

# Research Methods in Cognitive Science

## Week 4: The Credibility Revolution or Why We Are Not F\*KED

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2021-09-20

# Outline

- The crisis in science
  - Last Week Tonight with John Oliver
- What is replication?
- The history of the replication crisis in psychology
- The issues that lead to the crisis
  - Simmons et al. (2011)
- Potential Solutions
- Open Science
  - Open Science Framework
  - Preregistration
  - ORCID

# Poll

The screenshot shows a Slido poll interface. At the top, there are three navigation tabs: 'Rep' (selected), 'Q&A', and 'Polls'. On the right side of the header is a user profile icon. Below the header, the word 'Live poll' is displayed next to a person icon showing '0' participants. The main content area contains a poll question: 'Have you heard of the replication crisis prior to this class?'. Two options are listed: 'Yes' and 'No', each preceded by a radio button. A large green 'Send' button is centered below the options. Below the 'Send' button, the text 'Voting as Anonymous' is shown. At the bottom of the page, a dark footer bar contains a cookie consent message: 'Slido uses cookies to improve your experience, analyze traffic, and serve personalized ads. By clicking 'Allow all' you consent. [Learn more](#)'. It also includes three buttons: 'Privacy settings', 'Reject all', and 'Allow all'.

Live poll 0

Have you heard of the replication crisis prior to this class?

Yes

No

Send

Voting as Anonymous

Slido uses cookies to improve your experience, analyze traffic, and serve personalized ads. By clicking 'Allow all' you consent. [Learn more](#)

Privacy settings

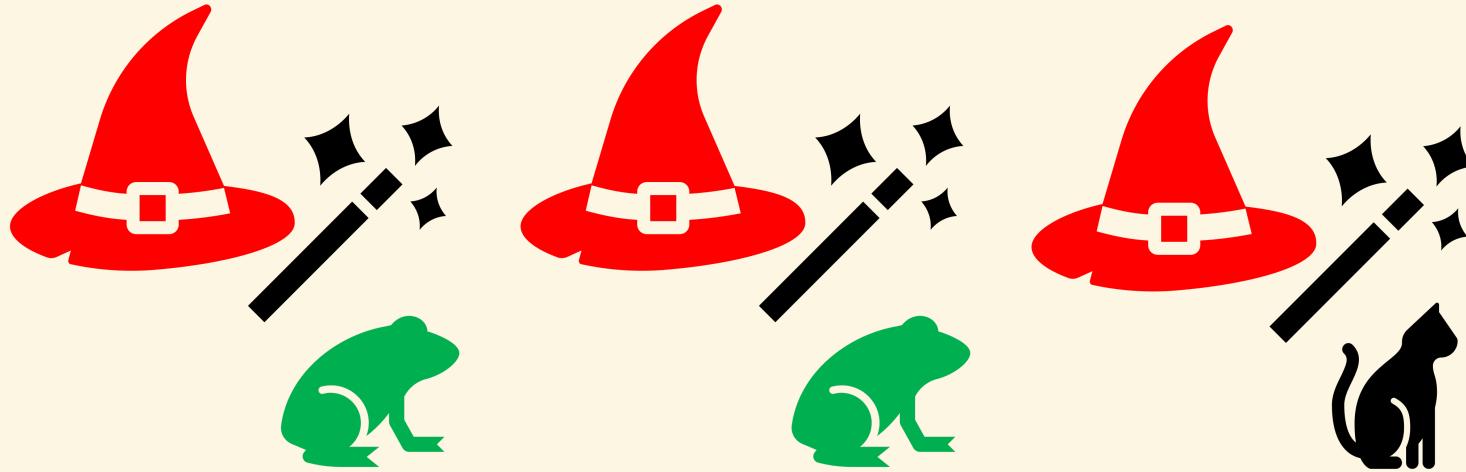
Reject all

Allow all

# **Is Science Fucked?**

<https://www.youtube.com/watch?v=ORnq1NpHdmw&t=666s>

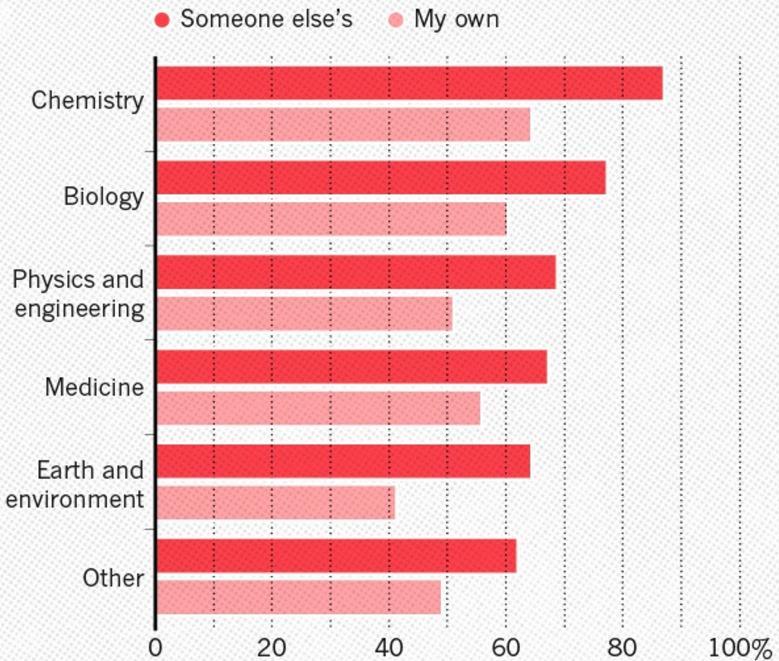
# Replication



- Replication can be successful
- Replication can be unsuccessful

## HAVE YOU FAILED TO REPRODUCE AN EXPERIMENT?

Most scientists have experienced failure to reproduce results.



Number of respondents from each discipline:  
Biology 703, Chemistry 106, Earth and environmental 95,  
Medicine 203, Physics and engineering 236, Other 233

©nature

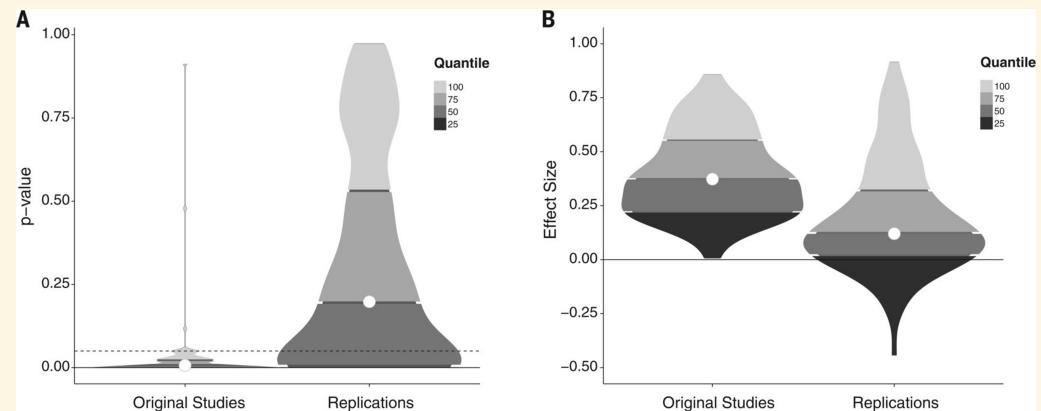
<https://www.nature.com/news/1-500-scientists-lift-the-lid-on-reproducibility-119970>

