# Preregistration

Elizabeth Ray & Neela Klein

# Outline

- Open Science
- Preregistration
  - Definition
  - History
  - Why preregister?
- How do you preregister on the open science framework website?
  - AsPredicted template
  - Social Psychology template
- References & suggested readings

# Outline

Template slides will have a darker background

# Preregistration is Part of Open Science

Open science is the movement to make scientific research and its dissemination accessible to all levels of society, amateur or professional.

# Open science is...

- accessible dissemination
- transparent
- reproducible
- shared through collaborative networks
- developed through collaborative networks
- arguably essential for accelerating scientific progress and innovation

# What is Preregistration?

- “The specification of a research design and analysis plan prior to observing the research outcomes (Nosek et al., 2018).”

- Sharing a detailed research plan and analysis plan before collecting data to establish a clear, predetermined research plan and enhance the credibility of the scientific process.

# What is the difference between preregistration and research design?

- Research design refers to the structure of a study—including how participants are selected, what variables are measured or manipulated, the procedures followed, and how data are collected. It's the blueprint for answering a research question (e.g., experimental vs. correlational design, between-subjects vs. within-subjects, longitudinal vs. cross-sectional).
- The distinction: Preregistration is the documentation of that design in advance, along with your specific hypotheses and planned analyses, often submitted to a public registry before collecting data.

# History - Where did preregistration come from?

- Recently, a growing interest in transparency, reproducibility, and reducing publication bias has led scientists and journals to become more interested in the pre-registration of research
- In the early 2010s, psychology faced a reckoning. A large number of famous findings—especially in social psychology—failed to replicate when other researchers tried to reproduce them using the same methods. This led to what's now known as the replication crisis.
- An open letter to the Guardian newspaper in June 2013 signed by 80 academics in psychology and neuroscience called for journals to adopt pre-registration as an option (Chambers & Munaf, 2013).

# Preregistration Is Increasingly Expected

Pre-registration of studies before they are conducted has recently become more feasible for researchers, and is encouraged by an increasing number of journals.

# Why do Preregistration?

This process helps prevent questionable practices including:

- ”P-hacking" (tweaking analyses until results are significant)
  - Only analyzing subsets of participants until you find significant results and presenting only those results
  - Analyzing data during data collection and collecting more data than originally planned (because increased sample size increases chances of significant results even effects are miniscule
- "HARKing" (Hypothesizing After Results are Known)
  - “Fishing” for significant results
- Lack of transparency: Unclear methods, incomplete data, hidden flexibility in decisions

# Preregistration is recognized by the academic associations

AMERICAN PSYCHOLOGICAL ASSOCIATION

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## Preregistration

Preregistration allows researchers to specify and share the details of their research in a public registry before conducting the study.

Preregistration serves multiple important purposes: e.g., (a) ensuring that research teams share a clear understanding of their research goals and processes, (b) separating the confirmatory aspects of the research from the exploratory aspects, (c) allowing for input from colleagues online prior to conducting the study, and (d) allowing journal editors to accept researchers' papers conditionally, regardless of the outcomes themselves. A growing number of APA journals offer badges recognizing preregistration of studies and/or analysis plans.

The American Psychological Association, British Psychological Society, and German Psychological Society have partnered with the Leibniz Institute for Psychology and Center for Open Science to create Preregistration Standards for Quantitative Research in Psychology.

The video on this page presents information about preregistration and the standards. The

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# Field Expectations

- **Open Science**

## Transparency and Openness Promotion

APA endorses the Transparency and Openness Promotion (TOP) Guidelines by a community working group in conjunction with the Center for Open Science (Nosek et al. 2015). The TOP Guidelines cover eight fundamental aspects of research planning and reporting that can be followed by journals and authors at three levels of compliance.

- Study Preregistration: Level 2, Requirement—Article states whether the study design and (if applicable) hypotheses of any of the work reported was preregistered and, if so, how to access it. Access to the preregistration must be available at submission. Authors opting for masked review must submit a masked copy via stable link or supplemental material.
- Analysis Plan Preregistration: Level 2, Requirement—Article states whether any of the work reported preregistered an analysis plan and, if so, how to access it. Access to the preregistration must be available at submission. Authors opting for masked review must submit a masked copy via stable link or supplemental material.

# Examples of Mixed Preregistration Status in Text

detect a medium effect size ($d$ = .41). This study's design and analysis plan was preregistered prospectively, before data were collected:

https://osf.io/n6v9y/?view_only=8f53a9b550f247b2bc7c9000b0127e0d

**Procedure**

Other. A sensitivity power analysis (G*Power; Faul et al., 2007) with an alpha of .05, minimum power of .80, and two-tailed tests indicated that the study was adequately powered to detect a medium effect size ($d$ = .40). This study was not preregistered.

**Procedure**

# Journal articles can be assigned badges

 **Open Data Badge**

**Open Data** badge for making publicly available the digitally shareable data necessary to reproduce the reported result. This includes annotated copies of the code or syntax used for all exploratory and principal analyses. If the data contains sensitive, personal information, a **PM (Protected Access)** notation will be added if the authors post their data according to the guidelines regarding protected access repositories.

 **Open Materials Badge**

**Open Materials** badge for making publicly available the digitally shareable materials/methods necessary to reproduce the reported results. Authors are also encouraged to make publicly available video recordings of their study procedures; in return, a **(BM)Visualized Methods** notation will be added to the authors' Open Materials badge.

 **Preregistered Badge***

**Preregistered** badge for having a preregistered design and analysis plan for the reported research and reporting results according to that plan. An analysis plan includes specification of the variables and the analyses that will be conducted. Please note that "Preregistration" does not require all analyses to be confirmatory (planned in advance); it merely requires investigators to state up front which analyses are confirmatory and which are exploratory. High-quality exploratory research is more than welcome in the pages of *Psychological Science*, as long as authors explicitly acknowledge that the analyses are exploratory and, when relevant, acknowledge potential constraints on the replicability of these findings. If the analysis plan was registered prior to observation of outcomes, the Open Practices note will include the notation **DE** (**Data Exist**). If there were strongly justified changes to an analysis plan, the Open Practices note will include the notation **TC** (**Transparent Changes**). Authors who have additional unreported registrations or unreported analyses without strong justification (as determined by the Editor-in-Chief) will not qualify for a badge.

# OSF Badges


**Open Data:**
All data necessary to reproduce the reported results that are digitally shareable are made publicly available. Information necessary for replication (e.g., codebooks or metadata) must be included.


**Open Data: Protected Access:**
A "PA" (Protected Access) notation may be added to open data badges if sensitive, personal data are available only from an approved third-party repository that manages access to data to qualified researchers through a documented process. To be eligible for an open data badge with such a notation, the repository must publicly describe the steps necessary to obtain the data and detailed data documentation (e.g. variable names and allowed values) must be made available publicly. A list of approved repositories is available online.


**Open Materials:**
All materials necessary to reproduce the reported results that are digitally shareable, along with descriptions of non-digital materials necessary for replication, are made publicly available.


**Preregistered:**
At least one study's design has been preregistered with descriptions of (a) the research design and study materials, including the planned sample size; (b) the motivating research question or hypothesis; (c) the outcome variable(s); and (d) the predictor variables, including controls, covariates, and independent variables. Results must be fully disclosed. As long as they are distinguished from other results in the article, results from analyses that were not preregistered may be reported in the article.


**Preregistered+Analysis Plan:**
At least one study's design has been preregistered along with an analysis plan for the research—and results are recorded according to that plan.

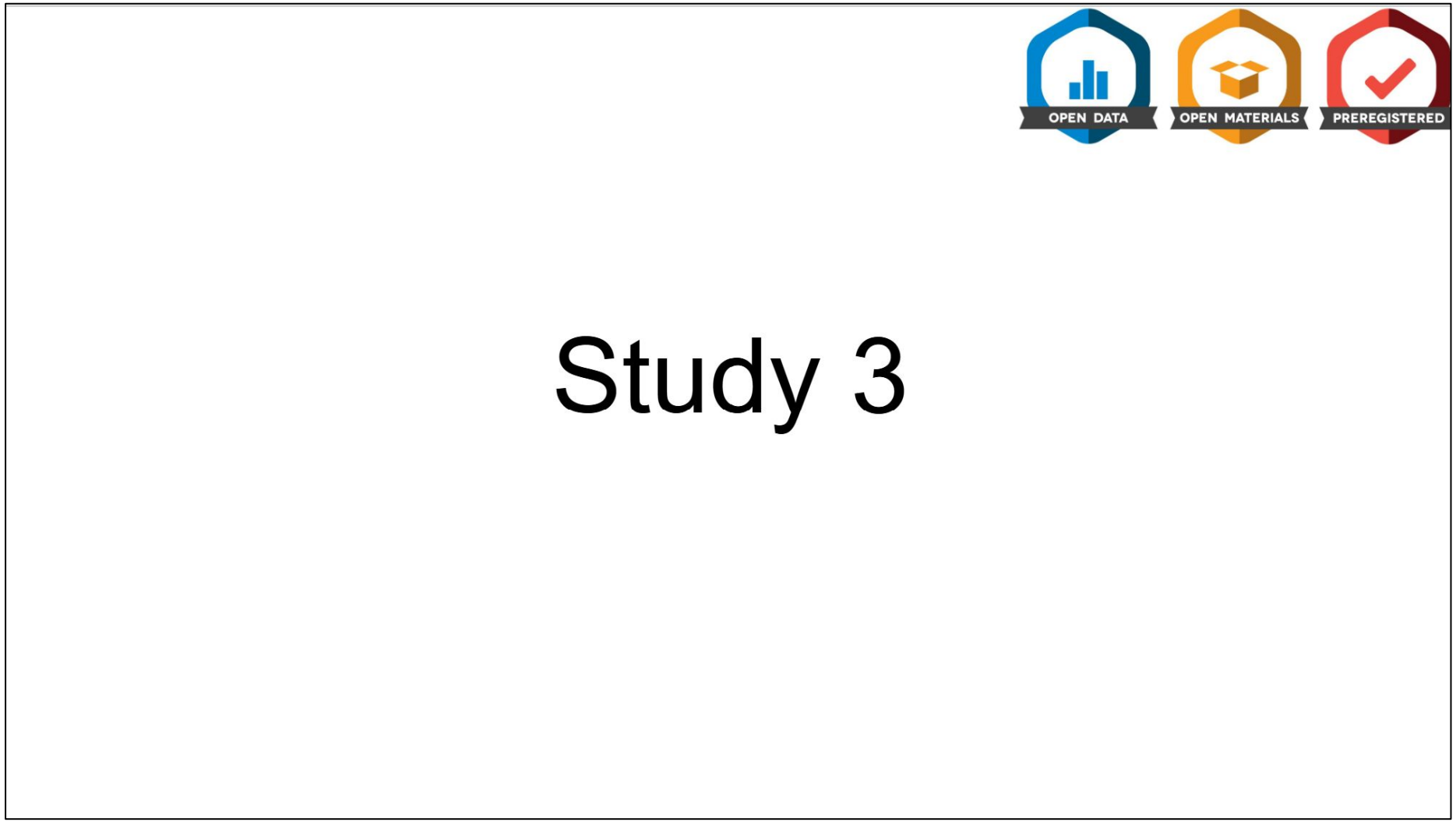
Note that it may not be possible to preregister a study or to share data and materials. Applying for open science badges is optional.

