# Is pre-registration of studies a bad idea or a very bad idea?

Shravan Vasishth (with Daniela Mertzen)

November 5, 2019



WHAT IS A PRE-REGISTRATION?



## What is a Pre-Registration?

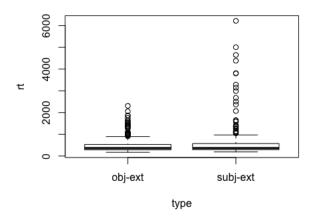
- Specification of study hypotheses, design and planned data analysis strategy before data collection begins.
- Time-stamped on OSF or aspredicted.org, or accepted for publication via a Registered Report.



## WHY IS IT IMPORTANT TO PRE-DEFINE THE ANALYSIS PLAN?



## Researcher degrees of freedom make any outcome possible





## Researcher degrees of freedom make any outcome possible Goal: show significant effect

```
By subject t-test: t(36) = -2.63, p-value = 0.013 By item t-test: t(14) = -2.15, p-value = 0.04956 [This was the published result.]
```



## Researcher degrees of freedom make any outcome possible

## Goal: show no significant difference

#### Take log transform:

```
By subject t-test: t(36) = -1.6549, p-value = 0.12
By item t-test: t(14) = -1.62, p-value = 0.13
```

#### Or fit a linear mixed model on raw RTs:

```
Formula: rt ~ so + (1 + so | subj) + (1 + so | item)
Fixed effects:
```

```
Estimate Std. Error t value (Intercept) 547.33 53.21 10.287 so 59.85 33.74 1.774
```



### Researcher degrees of freedom make any outcome possible Even the meaning of "statistically significant" is fluid

From a JML paper (Dillon et al., 2013):

"For total times this analysis **revealed a three-way interaction** that was significant by participants and marginal by items (F1(1, 39) = 8.0, p < .01; F2(1,47) = 4.0, p < .055;**minF0 (1, 81) = 2.66, p = .11**). This interaction did not reach significance in either' first-pass or probability of regression measures."

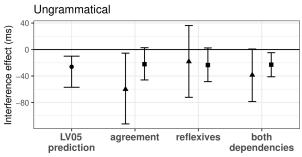
In fact, the interaction is not significant (look at the minF). Summary: Interaction in total time, first-pass reading time, first-pass regression not significant



## Researcher degrees of freedom make any outcome possible

Even the meaning of "statistically significant" is fluid

a) Grammatical conditions.



• LV05 ▲ Dillon et al., 2013 (N=40) ■ Replication (N=181)



## Researcher degrees of freedom make any outcome possible

Change the dependent measure when the original measure doesn't work out

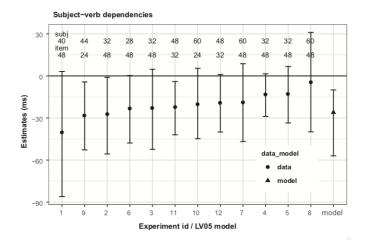
In our replication attempt, we see the same pattern in **first-pass regressions** that the original Dillon et al 2013 study found in **total time**:

- agreement: -0.06 [-0.09,-0.02]
- reflexives: -0.01 [-0.04, 0.03]

**Question**: Could one now argue that this effect in **first-pass regressions** confirm the original interaction claimed for **total time**? Recall that the original study found no effect in first-pass regressions.



## Researcher degrees of freedom make any outcome possible p-hacking and outlier "management"





## Researcher degrees of freedom make any outcome possible HARKing

- Hypothesizing After Results are Known.
- Researcher knowingly or unknowingly presents an unexpected result as one that has been predicted all along.
- Produces clean, confirmatory papers that journals prefer while maintaining illusion that research is hypothesis-driven.

## COGNITIVE SCIENCE A Multidisciplinary Journal

Cognitive Science (2015) 1–33 Copyright © 2015 Cognitive Science Society, Inc. All rights reserved. ISSN: 0364-0213 print/1551-6709 online DOI: 10.1111/cogs.12228

A Multiple-Channel Model of Task-Dependent Ambiguity Resolution in Sentence Comprehension

Pavel Logačev, Shravan Vasishth

Department of Linguistics, University of Potsdam

Received 5 April 2013; received in revised form 19 November 2014; accepted 20 November 2014



# One consequence of Researcher Degrees of Freedom: The replication crisis

'Replication crisis' (Open Science Collaboration, 2012) in psychological research: Many results from the literature cannot be reproduced.

