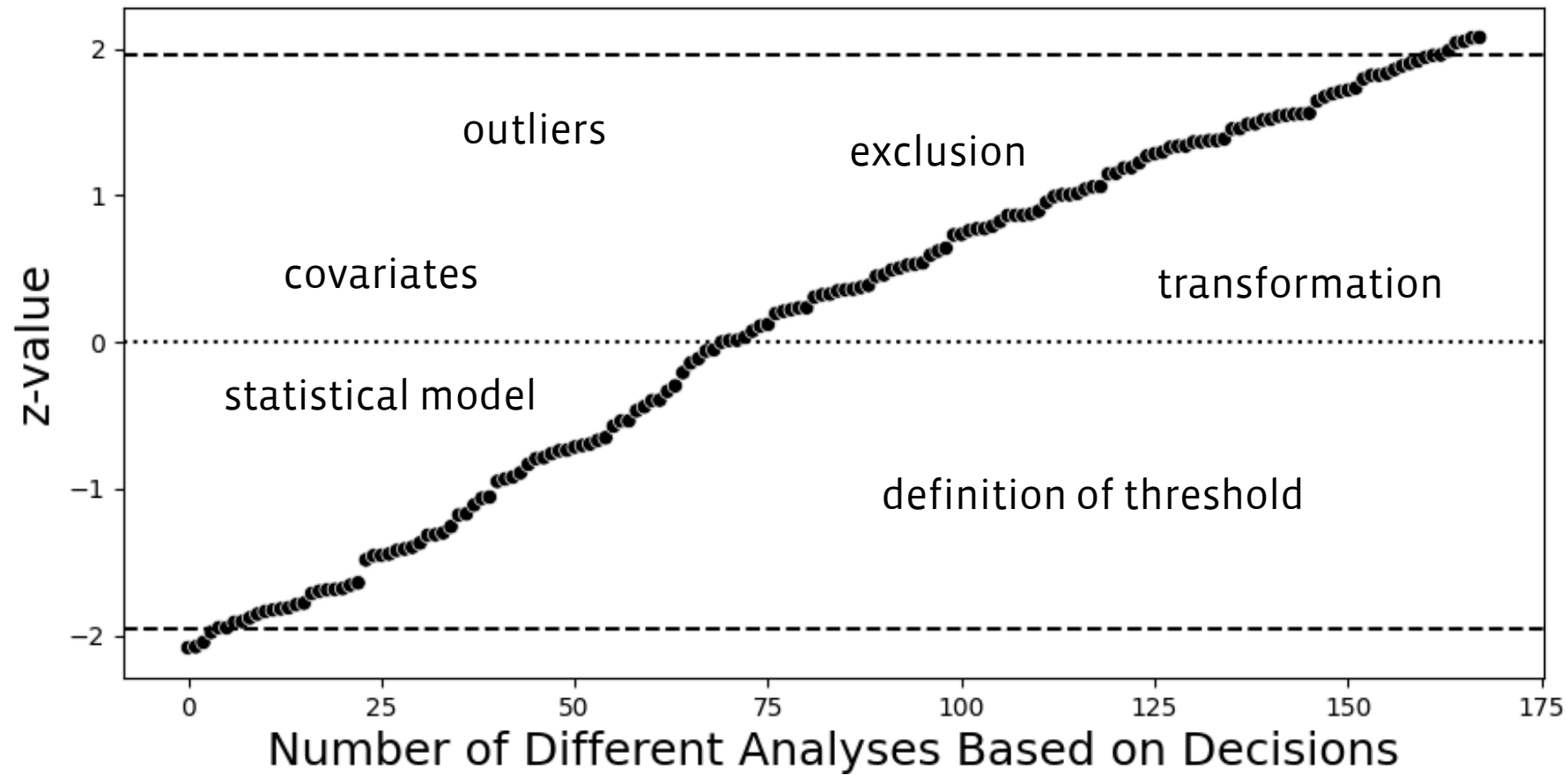
Adapted from Scargle, 1999

The Path to Incredibility

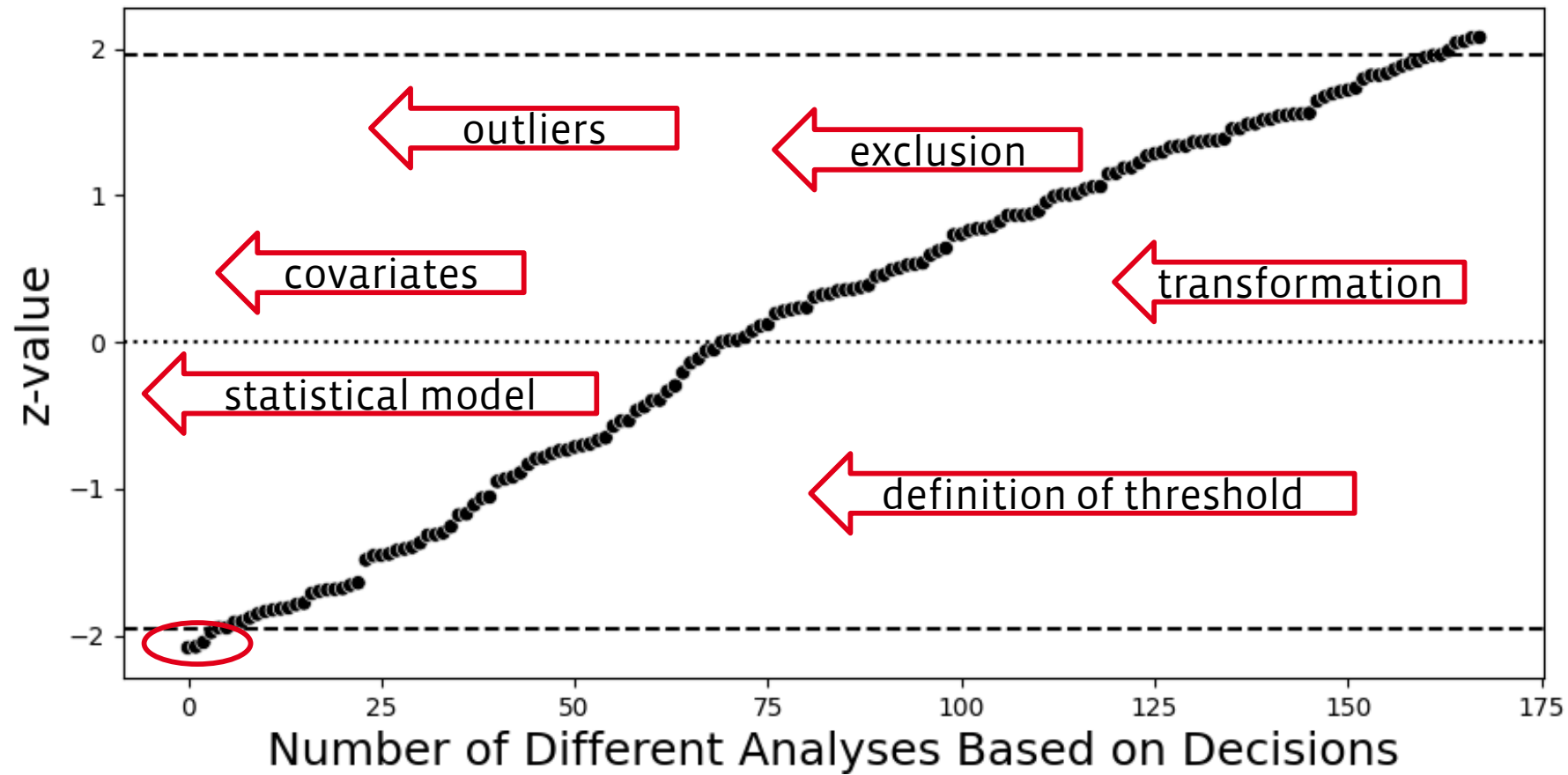


adapted from Brian Nosek, 2018: <https://osf.io/9m6tx/>

Multiverse



Multiverse



Prediction vs. “Postdiction”

property	prediction	“postdiction”
Influenced by investigation and outcome?	No	Yes
Null hypothesis significance testing (p-values) is fully applicable?	Yes	No
Confirmatory or exploratory?	confirmatory	exploratory
Valuable to the scientific process?	Yes	Yes

We only have to be able to differentiate between the two approaches.