# The Replication Crisis: A Timeline

- A little history
  - 2011: Daryl Bem published a paper in JPSP (top journal) claiming to have found evidence that ESP exists
    - PsychoPy Demo
  - 2011: Diederik Stapel busted for fabricating data (**58 papers retracted to date**)
  - 2011-present: Major findings (psychology) not replicated
    - E.g., Ego depletion, embodied cognition, power posing, social priming
  - 2015: Open Science Collaboration tried to replicate 100 psychology studies

# Open Science Collaboration (2015)

- Open Science Collaboration attempted to replicate 100 studies published in 3 top psychology journals in 2008
- Replications used materials supplied by original authors and were high-powered
  - Results: 39% of the original studies were successfully replicated
    - 25% of social psychology studies replicated
    - 50% of cognitive psychology studies replicated
      - Effect sizes overestimated in original studies



# Why?

## False Positive Psychology (Simmons, Nelson, & Simonsohn, 2011)

- False positives are Type 1 errors
  - Claim an effect exists when it actually does not
- Simmons, Nelson, & Simonsohn (2011) demonstrated that it's easy to statistically support a hypothesis that is actually false (i.e., find a false positive)

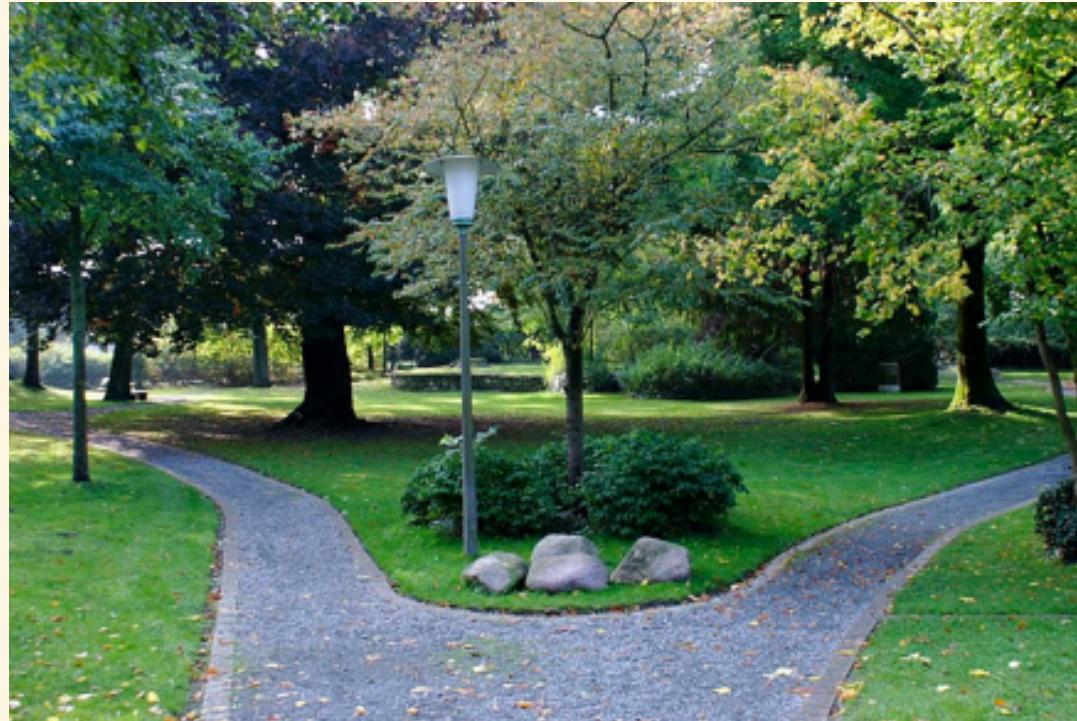
# The Dangers of False Positives

- Can be dangerous
  - E.g., health research: claim that a treatment is effective when actually it isn't, or even has negative side effects
- Wastes resources
  - Researchers waste time, effort, and money conducting research on effects that don't actually exist
- Hard to exercise false positives from the literature
- Not enough incentives for researchers to conduct replications that debunk the false positives
- Erodes the credibility of psychological science

**Why do we have a problem?**

# Researcher Degrees of Freedom

- Researchers may engage in questionable research practices (QPRs) not because they intend to be dishonest. Rather, they are motivated to make decisions that support their hypotheses
  - Make decisions so that p-value will be below .05 and can claim statistical significance



# Researcher Degrees of Freedom

- Which DV do you focus on?
- Measure the mean or the median?
- Which participants do you exclude?
- When do you stop collecting data?
- What analyses do you do?
- What covariates do you include?

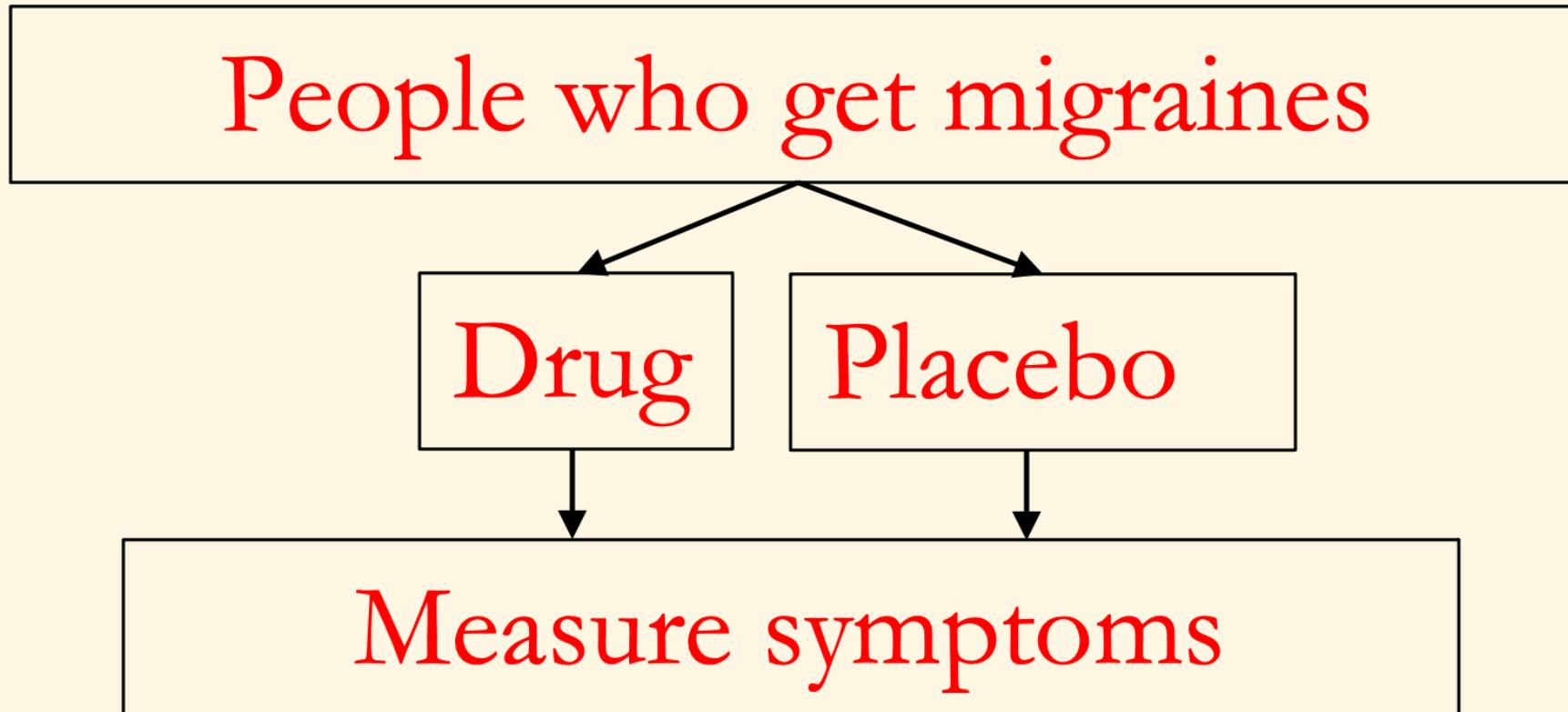
Making each decision increases the false positive rate (Type 1 error)