De Groot (1956/2014) The meaning of "significance" for different types of research.'



## Failures to replicate in psycholinguistics

Nieuwland review of early prediction effects

Neuroscience and Biobehavioral Reviews 96 (2019) 367-400



Contents lists available at ScienceDirect

#### Neuroscience and Biobehavioral Reviews

journal homepage: www.elsevier.com/locate/neubiorev



Review article

Do 'early' brain responses reveal word form prediction during language comprehension? A critical review



Mante S. Nieuwlanda,b,\*

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<sup>b</sup> Donders Institute for Brain, Cognition and Behaviour, Nijmegen, the Netherlands



## Failures to replicate in psycholinguistics

Vasishth et al, replication failure of Levy and Keller, 2013

Journal of Memory and Language 103 (2018) 151-175



Contents lists available at ScienceDirect

#### Journal of Memory and Language

journal homepage: www.elsevier.com/locate/jml

The statistical significance filter leads to overoptimistic expectations of replicability

Shravan Vasishth<sup>a,\*</sup>, Daniela Mertzen<sup>a</sup>, Lena A. Jäger<sup>a</sup>, Andrew Gelman<sup>b</sup>

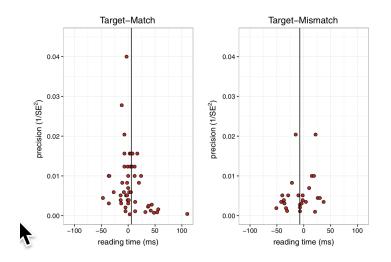


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## Big effects get published, but are overestimates

Gelman and Carlin, 2014, Jäger et al., 2017, Vasishth et al., 2018





 Registered reports force journal editors to make a decision to publish before results exist.



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  - $\rightarrow$  Whether these are positive or negative, novel or familiar is irrelevant.



- Registered reports force journal editors to make a decision to publish before results exist.
  - ightarrow Whether these are positive or negative, novel or familiar is irrelevant.
- Exploratory analyses are encouraged, but these will be clearly distinguishable from the confirmatory analysis.



# Registered Reports: Peer review before results are known to align scientific values and practices.

Registered Reports Participating Journals Details & Workflow Resources for Editors For Funders FAQ Allied Initiatives

Currently, 158 journals use the Registered Reports publishing format either as a regular submission option or as part of a single special issue. Other journals offer some features of the format. This list will be updated regularly as new journals join the initiative.

For an article type to qualify as a registered report, the journal policy must include at least these features:

- Peer review occurs prior to observing the outcomes of the research.
- Manuscripts that survive pre-study peer review receive an in-principle acceptance that will not be revoked based on the outcomes, but only on failings of
  quality assurance, following through on the registered protocol, or unresolvable problems in reporting clarity or style.

See also this table that compares the specific features of Registered Reports at different outlets.

If you are considering a Registered Reports submission but not sure how to get started, a good way to begin is to (a) read the specific author guidelines included in the list of participating journals below, (b) complete this template protocol and then (c) expand the template protocol into a full Stage 1 manuscript.

Journals that have adopted Registered Reports Special Issues Some Features



#### Benefits of sharing data and code:

- independent researchers can repeat analyses → helps to correct honest mistakes; ensures robustness of scientific record
- sharing materials also makes direct replication attempts easier



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- sharing materials also makes direct replication attempts easier
- avoids (actual) responses like the following:



• "We have looked both in ... and ..., but I am sorry to say we can't find those data anymore."



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- "...had to do some digging and finally found this file. I don't know if that's the ultimate version we used in the experiment, but it should be close. No idea about the fillers though. And I haven't found the original data yet."



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- "Regarding the ... data, ... is the one who has it. I have asked her a
  couple of times to send it, but she hasn't. I think the data are at her
  parents home in ..., but she doesn't go there often, because I don't
  think she gets along so well with her family. I will ask her again for
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- "I'm happy to provide our data for your project. During the summer,
  I don't visit my office regularly and that is where those data are
  stored, so it might be a few weeks before I send it along."