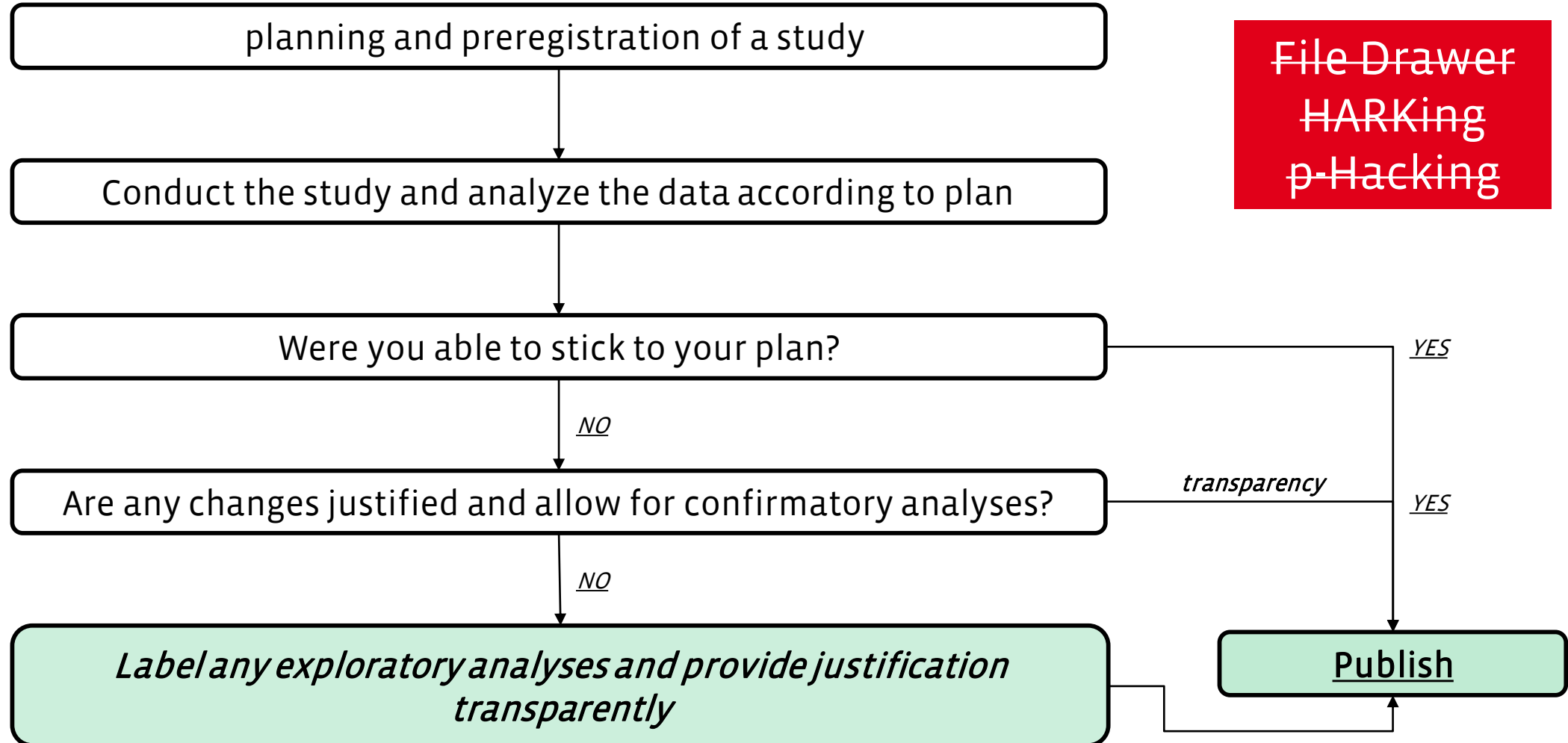
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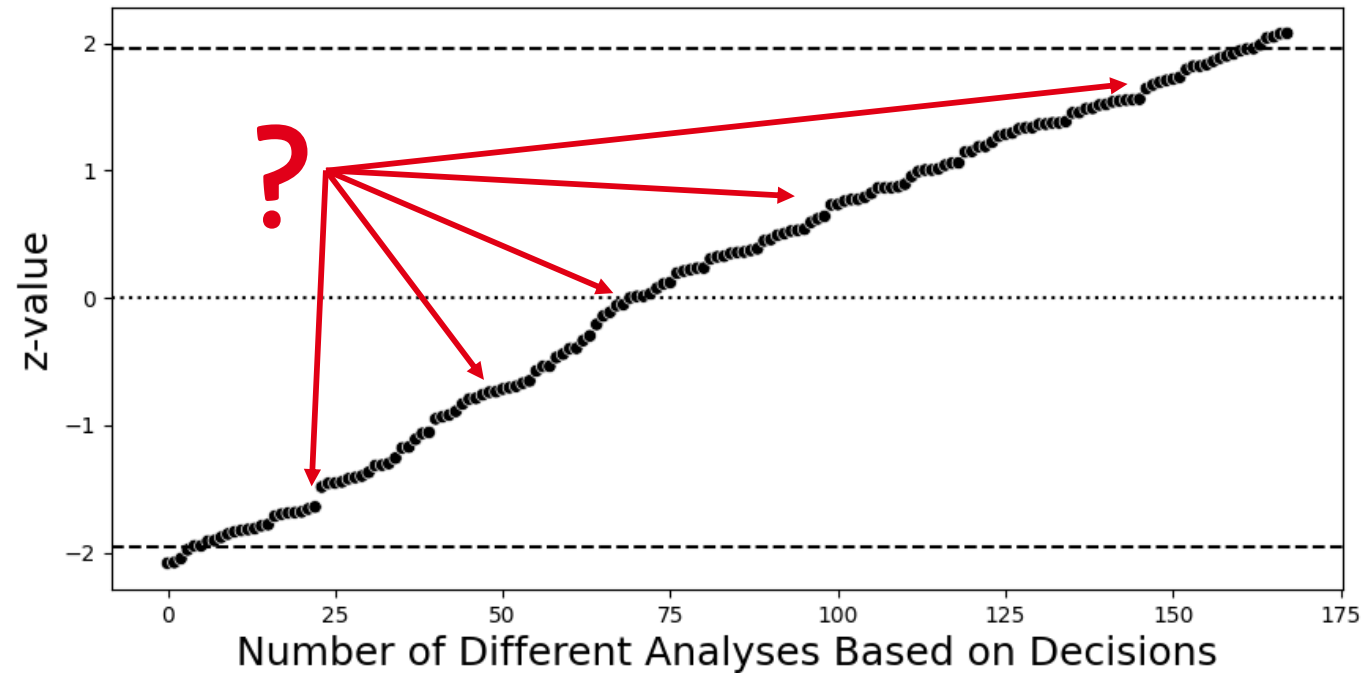
What is preregistration?

