Some hypotheses are "more vampirical than empirical—unable to be killed by mere evidence."

- Jeremy Freese

QUESTIONS ABOUT THESE SLIDES:

Please direct any questions and follow-up requests for information to Frank Hillary and Hollie Mullin:

fhillary@psu.edu

ham5439@psu.edu

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NATURE | COMMENT

Reproducibility: A tragedy of errors

David B. Allison, Andrew W. Brown, Brandon J. George & Kathryn A. Kaiser

03 February 2016

Mistakes in peer-reviewed papers are easy to find but hard to fix, report David B. Allison and colleagues.

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Subject terms: Communication · Publishing · Peer review

PNAS Proceedings of the National Academy of Sciences of the United States of America

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NEW RESEARCH IN Physical Sciences | Social Science

Reproducibility of research: Issues and proposed remedies

David B. Allison, Richard M. Shiffrin, and Victoria Stodden

PNAS published ahead of print March 12, 2018 https://doi.org/10.1073/pnas.1802324115

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Reproducibility

Marcia McNutt

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Science 17 Jan 2014:
Vol. 343, Issue 6168, pp. 229
DOI: 10.1126/science.1250475

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Science advances on a foundation of trusted discoveries.

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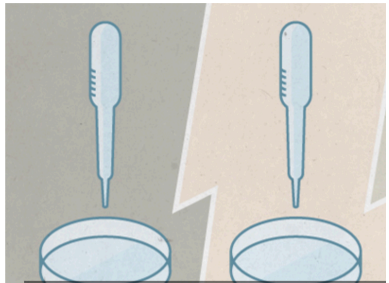

CHALLENGES IN IRREPRODUCIBLE RESEAR

No research paper can ever be considered to be the final word, a corroboration of research results is key to the scientific process. I especially animals and human beings, the complexity of the syste too easily lead to results that seem robust in the lab, and valid to but which do not stand the test of further studies. *Nature* has pub the worrying extent to which research results have been found wa of *Nature* and the *Nature* life sciences research journals have als our own houses in order, in improving the transparency and robus Journals, research laboratories and institutions and funders all ha of irreproducibility. We hope that the articles contained in this coll

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REPRODUCIBILITY INITIATIVE

PLOS ONE Launches Reproducibility Initiative

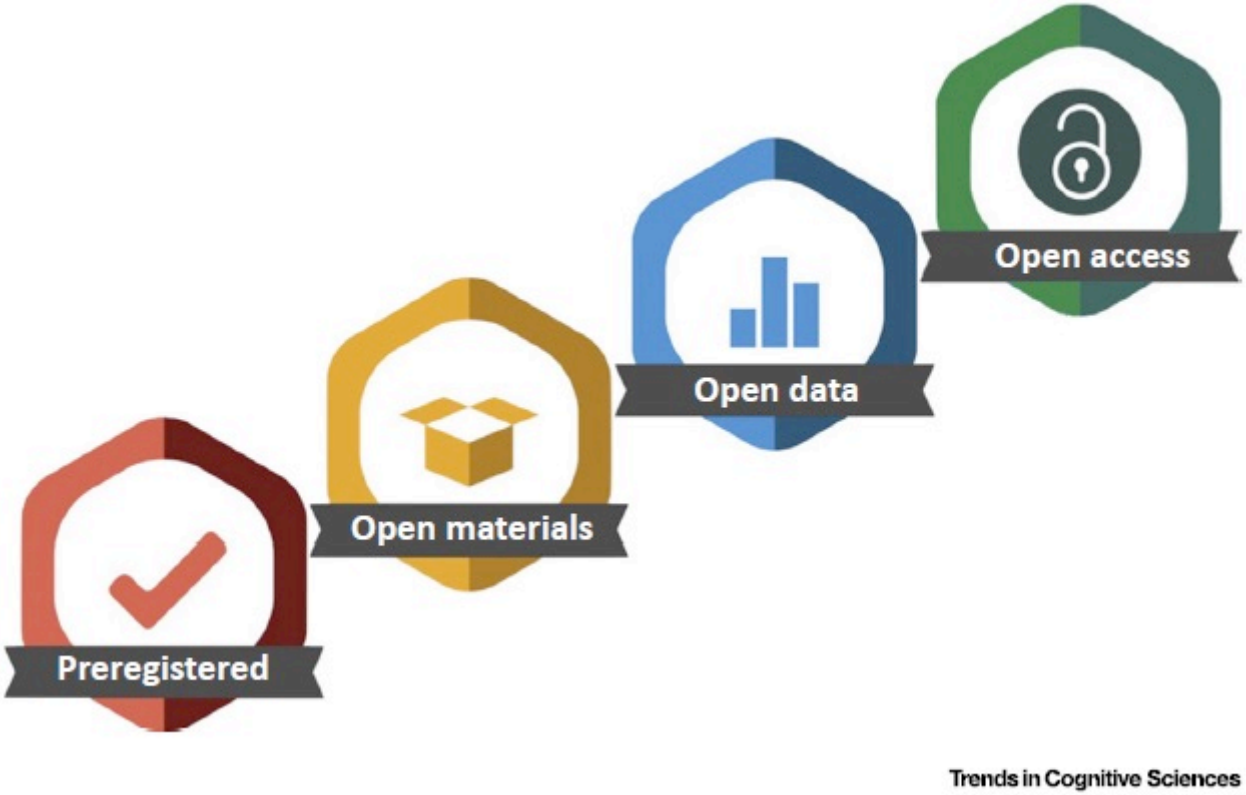
Posted August 14, 2012 by Damian Pattinson in Collections, Images, Media, Open Access, Peer review, Submissions

194

REPRODUCIBILITY INITIATIVE

PLOS ONE is pleased to announce a collaboration with Science Exchange and figshare in a groundbreaking new project: The Reproducibility Initiative. The initiative aims to help scientists validate their research findings by providing a mechanism for blind, independent replication by experts from Science Exchange's network of more than 1,000 providers at core facilities and contract research organizations.