# Examples of OSF badges - Title slide

## How to show badges

Elizabeth Ray & Neelamberi D. Klein

# Examples of OSF badges - Study section slide



# Examples of OSF badges - Methods slide

## Methods

N = 207 undergraduate students collected through Sona

In Lab study

Analytic sample: 196

131 Female, 60 Male, 4 Gender non-conforming, 1 omitted

Mean age = 18.74 sd = 0.93

White = 138, south asian = 14, black = 10

# Pros of Preregistration

- **Shows Credibility**. (Pre)registration signifies a dedication to methodological rigor and transparency, establishing trust within the scientific community, peer groups, and academic journals.
- **Maximizes Data.** Sharing data amplifies its influence, expediting scientific progress, and communicates the reliability of your research to the wider scientific audience.
- **Transparency**: (Pre)registration ensures transparency throughout the research process, preventing undisclosed modifications or selective reporting, bolstering the integrity of the study.
- **Reduced Bias**: By committing to a predefined plan, researchers diminish the temptation to alter methods or analyses based on observed results or external pressures, countering biases prevalent in the publish-or-perish culture.
- **Facilitates Reproducibility**: A meticulously documented preregistration facilitates the reproducibility of studies, contributing significantly to the cumulative advancement of scientific knowledge.
- **Enhanced Collaboration**: Effective collaboration thrives when study details are transparently communicated and easily accessible to fellow researchers within the scientific community.

# Pros of Preregistration

- **Streamlined processes.** OSF takes your research materials via metadata and connects them with various tools and workflows, making it easier for you to share materials without duplicating work.
- **Reduces Pressure of Positive Results & Publication Bias:** Registered Reports alleviate the pressure for positive results, countering the "file drawer problem" and promoting a more balanced and diverse literature.
- **Encourages Diverse Scientific Practice**: Registered Reports create a platform for high-quality research beyond traditional hypothesis testing, fostering inclusivity of exploratory and confirmatory studies, enriching the scientific literature.
- **Shorter Peer Review Process:** For confirmatory studies, the Registered Reports format expedites the publication process. Once the study design is accepted, researchers can seamlessly progress to data collection and analysis, facilitating a shorter and more straightforward peer review process.
- **Distinguishing confirmatory from exploratory research.** Ideally, research begins with an exploratory phase in which hypotheses and methods are tested without much prior evidence.  It then follows through to a confirmatory phase in which already-observed hypotheses and methods are replicated to ensure the validity of initial findings.

# Cons of Preregistration

- **Scooping**. Some fear that preregistration might expose their carefully crafted ideas, making them susceptible to scooping by other researchers. However, OSF has yet to have a document issue where a registration was 'stolen' or plagarized. OSF has also implemented other features to further minimize this concern including licensing your work, making it private for up to 4 years, and implementing time stamps.
- **Strictly Sticking to a Research Design.** Some fear (pre)registration imposes rigid constraints, limiting the ability to adapt to unexpected findings or methodological challenges. However, we cannot predict the future and (pre)registrations should be a plan, not a prison. On OSF, (pre)registrations are easily updatable to share how your team encountered unanticipated situations, and how you resolved them.
- **Only for Confirmatory Studies**. Some believe preregistration is only for confirmatory studies, limiting its applicability to exploratory research. This is far from the truth. Even in exploratory studies, (pre)registration transparency helps tell your story about your initial intentions, hypotheses, methodologies, and how you explored you data. This transparency increases the integrity and credibility of your study, showing the guardrails against bias and unethical practices (ex. HARKing)
- **Fear of Criticism.** Some are apprehensive about potential criticism from peers or reviewers when they submit a (pre)registration. However, there's a growing culture shift acknowledging we are human and make mistakes. You can also update your (pre)registration on OSF to correct any mistake or errors.
- **Time Constraint.** Some believe that all the forethought that goes with a (pre)registration takes up too much time. This is a natural bias. Spending the time to prepare and plan for potential issues actually streamlines the timeline, as you don't have to pause a study to figure out how to resolve the issue while keeping your data consistent.

# Types of Preregistrations

- Reviewed pre-registration (RPR)
  - Also called a Registered Report"
- Unreviewed pre-registration(UPR)
  - Does not involve reviewers before the data is collected.
  - Authors write out and time-stamp their full plan before conducting the study in order to be able to refer back to it later.  This self-registration allows authors to conduct research more or less as usual.  Unreviewed pre-registration thus leads to a review process very similar to the standard model, but with the reassurance that the authors' reports of method and analytic procedures have been specified a priori.
  - More common

# Philosophies of Preregistration

**Approach A:**

Preregister exploratory studies (study 1)

Preregister confirmatory follow up studies (study 2, 3,...)

**Approach B:**

Run a non-preregistered exploratory study 1

Preregister the confirmatory studies (study 2, 3,...)

# Preregistration Platforms

- OSF
- AsPredicted

ASPREDICTED

**Critical Condition – Known arm within experiment (#13289)**

**Created:** 08/11/2018 08:04 AM (PT)
**Public:** 08/17/2020 09:05 AM (PT)

**Author(s)**
Robert Mislavsky (Johns Hopkins University) - mislavsky@jhu.edu
Berkeley Dietvorst (University of Chicago) - berkeley.dietvorst@chicagobooth.edu
Uri Simonsohn (ESADE) - urisohn@gmail.com

**1) Have any data been collected for this study already?**
No, no data have been collected for this study yet.

**2) What's the main question being asked or hypothesis being tested in this study?**
Does knowing which arm of an experiment one was assigned to, influence the acceptability of the experiment as a whole?

**3) Describe the key dependent variable(s) specifying how they will be measured.**
Is it okay for Amazon to do this? (1 = It's really bad; 4 = It's okay (neutral); 7 = It's really good)

**4) How many and which conditions will participants be assigned to?**
Participants read that Amazon is considering two changes to its product recommendation system and is (a) running an experiment with those policies or (b) chooses one of the two. They then read which policy (a) they were randomly assigned to in the experiment or (b) which policy Amazon chose, and rate Amazon's actions. We also include a condition where participants read about an experiment, but do not learn which policy they were assigned to.

Therefore, there are 5 between-subject conditions: 2 (experiment vs. policy change) x 2 (receive "good" vs. "bad" policy) + 1 (experiment with no outcome information)

The policies are:
"Good" - Recommending most highly rated items
"Bad" - Recommending the most profitable items

**5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.**
For each policy (i.e., "good" and "bad") we will compare responses in the experiment condition to those in the policy change condition, using t-tests. We will also compare the ratings of the "experiment/bad outcome" condition to the "experiment/no outcome information" condition, and the "policy/bad outcome" condition to the "experiment/no outcome information" condition

**6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.**
We will include all participant responses that are recorded in the survey. We include a captcha, attention check and a screening question (filtering out participants who fail to complete the captcha and attention check and are not regular Amazon customers, defined as making at least one purchase per month). We will not collect the dependent variable for participants who do not pass these screenings.

**7) How many observations will be collected or what will determine sample size? No need to justify decision, but be precise about exactly how the number will be determined.**
1,000 (200/cell)

**8) Anything else you would like to pre-register? (e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)**
To describe the sample, we will collect age, gender, and whether participants are Amazon Prime members. We will compare responses for Prime and non-Prime members, but make no predictions.