# Covariates

Covariate: a variable in a statistical analysis that was typically not controlled or manipulated during data collection but was measured

- Hours awake & tantrums
  - covariate: Age

## Researcher Degrees of Freedom



**How many ways are there to analyze this data?**

# Where do false p values come from?

| P-hacking: trying lots of analyses until you get a desired outcome



If you torture  
the data long  
enough, it will  
confess to anything.

Ronald Coase

## QPRs: P-hacking

1. Stop collecting data once  $p < .05$
2. Analyze many measures, but report only those with  $p < .05$ .
3. Collect and analyze many conditions, but only report those with  $p < .05$ .
4. Use covariates to get  $p < .05$ .
5. Exclude participants to get  $p < .05$ .
6. Transform the data to get  $p < .05$ .

## Check this out

# Hack Your Way To Scientific Glory



You're a social scientist with a hunch: **The U.S. economy is affected by whether Republicans or Democrats are in office.** Try to show that a connection exists, using real data going back to 1948. For your results to be publishable in an academic journal, you'll need to prove that they are "statistically significant" by achieving a low enough p-value.

- 
- 1 CHOOSE A  
POLITICAL PARTY



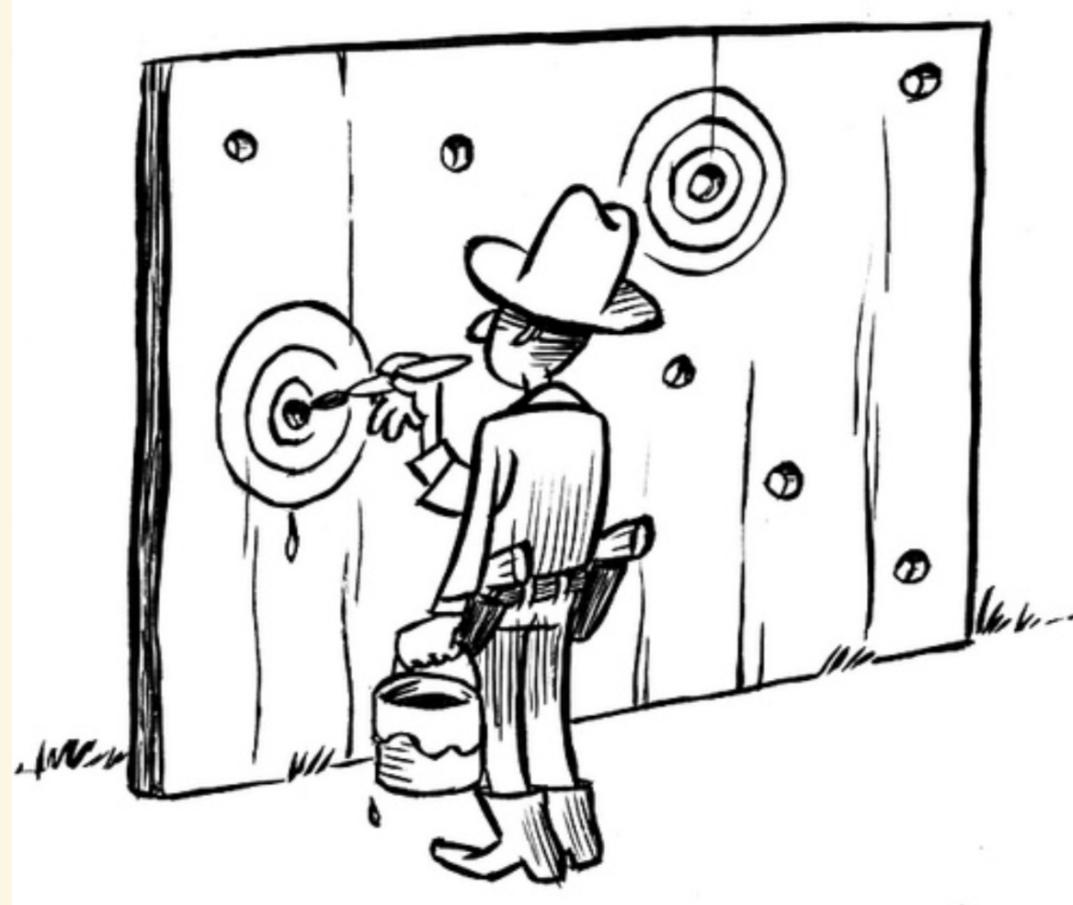
- 
- 2 DEFINE TERMS

Which politicians do you  
want to include?

Politicians

## QPRs: HARKing

Hypothesizing After Results are Known (HARKing): Presenting exploratory findings as confirmatory