- **A priori** documentation/publication of information on planned investigation, such as:
 - *study design, methods, hypotheses, analysis plan*
- **Independent** party registry
 - *E.g. Open Science Framework (OSF)*
 - **Embargo** upon submission is possible
- Time Stamp
- **Immutable**
 - *Can not be changed or deleted (without record)*

The Path to Credibility



Multiverse



By making analytical decisions in advance, preregistration ensures arbitrary results within the multiverse.

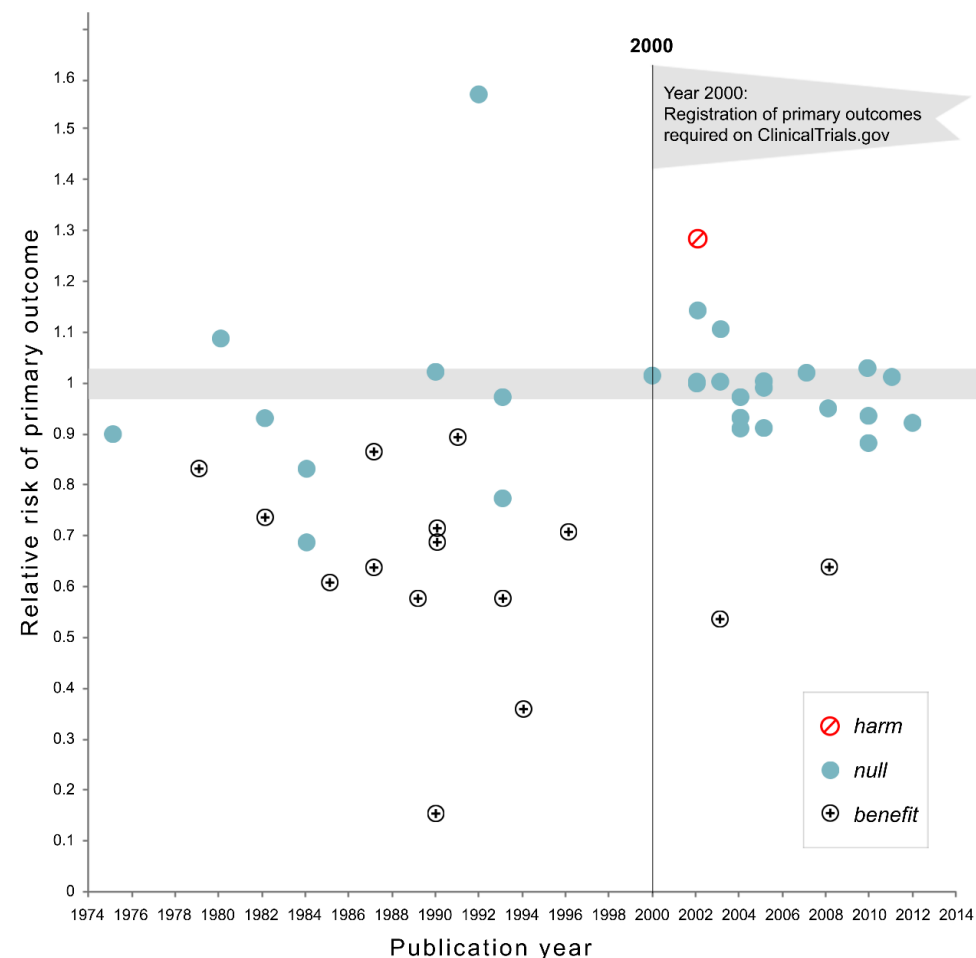
Is preregistration effective?