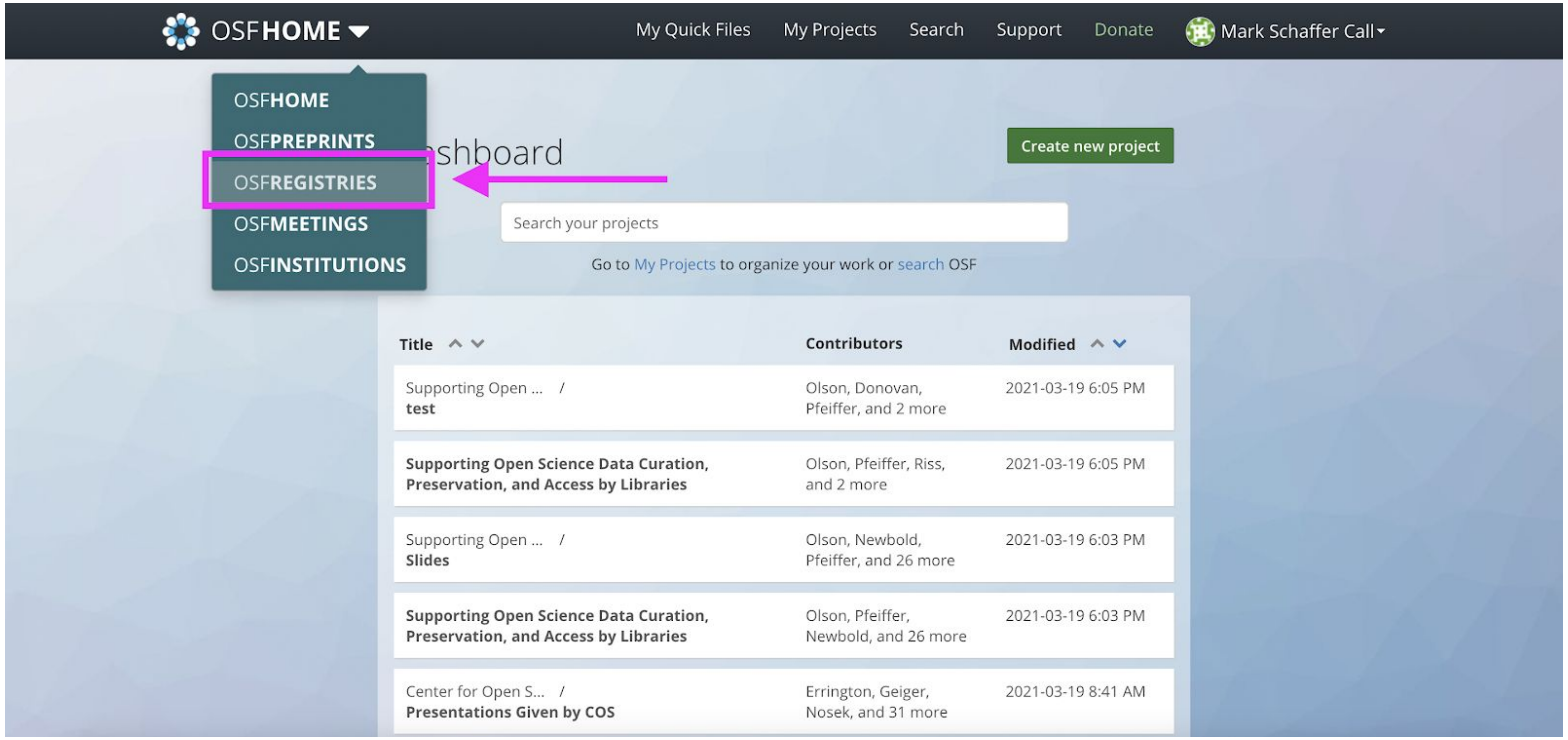
Version of AsPredicted Questions: 2.00

**Available at** https://aspredicted.org/kv692.pdf
(Permanently archived at http://web.archive.org/web/*/https://aspredicted.org/kv692.pdf)

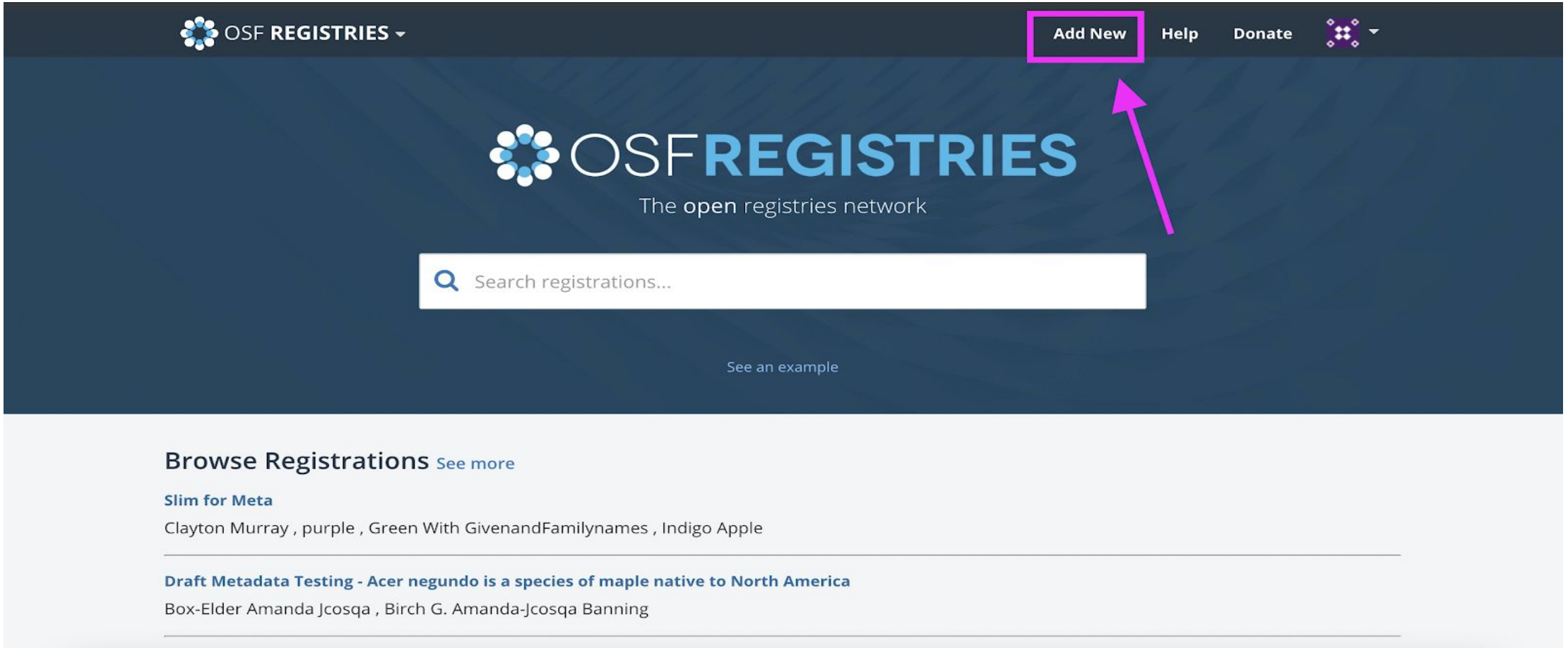
Wharton CREDIBILITY LAB

# How to make a preregistration on OSF

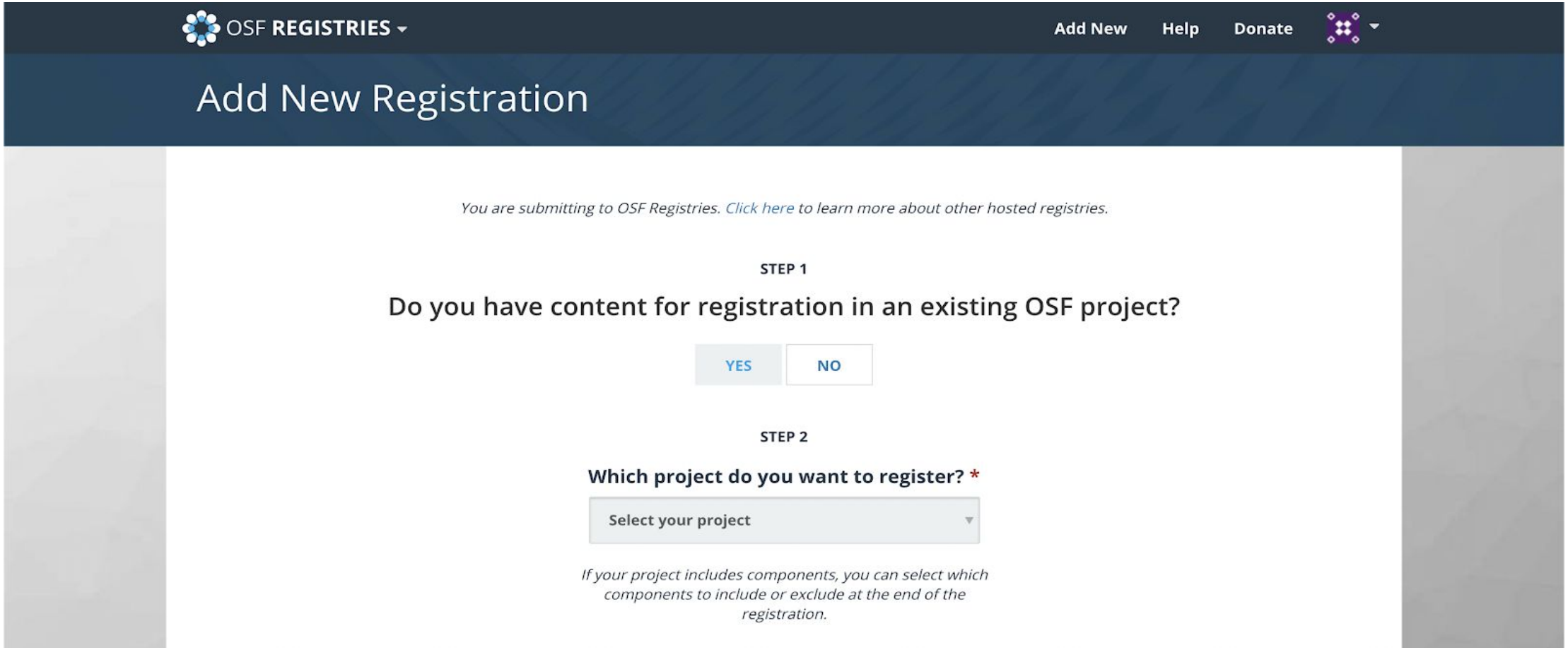
Click the dropdown next to “OSF Home”, and then click **OSF Registries**. The OSF Registry landing page will appear.