## QPRs: HARKing

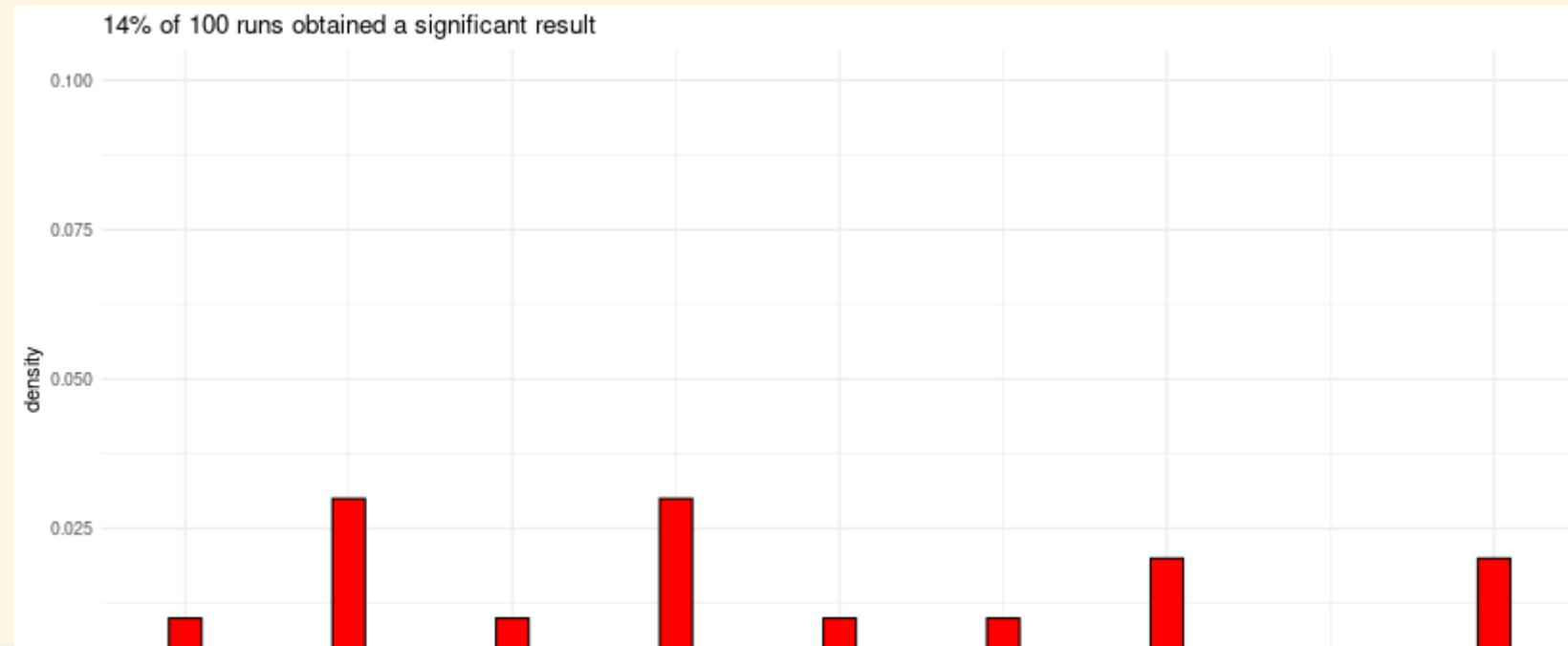
Hypothesizing After Results are Known (HARKing): Presenting exploratory findings as confirmatory

## QRP: Optional Stopping

- Data peeking
  - Run some participants, look at data (stop if desired threshold is reached)
- **do not do this unless you correct for it**
- Inflates Type 1 error

# Peeking Simulations

Just how bad is it to peek at your data every few observations and stop collecting data once you have a significant result? Simulate the false positive rate below. You can change the parameters in the sidebar (in the menu if minimised).



# Publication bias

- Traditionally, journals were biased in favor of publishing:
  1. Significant findings
    - Non-significant findings relegated to a researcher's "file drawer"
  2. Novel findings
    - Counterintuitive, surprising findings more likely to be published in top journals

## Interim Summary

1. Researcher degrees of freedom lead to flexibility in how we analyze our results
2. Publication bias makes it hard to get findings that are not statistically significant published
3. Scientists are incentivized to publish

Does this really mean we are f\*\*ked?



James Heathers

@jamesheathers

"Science is self-correcting" - sure, \*when we correct it\*, not because of Magical Progress (tm).

12:57 PM · Mar 25, 2017 · Twitter Web Client

# Credibility Revolution

The collage consists of three separate news articles arranged vertically.

**Vox Article:** The title is "What psychology's crisis means for the future of science". Below it, a subtitle reads: "The field is currently undergoing a painful period of introspection. It will emerge stronger than before." The author is Brian Resnick, updated on Mar 25, 2016. The date is Feb 19, 2016. The lead image shows a woman in a red shirt smiling. The category is SCIENCE.

**ThirtyEight Article:** The title is "Psychology Is Starting To Deal With Its Replication Problem". The author is Christie Aschwanden. The date is Aug. 27, 2015. The lead image shows a man in a lab coat looking at a computer screen.

**Social Media Icons:** A row of social media icons for Facebook, Twitter, and Google+ is positioned between the Vox and ThirtyEight articles.

## Potential Solutions

**Table 2.** Simple Solution to the Problem of False-Positive Publications

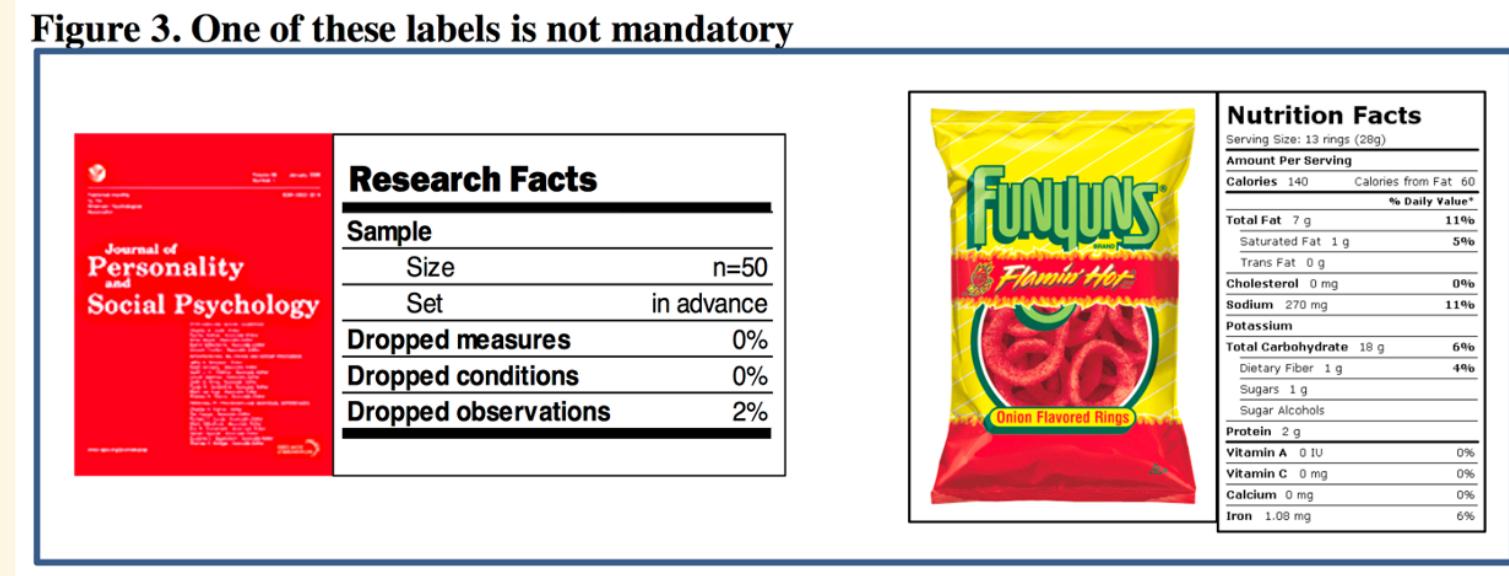
Requirements for authors

1. Authors must decide the rule for terminating data collection before data collection begins and report this rule in the article.
2. Authors must collect at least 20 observations per cell or else provide a compelling cost-of-data-collection justification.
3. Authors must list all variables collected in a study.
4. Authors must report all experimental conditions, including failed manipulations.
5. If observations are eliminated, authors must also report what the statistical results are if those observations are included.
6. If an analysis includes a covariate, authors must report the statistical results of the analysis without the covariate.

# 21 word solution

“We report how we determined our sample size, all data exclusions (if any), all manipulations, and all measures in the study.”