## Good practice

#### "The sin of data hoarding"

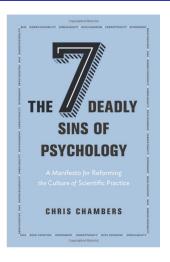
Major journals require authors to retain data for several years and share it with reader on request. In 2006, Jelte Wicherts and colleagues tested this by requesting data from 249 studies that appeared in four major journals.

"Unfortunately, 6 months later, after writing more than 400 emails—and sending some corresponding authors detailed descriptions of our study aims, (...)—we ended up with a meagre 38 positive reactions and the actual data sets from 64 studies (26% of the total number of 249 data sets)."

- 18% did not respond
- 35% refused to share data
- 20% promised to send it but never did
- all studies had been published in the previous 18 months



## Further reading



Chambers, C. (2017). The Seven Deadly Sins of Psychology. Princeton University Press.



## Pre-Registration

#### Potential problem with registered reports

 Loss of time because (a) paper has to be written, (b) have to wait for reviews, (c) have to respond to reviews, even before collecting any data.

#### Solution: Pre-registration without peer review

- E.g. on Open Science Framework (https://osf.io/), or
- AsPredicted (https://aspredicted.org/)

Source: Chambers, C. (2017). The Seven Deadly Sins of Psychology. Princeton University Press.





## Stage 1

 Manuscript (incl. hypotheses, methods, planned analyses) is submitted.

Source: https://osf.io/8mpji/wiki/home/

current list of participating journals, and a comprehensive FAO.





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- Manuscript (incl. hypotheses, methods, planned analyses) is submitted.
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## Stage 1

- Manuscript (incl. hypotheses, methods, planned analyses) is submitted.
- Stage 1 peer review (incl. 'Does the proposed study have sufficient power?')
- 'In Principle Acceptance' independent of results.

current list of participating journals, and a comprehensive FAO

Source: https://osf.io/8mpji/wiki/home/

### Stage 2

• Study is conducted.



#### Stage 2

- Study is conducted.
- Manuscript is resubmitted (+ results, discussion).



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  - results: confirmatory and exploratory analyses.



#### Stage 2

- Study is conducted.
- Manuscript is resubmitted (+ results, discussion).
  - results: confirmatory and exploratory analyses.
- Stage 2 peer review.



## Registered Reports

### Stage 2

- Study is conducted.
- Manuscript is resubmitted (+ results, discussion).
  - results: confirmatory and exploratory analyses.
- Stage 2 peer review.
- Publication of manuscript.

For detailed authors' guidelines see <a href="http://bit.ly/cortexinstructions">http://bit.ly/cortexinstructions</a>.



 $\dots$  REGISTERED REPORTS PREVENT EXPLORATION OF DATA AND CURB SCIENTIFIC CREATIVITY.



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**Verdict: False.** Authors should feel free to perform unregistered exploratory analyses with as much creativity as they can muster, the only requirement is that such analyses are labeled as exploratory.



...REGISTERED REPORTS ARE NOT SUITABLE FOR EXPLORATORY SCIENCE OR FOR DEVELOPING NEW METHODS WHERE THERE ARE NO HYPOTHESES.



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**Verdict: Red herring.** Irrelevant objection. Format not designed to be applicable to anything other than hypothesis-driven science.



...REGISTERED REPORTS CAN BE GAMED BY "PREREGISTERING" A STUDY THAT IS ALREADY COMPLETED.



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Verdict: True only for fraudsters.



REVIEWERS OF STAGE 1 SUBMISSIONS COULD STEAL MY IDEAS AND SCOOP ME.



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**Verdict: Possible but highly unlikely.** Concern does not stop researchers from applying for grant funding or presenting ideas at conferences  $\rightarrow$  much larger group of potential competitors.

Also, once in-principle acceptance awarded, journal cannot reject Stage 2 submission, because similar work was published elsewhere.



 $\dots$  REGISTERED REPORTS LOCK AUTHORS INTO PUBLISHING WITH A SPECIFIC JOURNAL.



...REGISTERED REPORTS LOCK AUTHORS INTO PUBLISHING WITH A SPECIFIC JOURNAL.