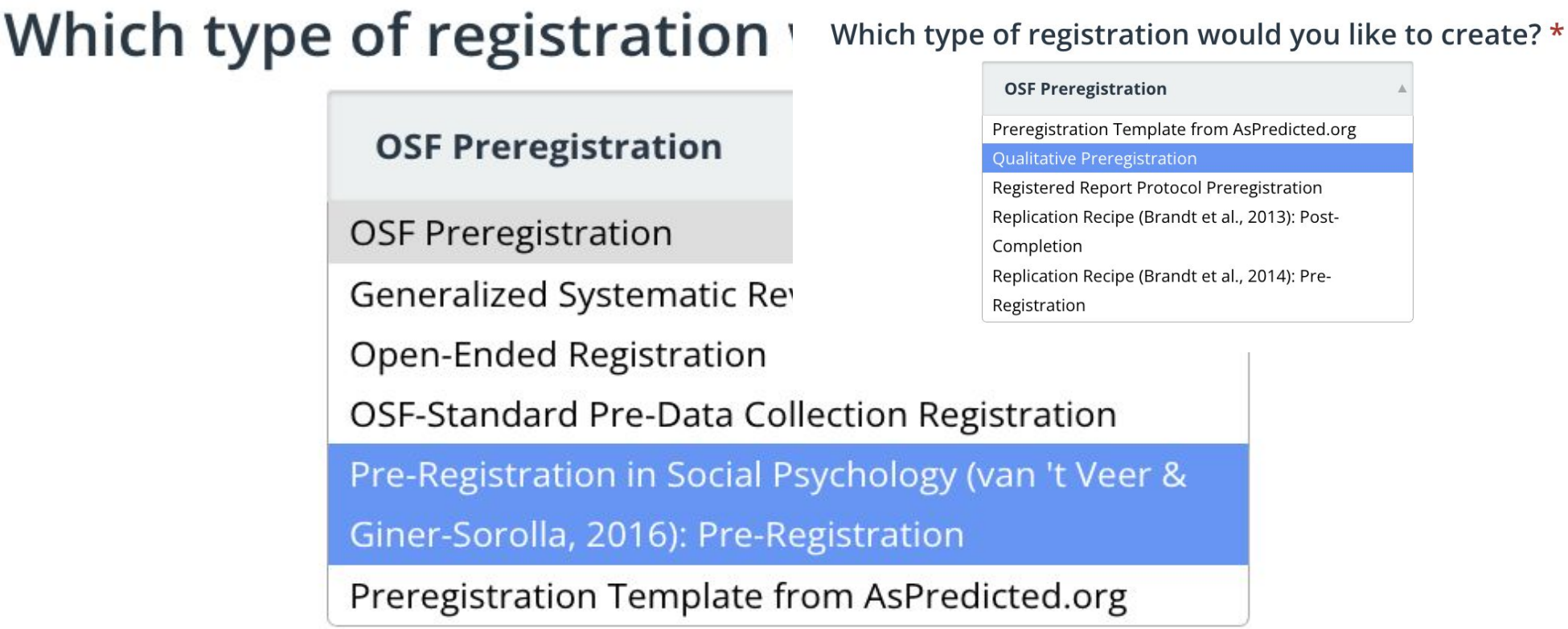
# Click **“Add New”** in the navigation bar.



# The **“Add New Registration”** page will appear.



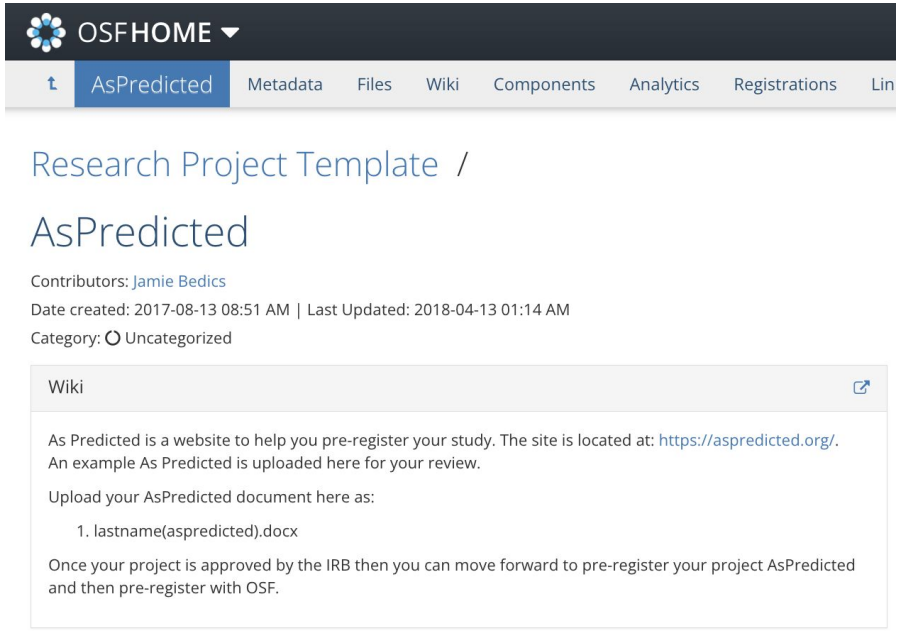
# Various Templates Are Available on OSF



# First, let's explore the AsPredicted template on OSF

**Instructions on Submitting to Open Science Framework:**

1. Visit the Open Science Framework website
2. Create an account (if you haven't already)
3. Once logged in, go to your Dashboard and select "Create new project"
4. After assigning a title for your project, you can add contributors to the project ("contributors" and "add"); I usually enter contributors in authorship order on the project
5. Select "Registrations" in the grey toolbar above, then "new registration"
6. Select "Preregistration Template from AsPredicted.org", then "create draft"
7. Copy/paste your answers into the online portal
8. Choose whether to make it public immediately, or wait 24 hours (when it will automatically go public)



# AsPredicted Question 1

Have any data been collected for this study already?

# AsPredicted Question 2

What's the main question being asked or hypothesis being tested in this study?

# AsPredicted Question 3

Describe the key dependent variable(s) specifying how they will be measured.

# AsPredicted Question 4

How many and which conditions will participants be assigned to?

https://osf.io/byu28/download

# Random assignment template

We will randomly assign participants to X of Y possible conditions: [condition 1 name], [condition 2 name], and/or, [condition 3 name].

Participants in [condition 1 name] will… [condition description].

Participants in [condition 2 name] will… [condition description].

Participants in [condition 3 name] will… [condition description].

# AsPredicted Question 5

Specify exactly which analyses you will conduct to examine the main question/hypothesis.

# Analysis template - general

To address Hypothesis 1, we will run a [specific model type: e.g. linear/logistic regression, one-way/two-way analysis of variance, independent/paired samples t-test ,etc.] with [Y variable] included as our outcome/dependent variable, and [X variable] included as our predictor/independent variable. We will enter [A, B, and C variables; e.g. sex, age, gender, race, income, etc.] as covariates in the model. A p-value of less than .05 will indicate a significant effect of the predictor variable(s) on our outcome/dependent variable, [Y variable].*

https://osf.io/byu28/download

# Analysis template - assumptions

We will first test if the assumptions necessary to interpret a [analysis type: linear regression, multiple linear regression, analysis of variance, etc.] are met. If not, we will apply the following corrective practices so that the model is interpretable…

# AsPredicted Question 6

Any secondary analyses?

# AsPredicted Question 7

How many observations will be collected or what will determine the sample size? No need to justify decision, but be precise about exactly how the number will be determined.

# Unknown n templates

Individuals who [exclusion criteria] will be excluded from the present analyses. We will not know our final N until initial analyses are run to identify the number of eligible participant responses across all of our variables of interest. However, our highest possible N can be estimated using the number of participant responses in the existing dataset. While N = [number of responses already collected], some participants will be excluded based on [exclusion criteria variables].

Thus, we will start with a maximum sample size of N = [number of responses already collected], and will exclude any individuals who [eligibility criteria]. Final N will be determined by the number of individuals who meet the criteria listed above.

https://osf.io/byu28/download

# Collected vs analyzed templates

Our final sample size for collected data will be N = [number of participant responses you will collect]. Our final sample size for analyzed data will be N = [number of collected responses] - any participants excluded based on [exclusion criteria].

# AsPredicted Question 8

Anything else you would like to pre-register? (e.g., data exclusions, variables collected for exploratory purposes, unusual analyses planned?)