Figure 3. One of these labels is not mandatory



# Potential Solutions

- Preregistrations
- A formalized (time-stamped) document that specifies all hypotheses & methodological choices in writing prior to data collection
  - Reduces RDoF
  - Can't p-hack
  - Can't HARK

## Experiment 2

### Method

### Participants



Open Science Framework

Ninety-six participants, ages 18–28 years, from the Carleton College community participated in Experiment 2. This sample size was predetermined using power analysis, and this experiment was preregistered via the Open Science Framework (<https://osf.io/b94yx/>).

Strand et al., 2018

# Potential Solutions

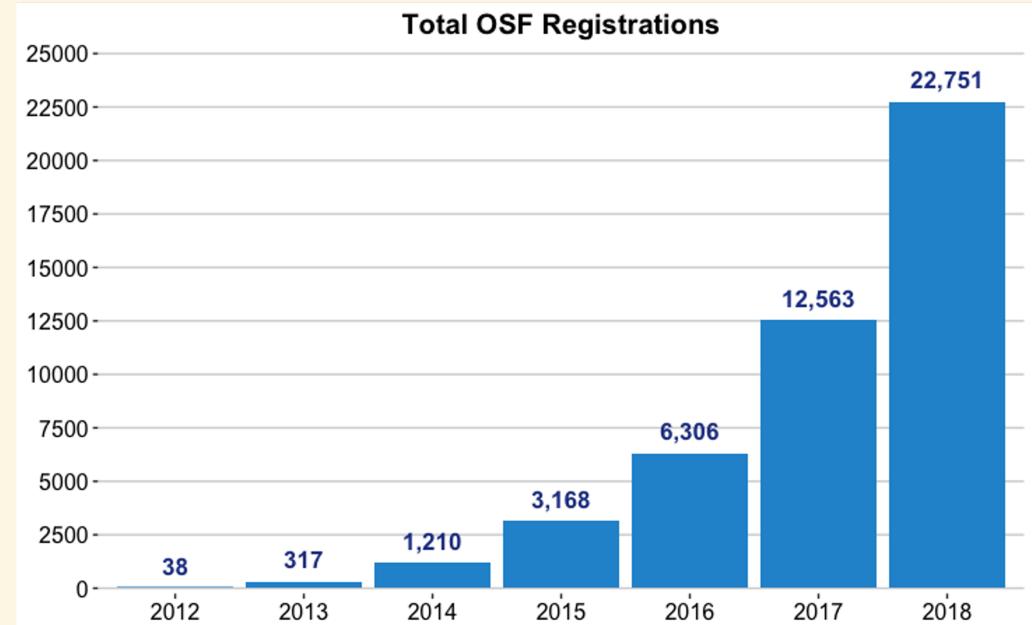
- Preregistrations

- OSF
- Aspredicted.org

Observer > 2018 > March > Preregistration Becoming the Norm in Psychological Science

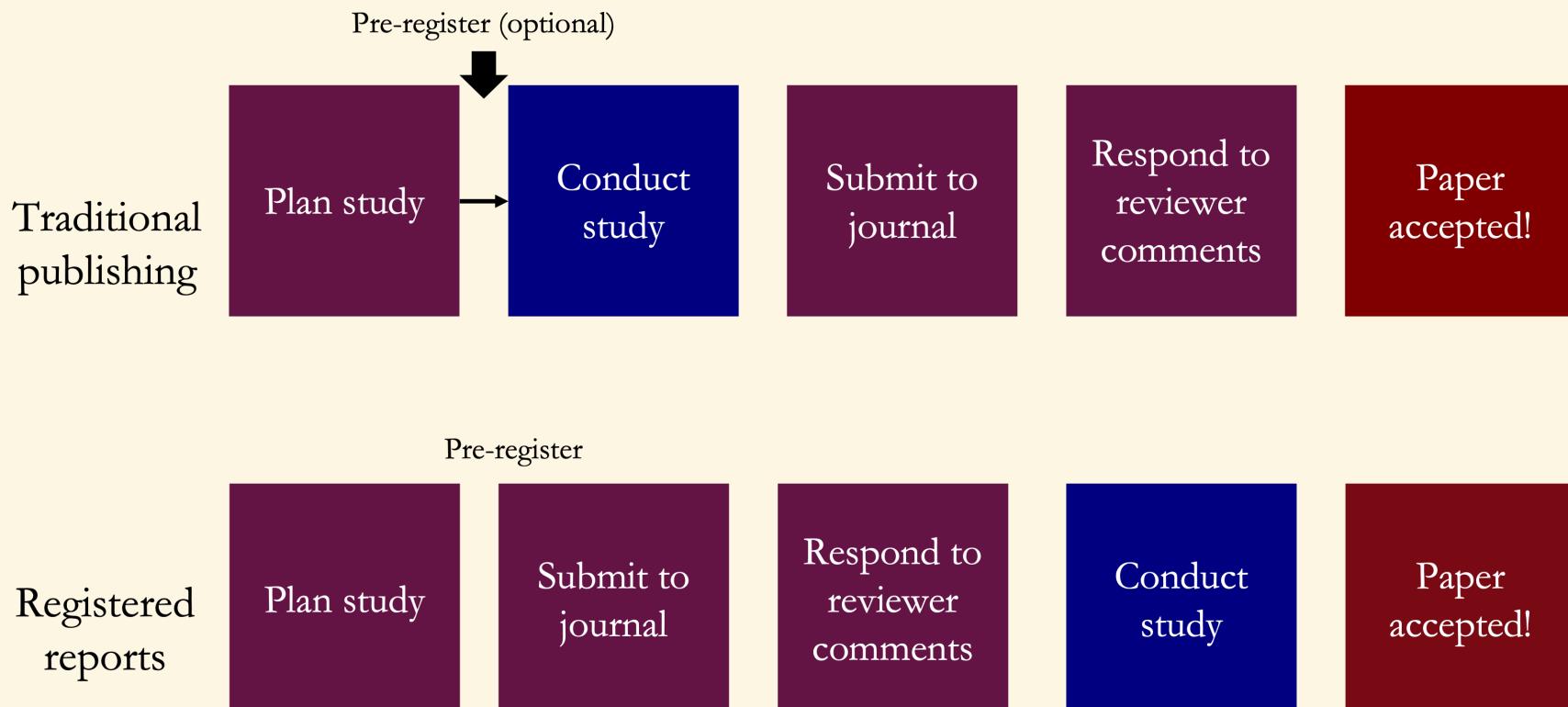
## Preregistration Becoming the Norm in Psychological Science