Rate of positive results
dropped from 57% to 8%
with the introduction of
obligatory
preregistration.

Kaplan & Irvin, 2015

“The strongest factor associated with the false positive or true positive study outcome was if the study had a specific a priori hypothesis.”

Swaen, Teggeler & van Amelsvoort, 2001



Benefits on an individual level

- Reduce implicit **bias**
 - *Improve **quality** of research*
- Distinction between **confirmatory** and **exploratory** investigations
- Increases focus on **project management**
 - *Preregistration involves increased careful planning*
- Initialization of **collaborations**
 - *Involvement of all project partners*
- Open Science Badges



<https://osf.io/tvyxz/wiki/1.%20View%20the%20Badges/>

Personal Benefits

Seven Selfish Reasons for Preregistration:



1. Take credit for your predictions.



4. Profit from online resources.



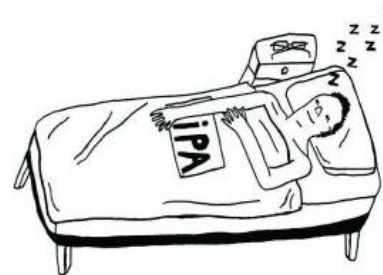
5. Increase your reputation and self-image.



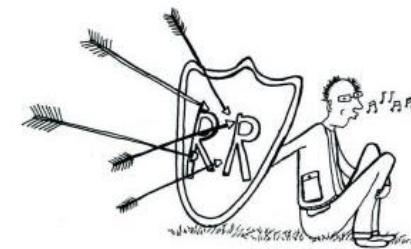
2. Experience the excitement.