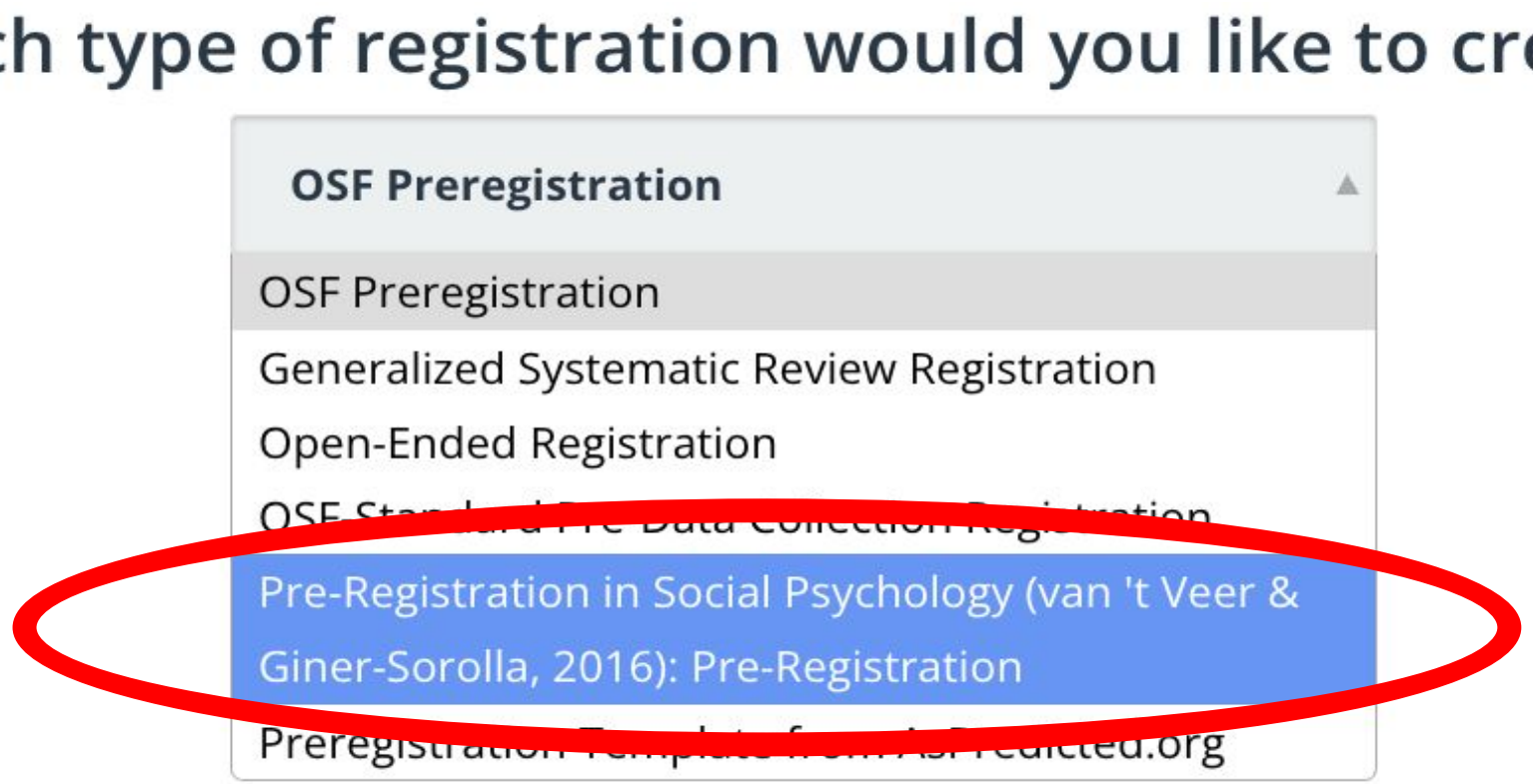
https://osf.io/byu28/download

# Exclusion criteria description templates

- eligibility threshold score (e.g. a score of 16 or higher on a particular screening measure)
- exclusions or unequal representation
  - demographic exclusions
  - political exclusions
  - first state you will check for unequal groups, if expected unequal groups are found…
- low data quality
  - attention checks
  - reported attention

Individuals who [exclusion criteria] will be excluded from the present analyses.

# Now let's look at a lengthier template



# Pre-Registration in Social Psychology

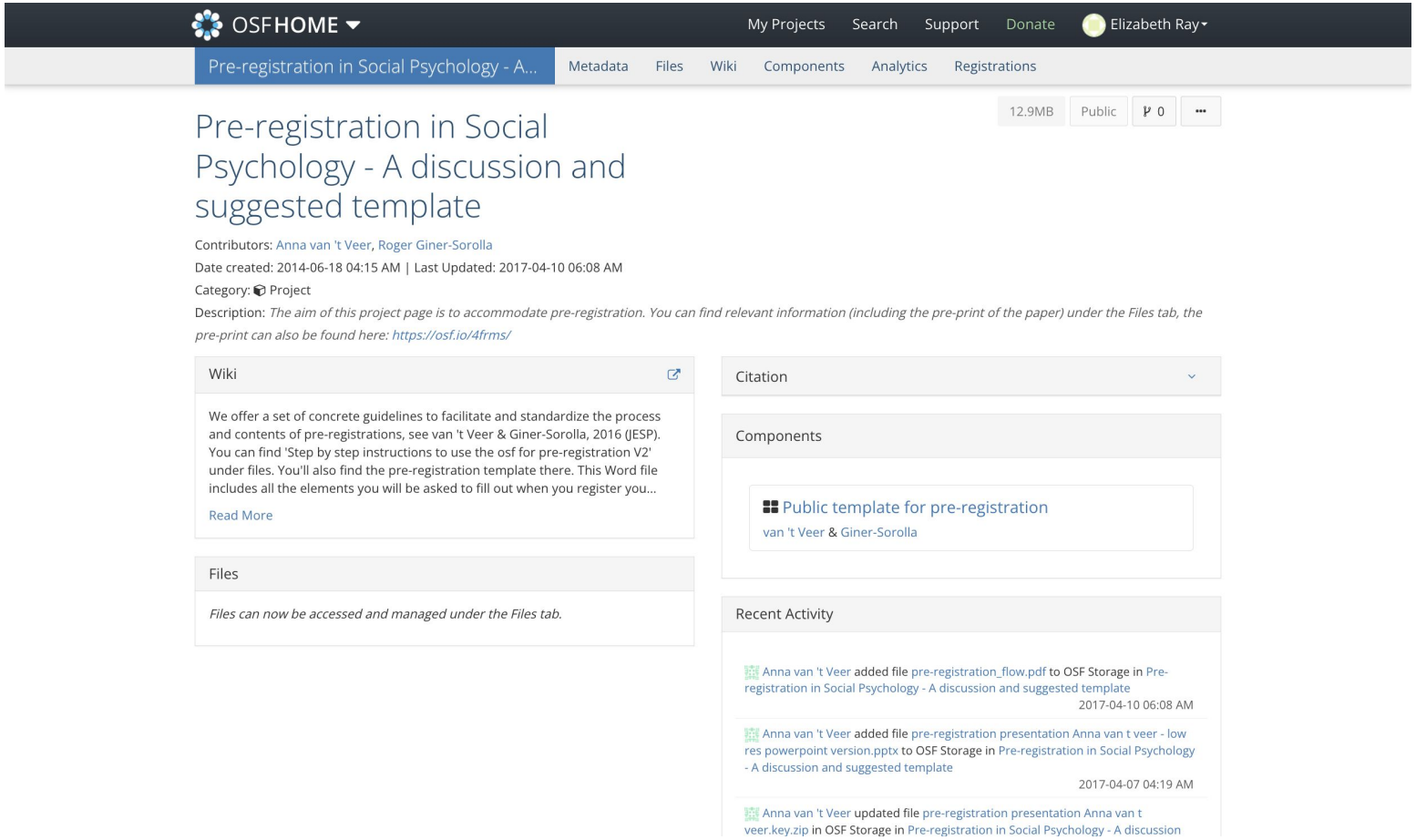
## Pre-Registration in Social Psychology—a Discussion and Suggested Template

Anna Elisabeth van 't Veer[a,b], Roger Giner-Sorolla[c]

[a] *Centre for Child and Family Studies, Leiden University, Leiden, Netherlands, vantveer@gmail.com / a.e.van.t.veer@fsw.leidenuniv.nl*
[b] *Department of Social Psychology, Tilburg Institute for Behavioral Economics Research, Tilburg University, Tilburg, Netherlands*
[c] *University of Kent, Canterbury, Kent, CT2 7NP, United Kingdom, R.S.Giner-Sorolla@kent.ac.uk*

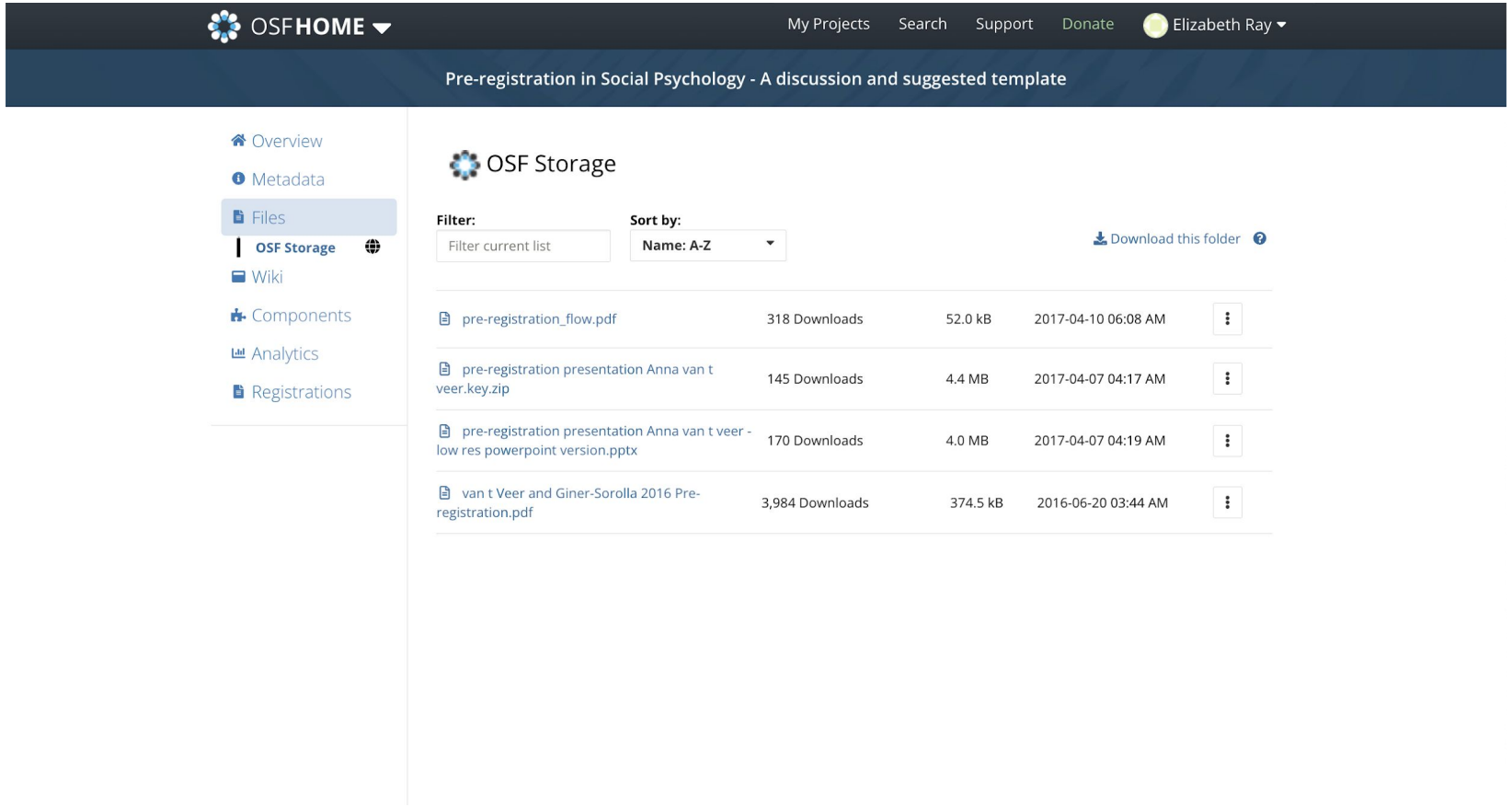
https://osf.io/sn6by

# Pre-Registration in Social Psychology




https://osf.io/56g8e/

# Pre-Registration in Social Psychology




https://osf.io/56g8e/

# Pre-Registration in Social Psychology

**Appendix A. Pre-registration in social psychology: A suggested template.**
Available on osf.io as an online pre-registration form that includes time stamping.