**Verdict:** False. Withdrawal of registered report is possible at any time. After in-principle acceptance: publication of withdrawn registration (includes abstract from Stage 1 submission and reason for withdrawal). Ensures process is transparent to scientific community.



...WE DON'T NEED REGISTERED REPORTS BECAUSE WE HAVE REPLICATION.



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**Verdict:** False. Argument ignores the fact that direct replication in psychology is extremely rare; associated with disincentives, such as journals' want for novelty.

Pre-registration could have positive impact: provisional acceptance of papers before investing resources.



...The case for Registered Reports assumes that scientists act dishonestly, and sends the message that there is no trust in the scientific community.



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**Verdict: Red herring.** Argument rests on false premise that bad practice is synonymous with deliberate deceit.

Bias and questionable research practices can be unconscious or stem from ignorance without implying any dishonesty.

Argument places greater emphasis on how we feel than on how research is actually conducted.

Regardless of conscious or unconscious "bad practice", the solutions are the same.



## Pre-registration at OSF – What has to be done?

- Registration at https://osf.io/.
- ② Creation of a project.
- Insertion of an abstract for the project:

#### test

#### Contributors: Dorothea Pregla

Date created: 2017-06-22 06:07 PM | Last Updated: 2017-06-22 06:11 PM

Category: Project 📦

Description: Add a brief description to your project

License: Add a license



## Upload the project

- a Upload the whole project as one PDF file. alternatively:
- b Upload the components of the project.



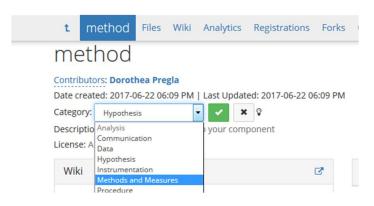
## Upload the project

- a Upload the whole project as one PDF file
- Inclusion of:
  - aim of the study,
  - hypotheses & predictions,
  - procedure,
  - design (including example item),
  - stopping rule,
  - analysis plan



## Upload the project

b Upload the components of the project:





## Who can see the project?

- Certain parts or the whole project can be made public.
- The project is not visible to anyone as long as it is not made public.
- To make the project public select those parts that shall be public:

## Change privacy settings

Adjust your privacy settings by checking the boxes below.

Checked projects and components will be **public**. Unchecked components will be **private**.

Select: Make all public | Make all private



## Who can see the project?

- Public parts can be seen by anyone (including unregistered visitors of OSF).
- Public parts can be made private again.
- Projects can be pre-registered without making them public.



## How to pre-register a project

#### 1 Select a registration method (e.g. OSF-Standard)

#### Register

Registration creates a frozen version of the project that can never be edited or deleted but can be withdraw remains editable but will now have the registration linked to it. Things to know about registration:

- · Ensure your project is in the state you wish to freeze before registering.
- · Consider turning links into forks.
- Registrations can have embargo periods for up to four years. If you choose an embargo period, the r
  automatically become public when the embargo expires.
- Withdrawing a registration removes the contents of the registrations but will leave behind a log show
  was created and withdrawn.

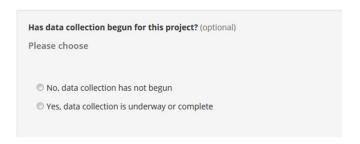
Continue your registration by selecting a registration form:

- Prereg Challenge 6
- Open-Ended Registration 6
- AsPredicted Preregistration 6
- OSF-Standard Pre-Data Collection Registration 6
- Replication Recipe (Brandt et al., 2013): Pre-Registration 6
- Replication Recipe (Brandt et al., 2013): Post-Completion 6
- Pre-Registration in Social Psychology (van 't Veer & Giner-Sorolla, 2016): Pre-Registration 6



## How to pre-register a project

2 Fill in the registration form & submit it.



3 Link the pre-registration when the study is submitted for publication.



## How to pre-register a project

Find the OSF pre-registration instructions here: http://bit.ly/Q\_SFB1287



# What has changed for my lab after adopting these practices?

- Slower data collection and publication:
  - 7 papers in 2018
  - 6 in 2017
  - 11 in 2016
  - 10 in 2015
- Discuss the ambiguities of the results openly in papers.
- Occasionally got rejected from a top journal because "story didn't bring closure."
- Releasing data caught mistakes before publication.

Overall, I feel that the quality of our work has improved.