BRIAN A. NOSEK AND D. STEPHEN LINDSAY



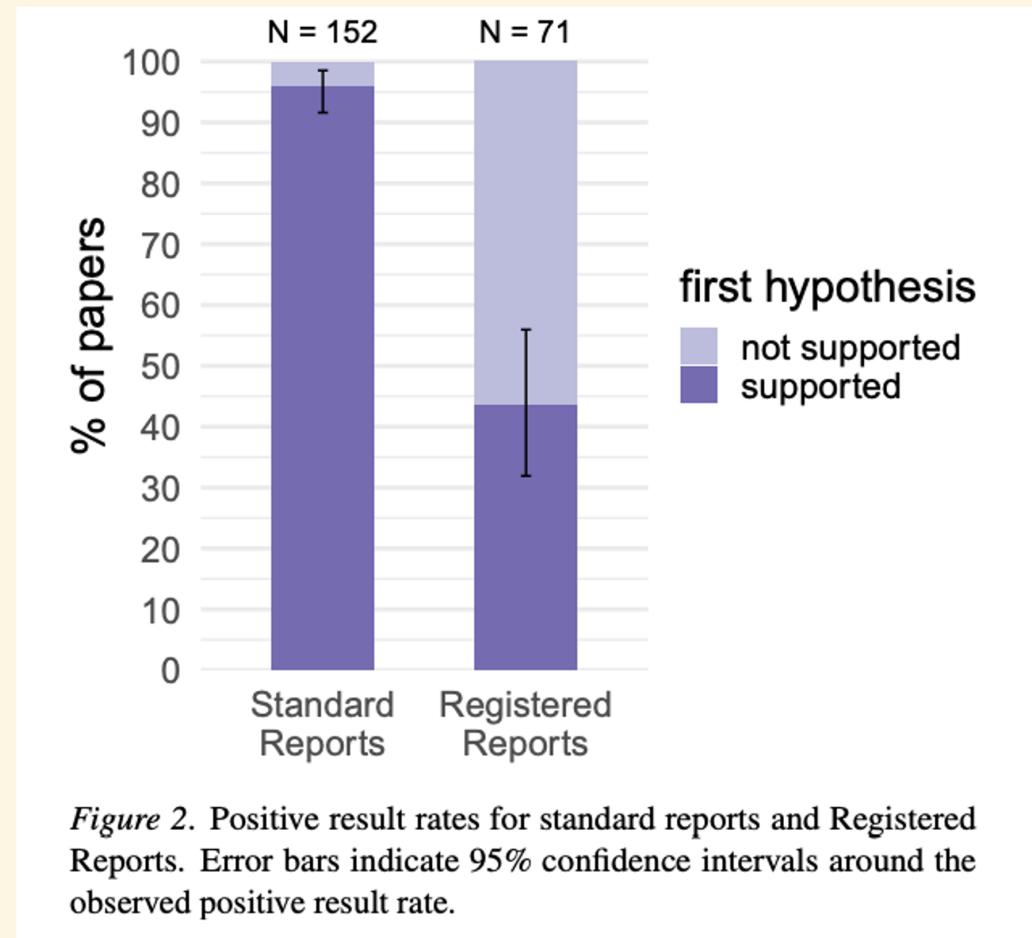
# Potential Solutions

- Registered Reports
  - Review and acceptance prior to data collection



# Potential Solutions

- Registered Reports
  - Reduces RDoF
  - Can't p-hack
  - Can't HARK
  - Reduces publication bias



<https://psyarxiv.com/p6e9c/>

## Potential Solutions

- Sharing
  - Posting all data and code on OSF
  - Sharing stimulus materials, lists, etc

## Potential solutions

- Increased power/increased sample size
  - Effect sizes in psychology are **smallish**

| Small effect sizes can only be accurately detected with high statistical power

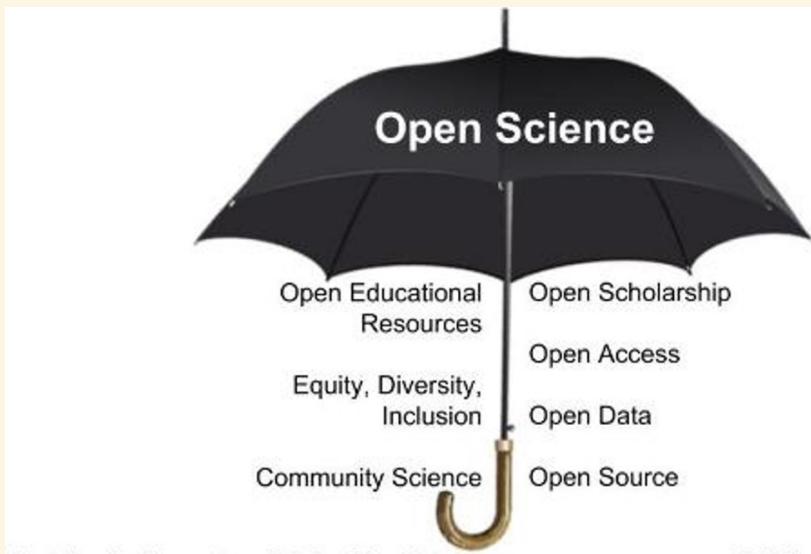
- Simmons et al. (2011) suggest at least  $N = 20$  per group, but this isn't large enough

- Use of within-participants designs affords more power
- More online studies?

# Open Science

- What is it?

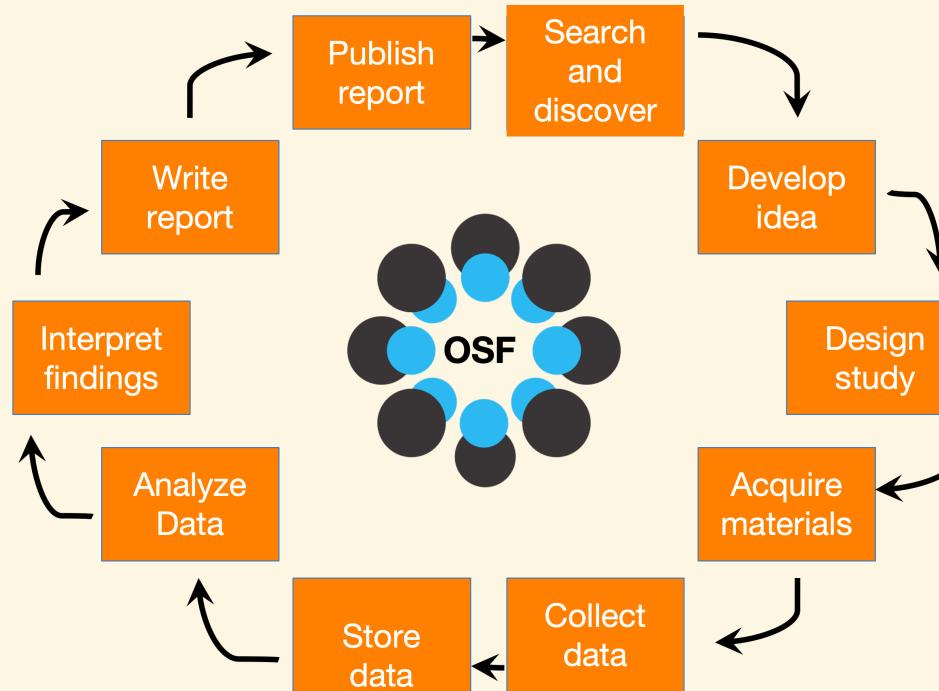
The movement to make scientific research, data, and dissemination accessible to all levels of an inquiring society



- Transparency
  - Preregistration
    - OSF
    - Aspredicted.org
- Openness
  - Papers but also data
- Integrity

# Open Science Framework

OSF is a free and open source project management tool that supports researchers throughout their entire project lifecycle.