| Section | Essential elements | Recommended elements |
|---|---|---|
| **A. Hypotheses** | 1. Describe the (numbered) hypotheses in terms of relationships between your variables.<br>2. For interaction effects, describe the expected shape of the interactions.<br>3. If you are manipulating a variable, make predictions for successful check variables or explain why no manipulation check is included. | 4. A figure or table may be helpful to describe complex interactions.<br>5. For original research, add rationales or theoretical frameworks for why a certain hypothesis is tested.<br>6. If multiple predictions can be made for the same IV-DV combination, describe what outcome would be predicted by which theory. |
| **B. Method** | | |
| Design | List, based on your hypotheses from section A:<br>1. Independent variables and all their levels<br>a. whether they are within- or between-participants;<br>b. the relationship between them (e.g., orthogonal, nested).<br>2. Dependent variables.<br>3. Third variables acting as covariates or moderators. | |
| Planned sample | 4. If applicable, describe pre-selection rules.<br>5. Indicate where, from whom and how the data will be collected.<br>6. Justify planned sample size.<br>7. Describe data collection termination rule. | |
| Exclusion criteria | 8. Describe anticipated data exclusion criteria.<br>Some examples of exclusion criteria are:<br>a. missing, erroneous, or overly consistent responses;<br>b. failing check-tests or suspicion probes;<br>c. demographic exclusions;<br>d. data-based outlier criteria;<br>e. method-based outlier criteria (e.g. too short or long response times). | 9. Set fail-safe levels of exclusion at which the whole study needs to be stopped, altered, and restarted. |
| Procedure | 10. Describe all manipulations, measures, materials and procedures including the order of presentation and the method of randomization and blinding (e.g., single or double blind), as in a published Methods section. | |
| **C. Analysis plan** | | |
| Confirmatory analyses | Describe the analyses that will test each main prediction from the hypotheses section. For each one, include:<br>1. the relevant variables and how they are calculated;<br>2. the statistical technique;<br>3. each variable's role in the technique (e.g., IV, DV, moderator, mediator, covariate);<br>4. rationale for each covariate to be used, if any;<br>5. if using techniques other than null hypothesis testing (for example, Bayesian statistics), describe your criteria and inputs towards making an evidential conclusion, including prior values or distributions. | Specify contingencies and assumptions, such as:<br>6. method of correction for multiple tests;<br>7. the method of missing data handling (e.g., pairwise or listwise deletion, imputation, interpolation);<br>8. reliability criteria for item inclusion in scale;<br>9. anticipated data transformations;<br>10. assumptions of analyses, and plans for alternative/corrected analyses if each assumption is violated. |

# Pre-Registration in Social Psychology - Step 1

## Pre-Registration in Social Psychology (van't Veer & GinerSorolla, 2016)

### Metadata

### Hypotheses

Essential Elements

Description of essential elements.

**Hypotheses ***

Describe the (numbered) hypotheses in terms of directional relationships between your (manipulated or measured) variables.

Text box

# Pre-Registration in Social Psychology - Step 2

**Methods**
Essential Elements

Description of essential elements
**Design**

List, based on your hypotheses from section A:
**Independent variables** *
Independent variables with all their levels: (required)

Whether they are within- or between-participant,

The relationship between them (e.g., orthogonal, nested).

Text box

**Dependent Variables** *
List dependent variables, or variables in a correlational design. (required)

Text box

**Third Variables** *
Third variables acting as covariates or moderators. (required)

Text box

# Pre-Registration in Social Psychology - Step 3

Planned Sample

**Pre-Selection Rules ***
If applicable, describe pre-selection rules. (required)

Text box

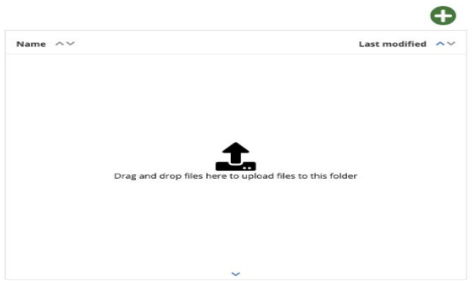
**Data Collection ***
Indicate where, from whom and how the data will be collected. (required)

Text box

**Planned Sample Size ***
Justify planned sample size (required)

Text box

**Power Analysis File**
If applicable, you can upload a file related to your power analysis here (e.g., a protocol of power analyses from G*Power, a script, a screenshot, etc.).



# Pre-Registration in Social Psychology - Step 4

**Exclusion Criteria ***
Describe anticipated specific data exclusion criteria. For example:

A. Missing, erroneous, or overly consistent responses;

B. Failing check-tests or suspicion probes;
C. Demographic exclusions;
D. Data-based outlier criteria;
E. Method-based outlier criteria (e.g. too short or long response times).
F.

Text box

# Pre-Registration in Social Psychology - Step 5

## Analysis Plan

Essential elements

**Confirmatory Analyses**
Describe the analyses that will test the first main prediction from the hypotheses section.
Include:

**Relevant variables ***
The relevant variables and how they are calculated;

Text box

**Statistical technique ***
The statistical technique;

Text box

**Variable Roles ***
Each variable's role in the technique (e.g., IV, DV, moderator, mediator, covariate);

Text box

# Pre-Registration in Social Psychology - Step 6

**Missing Data**

The method of missing data handling (e.g., pairwise or listwise deletion, imputation, interpolation).

Text box

# Pre-Registration in Social Psychology - Step 7

**Data Collection ***
Has data collection begun for this project? (required)

Please choose:

- No, data collection has not begun
- Yes, data collection is underway or complete.

**Data Observation ***
If data collection has begun, have you looked at the data?

Please choose:

- Yes
- No

**Start and End Dates**
The (estimated) start and end dates for this project are:

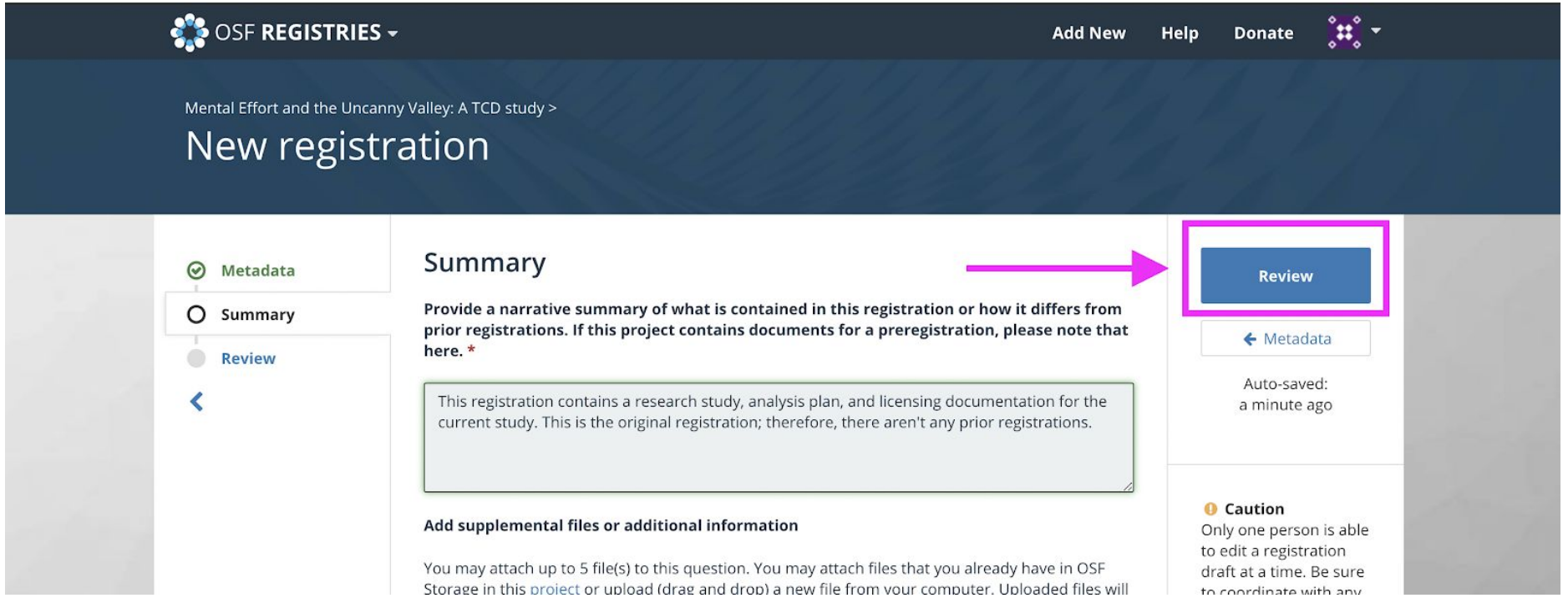
Text box

**Additional Comments**
Any additional comments before I pre-register this project

Text box

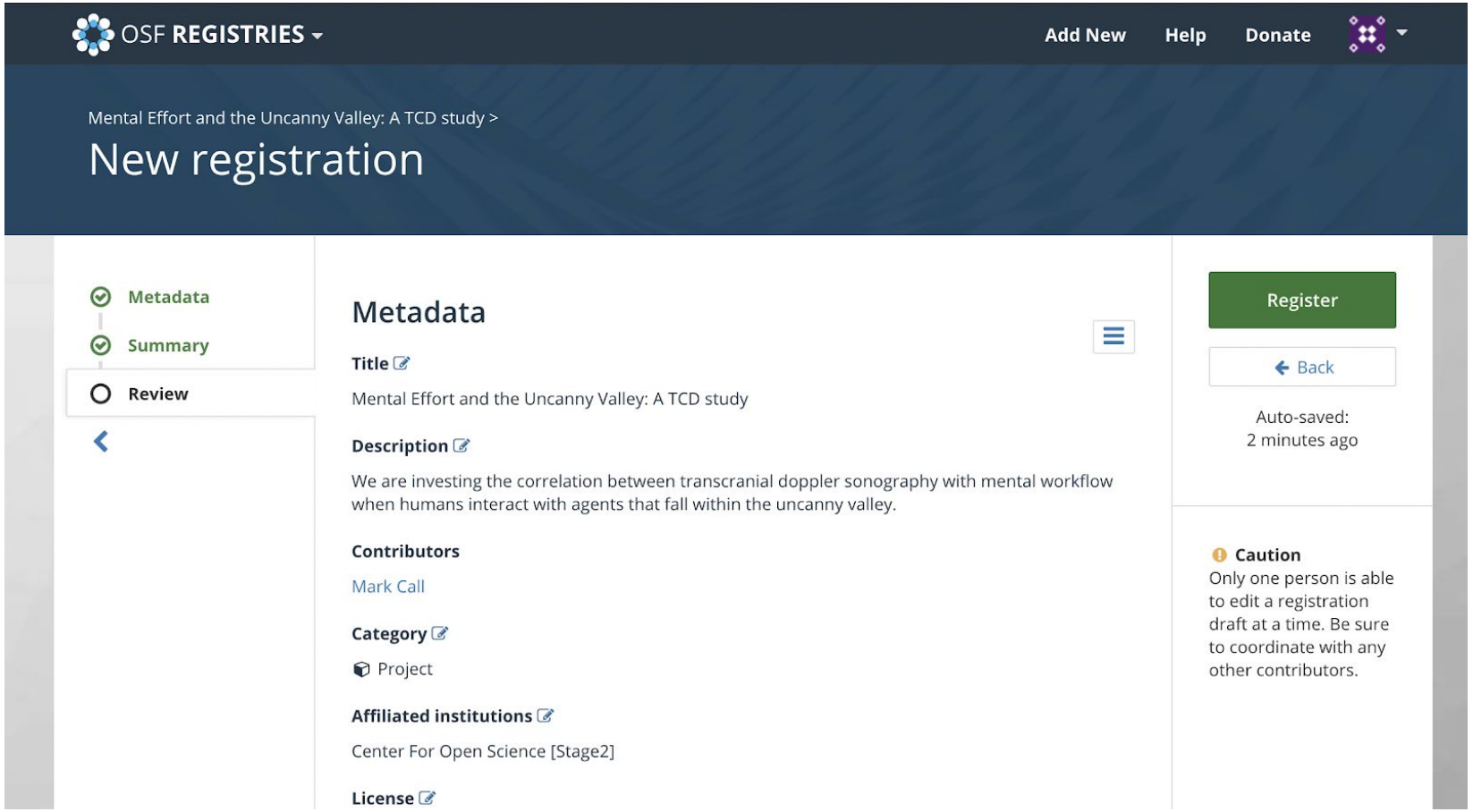
# Pre-Registration in Social Psychology - Step 8

When you get to the last page in your template, click the **Review** button.



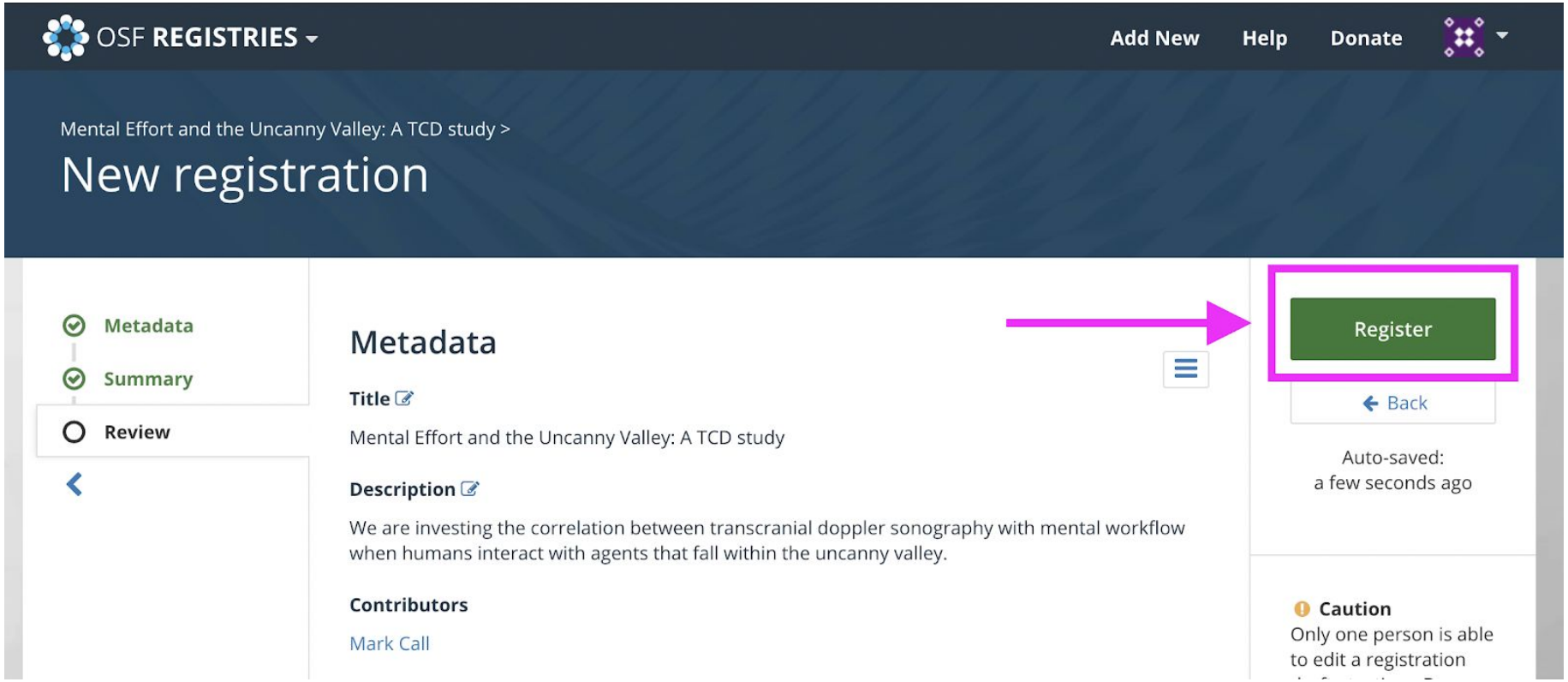
# Pre-Registration in Social Psychology - Step 9

## View the draft



# Pre-Registration in Social Psychology - Step 10

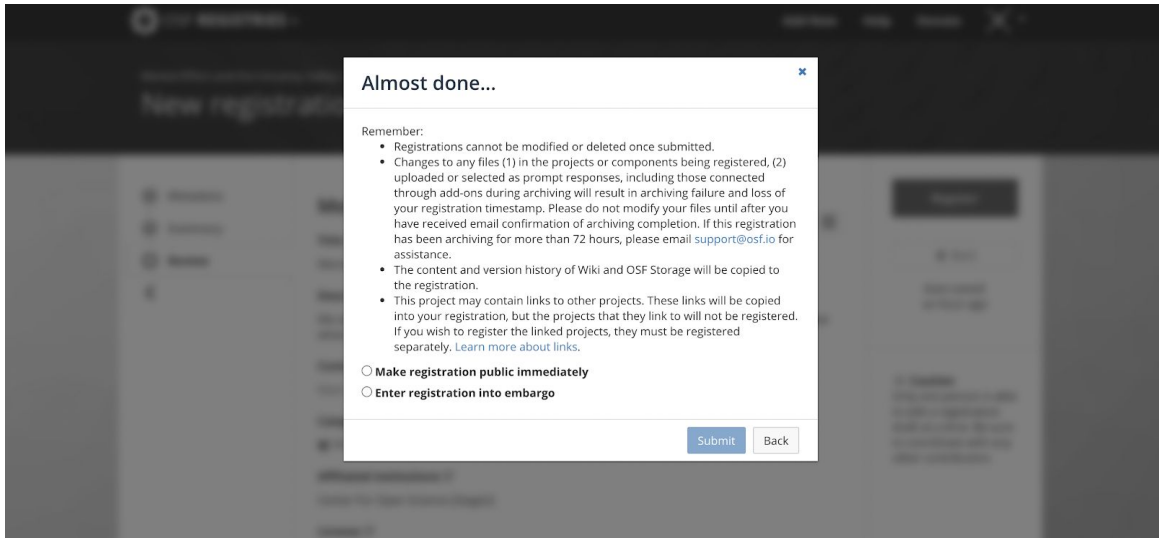
Click the **Register** button when you're ready, and a window will appear.