3. Prevent the data from taking you hostage.



6. Await your results without fear with in-principle acceptance.

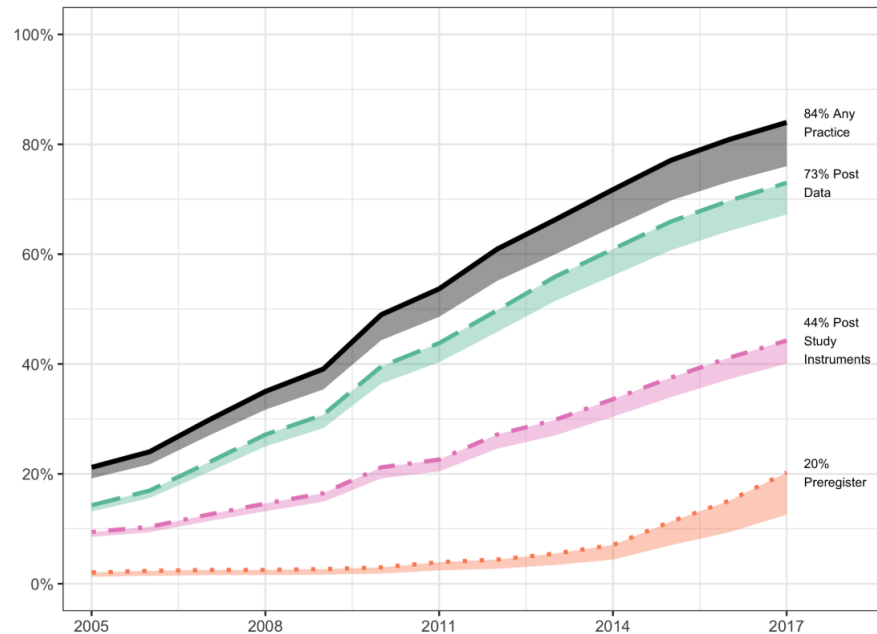


7. Protect yourself against post-hoc critique.

Illustrations by Stella de Kort, www.stelladekort.nl

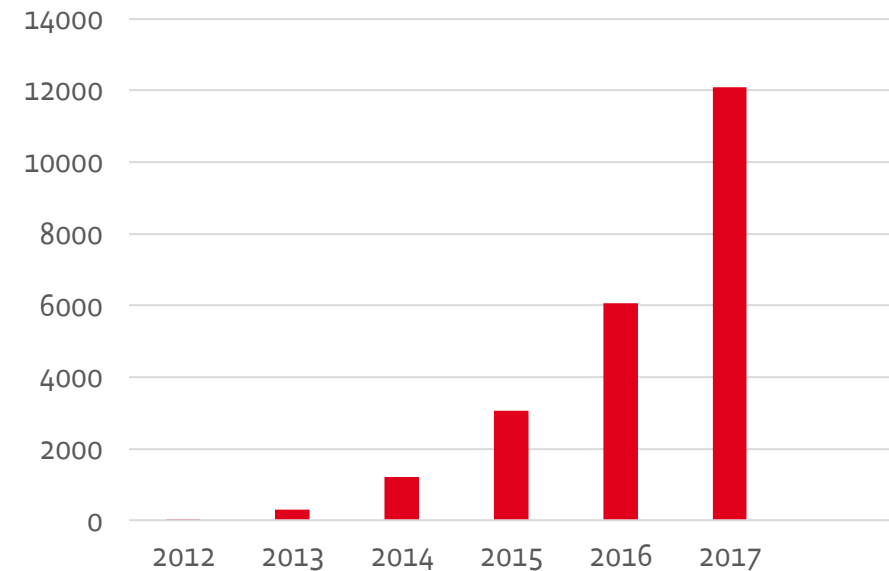
Wagenmakers & Dutilh, 2016

Adopting preregistration



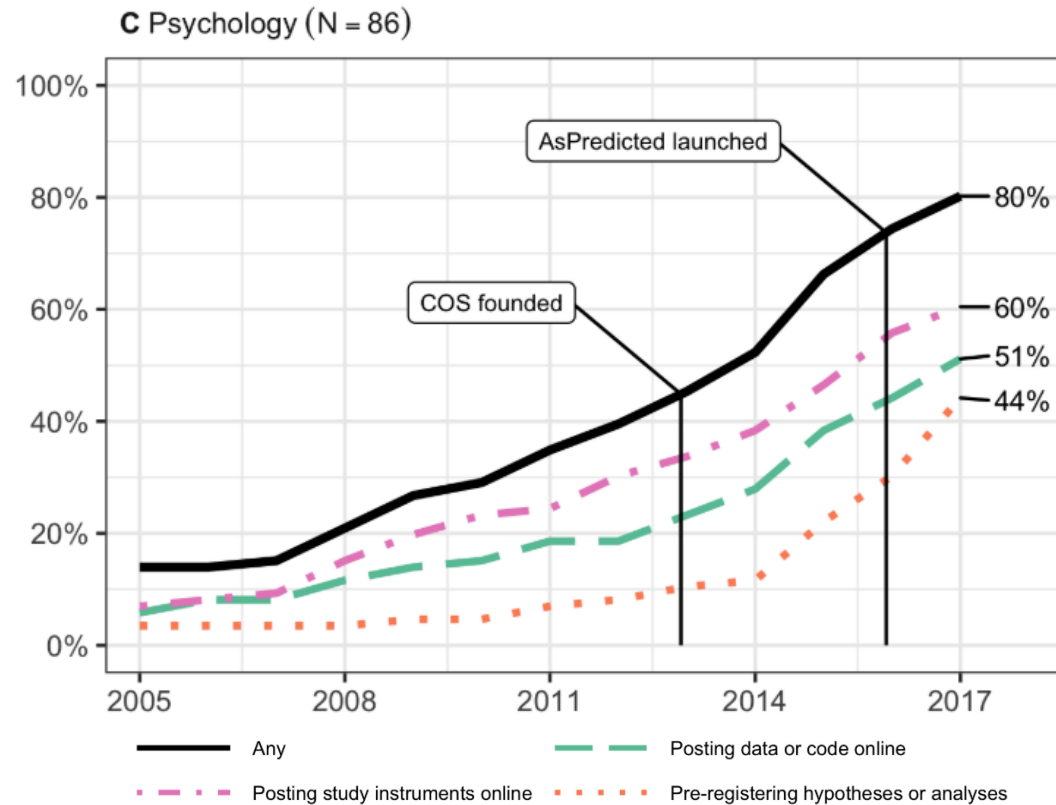
Christensen et al., 2020

Number of Preregistrations on OSF

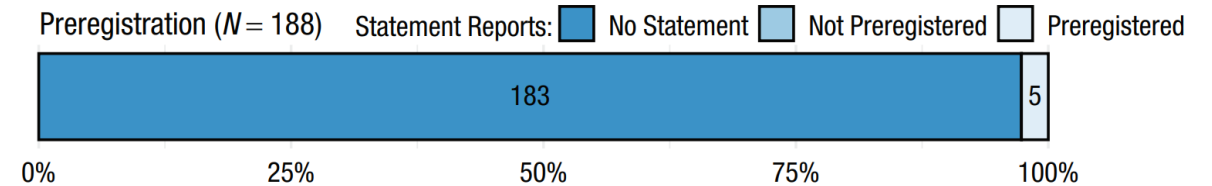


Adapted from Nosek & Lindsay 2018
<https://www.psychologicalscience.org/observer/preregistration-becoming-the-norm-in-psychological-science>

Adopting preregistration (Psychology)



Christensen et al., 2020



Hardwicke et al., 2021

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Content and Templates

- Metadata
 - *Title, Contributors, Subject, Tags...*