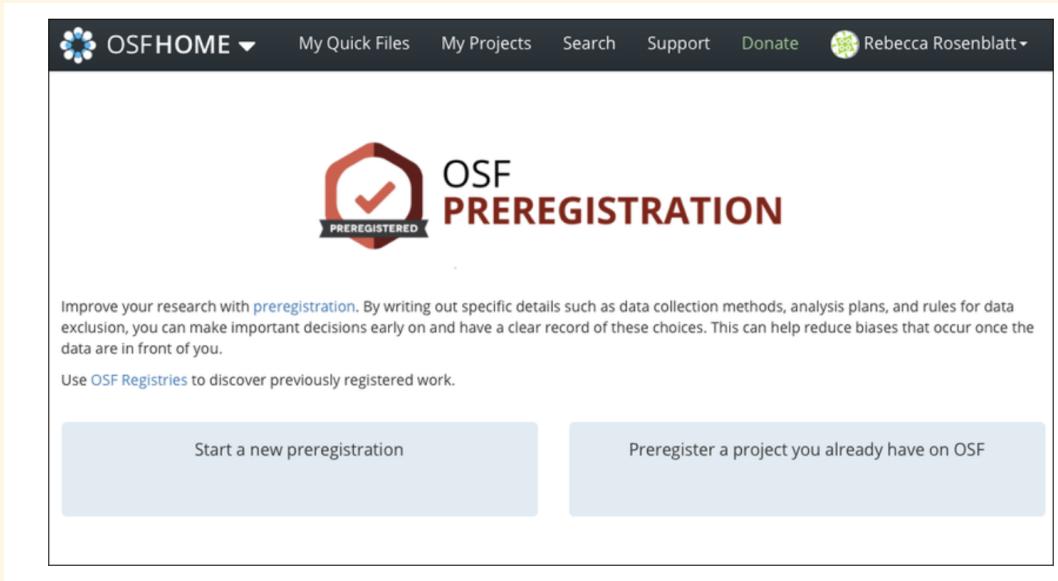
**A one-stop resource for scientists**

# Preregistration

1. Create an OSF account

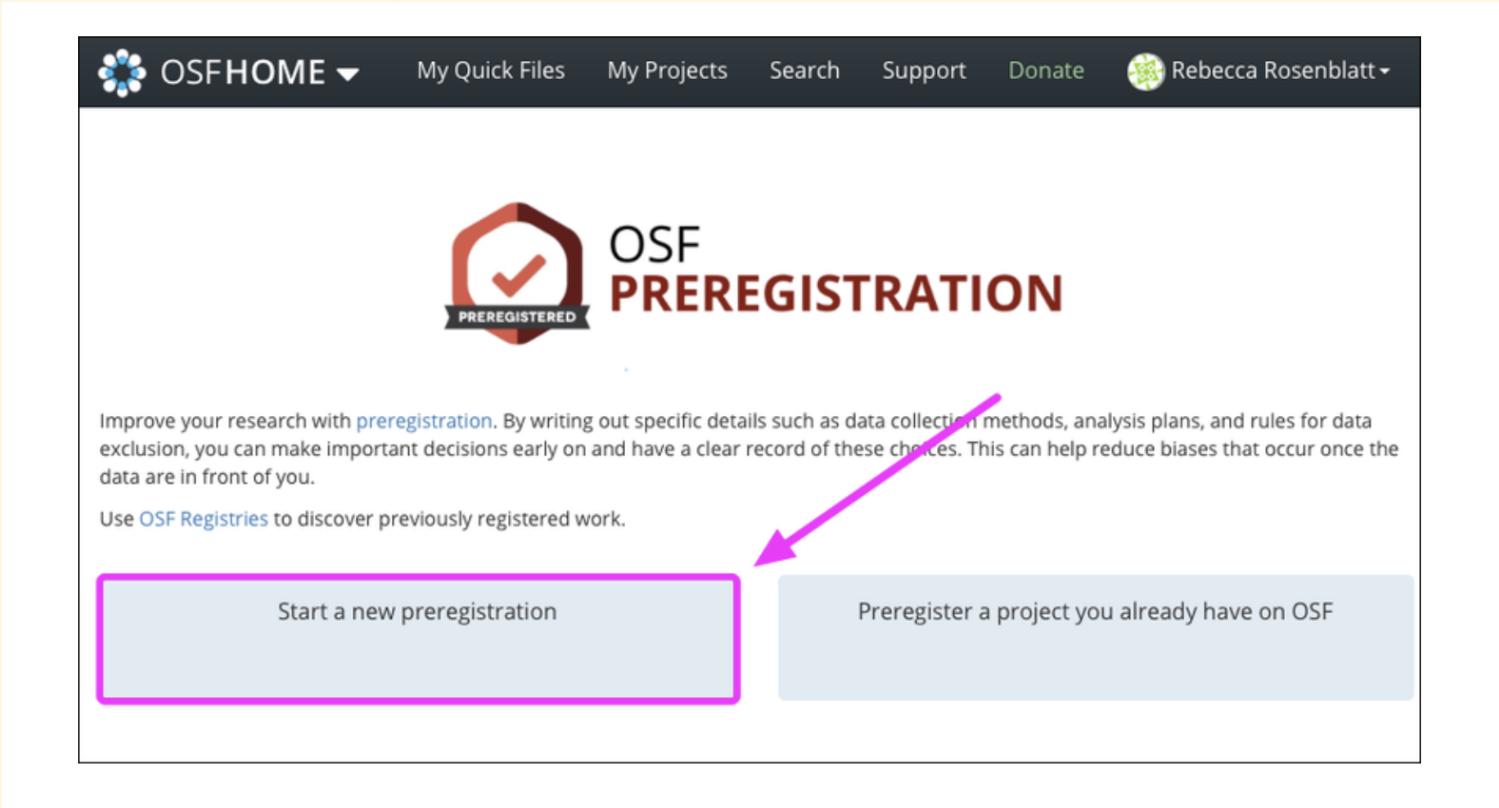
2. Start a preregistration

- First, sign in to the OSF, and go to <https://osf.io/prereg/>.
- You will be taken to the "OSF Preregistration" landing page.