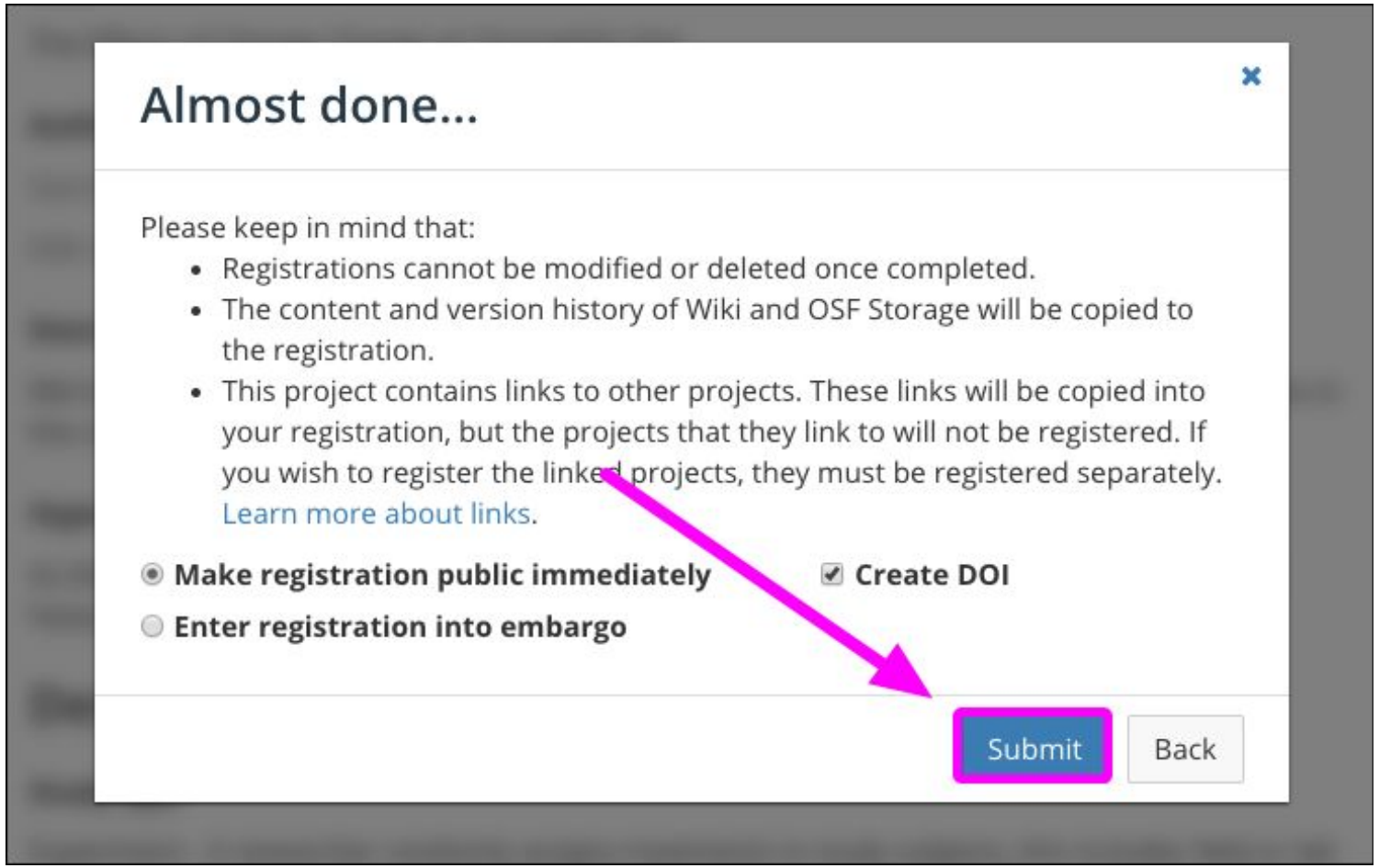
# Pre-Registration in Social Psychology - Step 11

Decide if you want to make your registration public immediately or embargoed.

Selecting **Make registration public immediately** will display the **Create DOI** checkbox. Select the checkbox if you want to associate a DOI with your registration.



# Pre-Registration in Social Psychology - Step 12



# References


- Van't Veer, A. E., & Giner-Sorolla, R. (2016). Pre-registration in social psychology—A discussion and suggested template. *Journal of experimental social psychology*, *67*, 2-12.
- OSF. (n.d.). What is open science? https://www.cos.io/open-science
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- American Psychological Association. (n.d.). *Preregistration* . American Psychological Association. https://www.apa.org/pubs/journals/resources/preregistration#:~:text=Preregistration%20allows%20researchers%20to%20plan,plans%20before%20conducting%20the%20research.

# Suggested Reading

- Van't Veer, A. E., & Giner-Sorolla, R. (2016). Pre-registration in social psychology—A discussion and suggested template. *Journal of experimental social psychology*, *67*, 2-12.
- Nosek, B. A., Ebersole, C. R., DeHaven, A. C., & Mellor, D. T. (2018). The preregistration revolution. *Proceedings of the National Academy of Sciences*, *115*(11), 2600-2606.

PNAS

# The preregistration revolution

Brian A. Nosek[a,b,1], Charles R. Ebersole[b], Alexander C. DeHaven[a], and David T. Mellor[a]

[a]Center for Open Science, Charlottesville, VA 22903; and [b]Department of Psychology, University of Virginia, Charlottesville, VA 22904

Edited by Richard M. Shiffrin, Indiana University, Bloomington, IN, and approved August 28, 2017 (received for review June 15, 2017)

**Progress in science relies in part on generating hypotheses with existing observations and testing hypotheses with new observations. This distinction between postdiction and prediction is appreciated conceptually but is not respected in practice. Mistaking generation of postdictions with testing of predictions reduces the credibility of research findings. However, ordinary biases in human reasoning, such as hindsight bias, make it hard to avoid this mistake. An effective solution is to define the research questions and analysis plan before observing the research outcomes—a process called preregistration. Preregistration distinguishes analyses and outcomes that result from predictions from those that result from postdictions. A variety of practical strategies are available to make the best possible use of preregistration in circumstances that fall short of the ideal application, such as when the data are preexisting. Services are now available for preregistration across all disciplines, facilitating a rapid increase in the practice. Widespread adoption of preregistration will increase distinctiveness between hypothesis generation and hypothesis testing and will improve the credibility of research findings.**

methodology | open science | confirmatory analysis | exploratory analysis | preregistration

Progress in science is marked by reducing uncertainty about nature. Scientists generate models that may explain prior observations and predict future observations. Those models are approximations and simplifications of reality. Models are iteratively improved and replaced by reducing the amount of prediction error. As prediction error decreases, certainty about what will occur in the future increases. This view of research progress is captured by George Box's aphorism: "All models are wrong but some are useful" (1, 2).

Scientists improve models by generating hypotheses based on existing observations and testing those hypotheses by obtaining new observations. These distinct modes of research are discussed by philosophers and methodologists as hypothesis-generating versus hypothesis-testing, the context of discovery versus the context of justification, data-independent versus data-contingent overconfidence in post hoc explanations (postdictions) and inflate the likelihood of believing that there is evidence for a finding when there is not. Presenting postdictions as predictions can increase the attractiveness and publishability of findings by falsely reducing uncertainty. Ultimately, this decreases reproducibility (6–11).

## Mental Constraints on Distinguishing Predictions and Postdictions

It is common for researchers to alternate between postdiction and prediction. Ideas are generated, and observed data modify those ideas. Over time and iteration, researchers develop understanding of the phenomenon under study. That understanding might result in a model, hypothesis, or theory. The dynamism of the research enterprise and limits of human reasoning make it easy to mistake postdiction as prediction. The problem with this is understood as post hoc theorizing or hypothesizing after the results are known (12). It is an example of circular reasoning—generating a hypothesis based on observing data, and then evaluating the validity of the hypothesis based on the same data.

Hindsight bias, also known as the I-knew-it-all-along effect, is the tendency to see outcomes as more predictable after the fact compared with before they were observed (13, 14). With hindsight bias, the observer uses the data to generate an explanation, a postdiction, and simultaneously perceives that they would have anticipated that explanation in advance, a prediction. A common case is when the researcher's prediction is vague so that many possible outcomes can be rationalized after the fact as supporting the prediction. For example, a biomedical researcher might predict that a treatment will improve health and postdictively identify the one of five health outcomes that showed a positive benefit as the one most relevant for testing the prediction. A political scientist might arrive at a model using a collection of covariates and exclusion criteria that can be rationalized after the fact but would not have been anticipated as relevant beforehand. A chemist may have random variation occurring across a number of results and nevertheless be able to construct a narrative post facto that imbues meaning in the randomness. To an audience of historians (15), Amos Tversky provided a cogent



Pre-Registration in Social Psychology—a Discussion and Suggested Template

Anna Elisabeth van 't Veer[a,b], Roger Giner-Sorolla[c]

[a]*Centre for Child and Family Studies, Leiden University, Leiden, Netherlands, vantveer@gmail.com / a.e.van.t.veer@fsw.leidenuniv.nl*
[b]*Department of Social Psychology, Tilburg Institute for Behavioral Economics Research, Tilburg University, Tilburg, Netherlands*
[c]*University of Kent, Canterbury, Kent, CT2 7NP, United Kingdom, R.S.Giner-Sorolla@kent.ac.uk*

**Abstract**

Pre-registration of studies before they are conducted has recently become more feasible for researchers, and is encouraged by an increasing number of journals. However, because the practice of pre-registration is relatively new to psychological science, specific guidelines for the content of registrations are still in a formative stage. After giving a brief history of pre-registration in medical and psychological research, we outline two different models that can be applied—reviewed and unreviewed pre-registration—and discuss the advantages of each model to science as a whole and to the individual scientist, as well as some of their drawbacks and limitations. Finally, we present and justify a proposed standard template that can facilitate pre-registration. Researchers can use the template before and during the editorial process to meet article requirements and enhance the robustness of their scholarly efforts.

*Keywords:* pre-registration, research methods, solid science, Reviewed Pre-registration (RPR), Unreviewed Pre-registration (UPR)

*Article accepted:* march 2016, http://dx.doi.org/10.1016/j.jesp.2016.03.004

*Supplemental material:* https://osf.io/56g8e/

*Please note this text reflects the version of the paper before final editing and typesetting.*