- Study Design
 - *Type, Blinding, Randomization...*
- Sampling
 - *Data collection, Subjects, Sample size...*
- Analysis
 - *Variables, Manipulation, Aggregation, Statistics, outlier/missing data policy...*

Continue your registration by selecting a registration form:

- OSF Preregistration ⓘ
- Open-Ended Registration ⓘ
- Qualitative Preregistration ⓘ
- Secondary Data Preregistration ⓘ
- Registered Report Protocol Preregistration ⓘ
- OSF-Standard Pre-Data Collection Registration ⓘ
- Preregistration Template from AsPredicted.org ⓘ
- 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 ⓘ

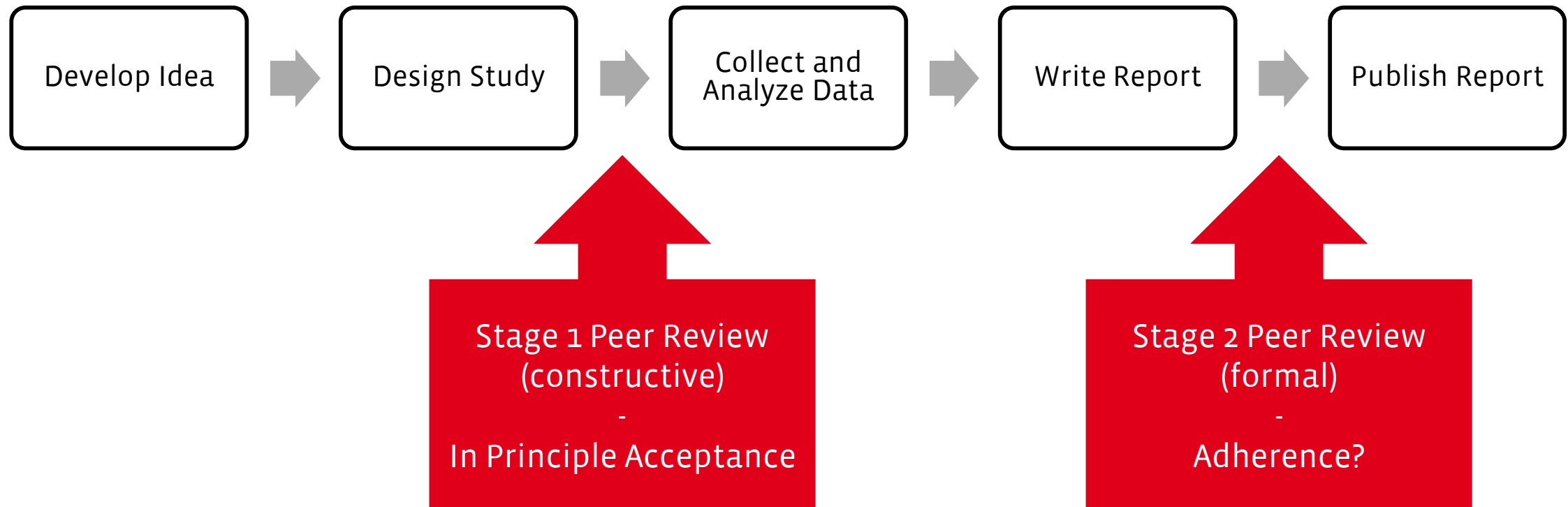
<https://osf.io>

How to preregister

- Online registries
 - *e.g. OSF, AsPredicted, Prospero*
- Registered Reports
- Other publication methods
 - *Study protocol*
 - *Poster at conference*