# Preregistration

- Click start a new preregistration

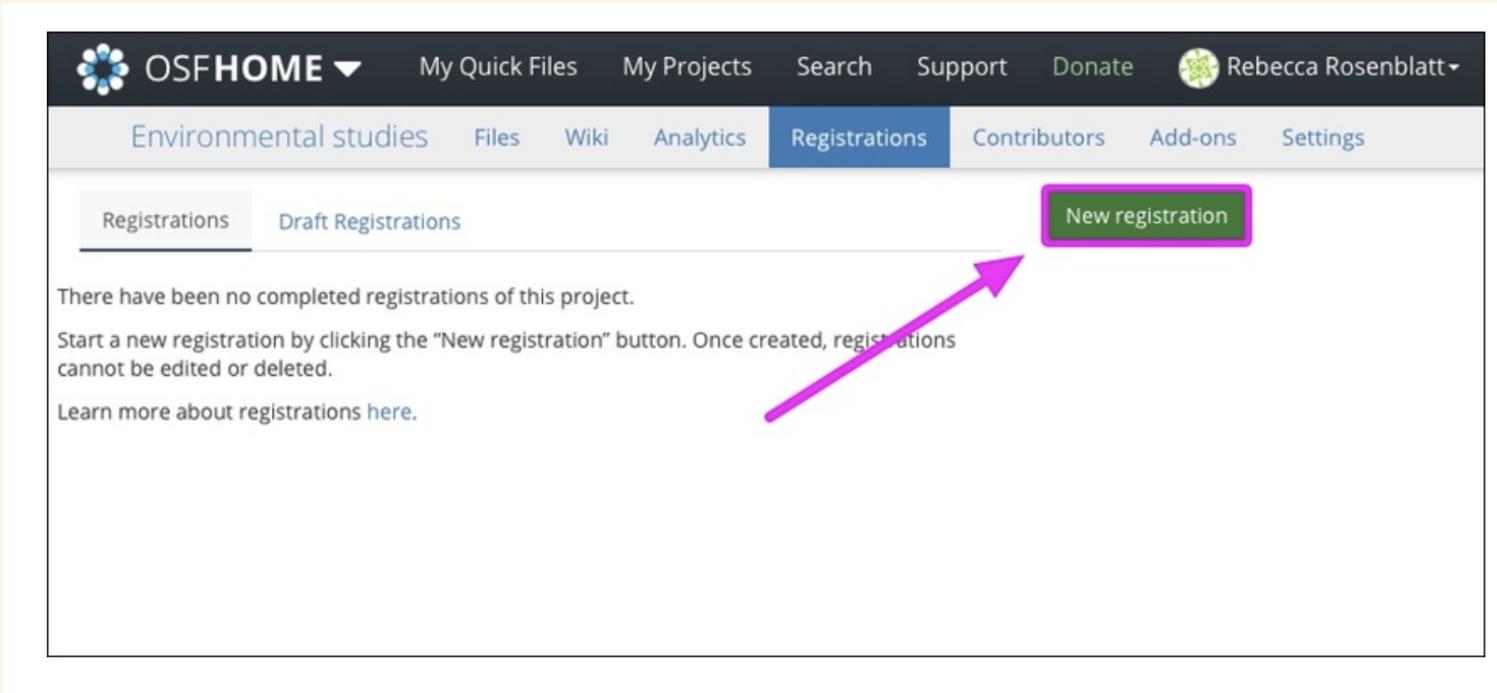


## Preregistration

- A textbox will appear
  - Enter a title for your preregistration into the textbox, then click **Continue**

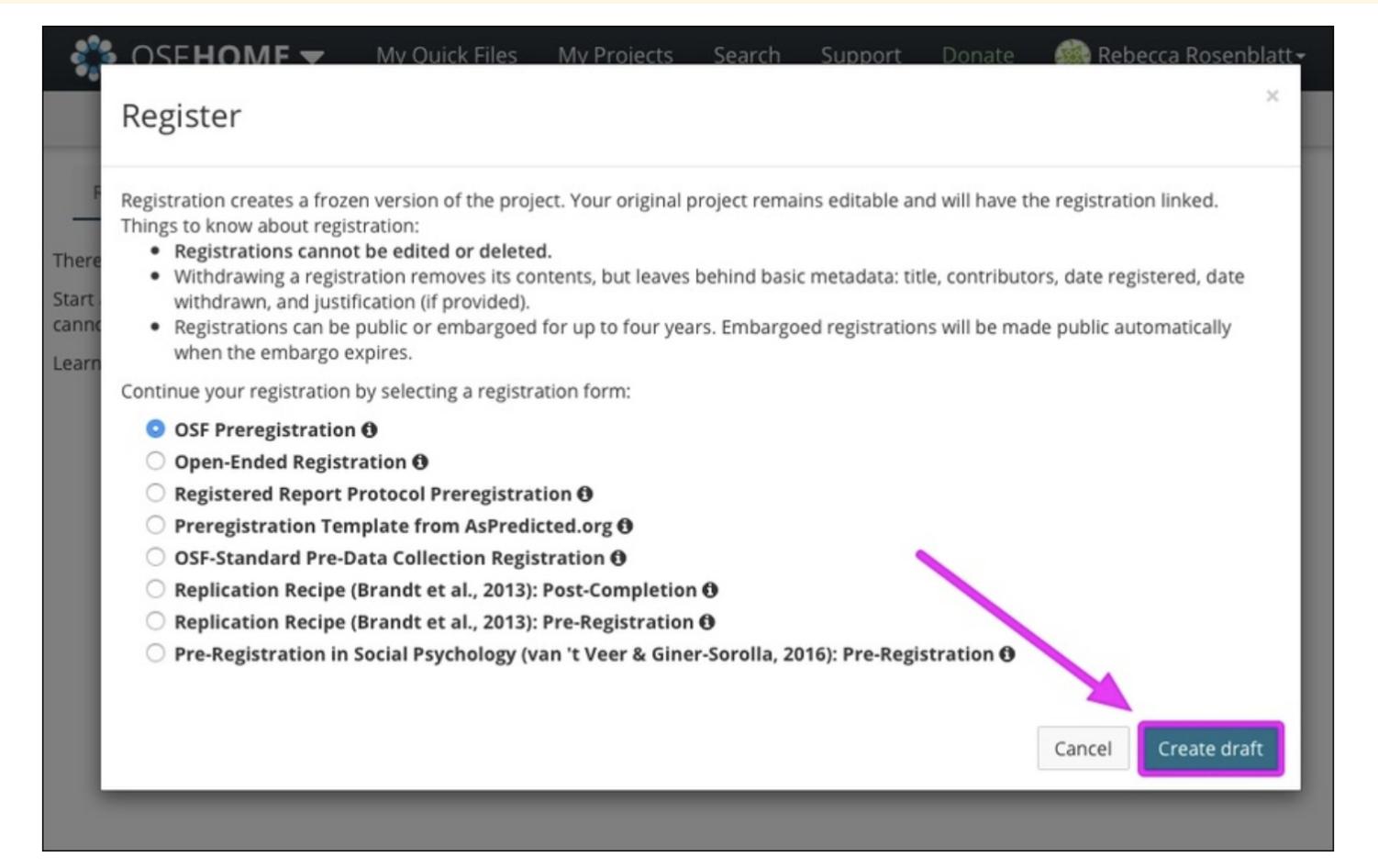
# Preregistration

- An OSF project will be created, and you will be taken to the project's **Registrations** page.
- Click the **New registration** button



# Preregistration

- Select OSF Preregistration from the list, then click the **Create Draft** button.



# Preregistration

- The preregistration form will appear

The screenshot shows the OSF REGISTRIES interface for creating a new registration. The top navigation bar includes the OSF REGISTRIES logo, a search bar, and links for Help, Donate, and user profile. The page title is "Environmental Science > New registration". On the left, a sidebar lists registration types: Metadata (selected), Study Information, Design Plan, Sampling Plan, Variables, Analysis Plan, Other, and Review. A back arrow is at the bottom of the sidebar. The main content area is titled "Registration Metadata" and contains fields for "Title" (Environmental Science), "Description" (empty), "Category" (Project), and "Affiliated institutions" (empty). A "Next" button is on the right, and a status message indicates the entry was auto-saved a few seconds ago.

OSF REGISTRIES

Environmental Science >

## New registration

Metadata

- Study Information
- Design Plan
- Sampling Plan
- Variables
- Analysis Plan
- Other
- Review

Next →

Auto-saved:  
a few seconds ago

**Registration Metadata**

This metadata applies only to the registration you are creating, and will not be applied to your project.

**Title \***

Environmental Science

**Description \***

**Category**

Project

Affiliated institutions

# Preregistration

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OSF REGISTRIES

Environmental Science >

## New registration

Metadata

Study Information

Design Plan

Sampling Plan

Variables

Analysis Plan

Other

Review

←

**Registration Metadata**

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**Title \***

Environmental Science

**Description \***

**Category**

Project

Affiliated institutions

Next →

Auto-saved:  
a few seconds ago

## ORCID

- Go to <https://orcid.org/register>