Registered Report



Adapted from <https://osf.io/rr/>

Methods

Method	Pro	Con
Online Registry	<ul style="list-style-type: none">• Easy and fast• Most widely used• Stepwise approach easily applicable	<ul style="list-style-type: none">• No quality assurance• Harder to discern between good and bad registration
Registered Reports	<ul style="list-style-type: none">• Gold standard• “In Principle Acceptance” status• Constructive review process• Counteracts File Drawer	<ul style="list-style-type: none">• Takes much more time• Less predictable
Other publication of study protocol (article, conference poster ...)	<ul style="list-style-type: none">• Additional publication	<ul style="list-style-type: none">• Focusses on the dissemination of methods rather than decreasing degrees of freedom

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Obstacles and Concerns

- Too much **extra** work!
 - *It is not going to be wasted, but worth it*
- Too restrictive, science needs **freedom**!
 - *You are free to explore, just label accordingly*
- It's not going to stop **fraud** anyway!
 - *No, but it is still helpful and might make it harder*
- Someone is going to **steal** my ideas!
 - *Embargo*

Nosek et al., 2018

References

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<https://doi.org/10.1093/ije/30.5.948>
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What funders can do

- Raise **awareness**
 - *Lectures, workshops, conference participation...*
- **Guided Workflows**
 - *Manuals, templates, tutorials...*
- **Policy**
 - *Guidelines, application evaluation, grants...*
- Partnerships with **registries** as well as journals offering **registered reports**

Nosek et al., 2018

Key principles

- Avoid bias/influence by making important **decisions** and careful planning **in advance**
- Be as **transparent** as possible
- **Changes and exploratory analyses** are no problem, as long as you report and are able to justify them

Be aware of these principles and of what you are trying to achieve. If you are honest, preregistration will come naturally to you!

Obstacles and Concerns

“No, it’s too much extra work!”

- There is extra effort involved. Ask yourself if it could be worth it
- Most of it will have to be done at some point anyway
- Start slowly and incrementally, efficiency will increase

Nosek et al., 2018

Obstacles and Concerns

“No, I don’t want my freedom taken away!”

- You are free to explore
- Lack of freedom only with regards to lack of transparency
- Differentiation between confirmatory and exploratory investigations is vital
- “It’s a plan, not a prison” - <https://www.cos.io/blog/preregistration-plan-not-prison>

Nosek et al., 2018

Obstacles and Concerns

“No, I need to be able to change my plans throughout the project!”

- Justify those changes
- Be transparent
- Report as early as possible, potentially through another preregistration
- Sensible changes are no problem

Nosek et al., 2018

Obstacles and Concerns

“No, I want to use existing data!”

- Register before examining the data
- Try to blind as much as possible
- Clearly state how much you knew about the data before analyzing it

Nosek et al., 2018

Obstacles and Concerns

“No, I have no predictions!”

- Exploratory investigation
- Label accordingly and adapt statistical analyses accordingly
- Consider hold out sample

Nosek et al., 2018

Obstacles and Concerns

“No, I need to look into the data, before I am able to decide on the analyses!”

- Be upfront about the decision you will have to make
- Consider the feasibility of a decision tree
- Consider stepwise preregistration
- Consider multiverse analysis

Nosek et al., 2018

Obstacles and Concerns

“No, I don’t want my ideas stolen!”

- Time stamps can be valid without publication of your study plan
- Registrations can be embargoed (e.g. 4 years with OSF)
- It makes sense to publish your preregistration no later than your article

Nosek et al., 2018

Obstacles and Concerns

“No, it won’t stop fraud anyway!”

- No it will not, but it will make it harder and more explicit
- Helps to reduce implicit biases and to be honest to yourself
- Consider it a useful tool for scientists, who strive for better research
- Quality checks are necessary

Nosek et al., 2018