What are the anchors for open and reproducible science….?



The Kindergartener's Guide to Improving Research

1. Show your work
2. Share

Kidwell et al., 2016, *PLOS Biology*

Slide: Brian Nosek

"…we p-hack because we're human--with human motivations and biases. The answer is openness"

--Jeff Spies, COS

How do we increase the reliability of our science?

Transparency

Sharing

What are the anchors for open and reproducible science….?

Open access Original research

BMJ Open Science

Publication rate in preclinical research: a plea for preregistration

Mira van der Naald ,[1,2] Steven Wenker,[1] Pieter A Do
Kimberley E Wever ,[4] Steven A J Chamuleau[1,2]

Received: 26 February 2021 | Revised: 9 August 2021 | Accepted: 6 December 2021
DOI: 10.1002/jrsm.1540

SOFTWARE FOCUS

Research Synthesis Methods WILEY

Facilitating open science practices for research syntheses: PreregRS guides preregistration

Jürgen Schneider | Iris Backfisch | Andreas Lachner

PNAS Nexus, 2022, 1, 1–6
https://doi.org/10.1093/pnasnexus/pgac016
Advance access publication date: 16 March 2022
Perspective

PNAS nexus

Declaration of common standards for the preregist[illegible] of animal research—speeding up the scientific pro[illegible]

Céline Heinl[a,*], Anna M.D. Scholman-Végh[b], David Mellor[c], Gilbert Schönfelder[a,d], Daniel Strech[e], Steven Cl[illegible] and Bettina Bert[a]

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[d]Charité-Universitätsmedizin Berlin, corporate member of Freie Universität Berlin, Humboldt-Universität zu Berlin, and Berlin Institute of Healt[illegible] Germany
[e]QUEST Center for Responsible Research, Berlin Institute of Health (BIH) at Charité, 10178 Berlin, Germany
[f]Department of Cardiology, Amsterdam University Medical Center, 1105 AZ Amsterdam, The Netherlands
*To whom correspondence should be addressed: Email: celine.heinl@bfr.bund.de
Edited By: Karen E. Nelson.

PLOS BIOLOGY

META-RESEARCH ARTICLE

Ensuring the quality and specificity of preregistrations

Marjan Bakker[1‡*], Coosje L. S. Veldkamp[2‡], Marcel A. L. M. van Assen[1,3], Elise A. V. Crompvoets[1,4], How Hwee Ong[5], Brian A. Nosek[6,7], Courtney K. Soderberg[6], David Mellor[6], Jelte M. Wicherts[1]

1 Department of Methodology and Statistics, Tilburg University, Tilburg, the Netherlands, **2** Faculty of Social Sciences, Utrecht University, Utrecht, the Netherlands, **3** Department of Sociology, Utrecht University, Utrecht, the Netherlands, **4** Cito Institute for Educational Measurement, Arnhem, the Netherlands, **5** Department of Social Psychology, Tilburg University, Tilburg, the Netherlands, **6** Center for Open Science, Charlottesville, Virginia, United States of America, **7** Department of Psychology, University of Virginia, Virginia, United States of America

‡ MB and CLSV are co-first authors on this work.
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CENTER FOR
OPEN SCIENCE

Design your Research Like its 2023!: Preregister your study and Analysis Plans

Pre-registration for Publication

- **What is Pre-registration?**
- **When could one consider this approach?**

COS 10 YEARS

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Science Works Best in the Open

Pre-registration: A Plan not a Prison

How can pre-registration help?

What problems does preregistration fix?

- ☞ The file drawer problem
- ☞ *P*-hacking: Unreported flexibility in data analysis
- ☞ HARKing: Hypothesizing after results are known

Preregistration revolution: https://osf.io/2dxu5/?_ga=2.266559822.1985242949.1561992051-331352688.1561992051

What else does pre-registration do?

Provides a document that can be evaluated by reviewers for publication

The current culture does not promote efficient science or the open study of phenomena because *researchers infrequently publish and share the results with the scientific community when interventions fail*.

It is essential for the scientific community to be aware of both successes and failures of well-designed clinical interventions, *making null findings a vital part of the scientific landscape* and ultimately expediting research

Preregistration revolution: https://osf.io/2dxu5/?_ga=2.266559822.1985242949.1561992051-331352688.1561992051

What else does pre-registration do?

Helps investigators calibrate confidence in findings

Helps to differentiate prediction from post-diction.

Preregistration revolution: https://osf.io/2dxu5/?_ga=2.266559822.1985242949.1561992051-331352688.1561992051

Pre-registration FAQs:

- **If my pre-registered hypotheses are NOT supported will it keep me from publishing my results?**
- **Can I pre-register a study where data have been collected?**
- **What if my analytical strategy changes during the study?**

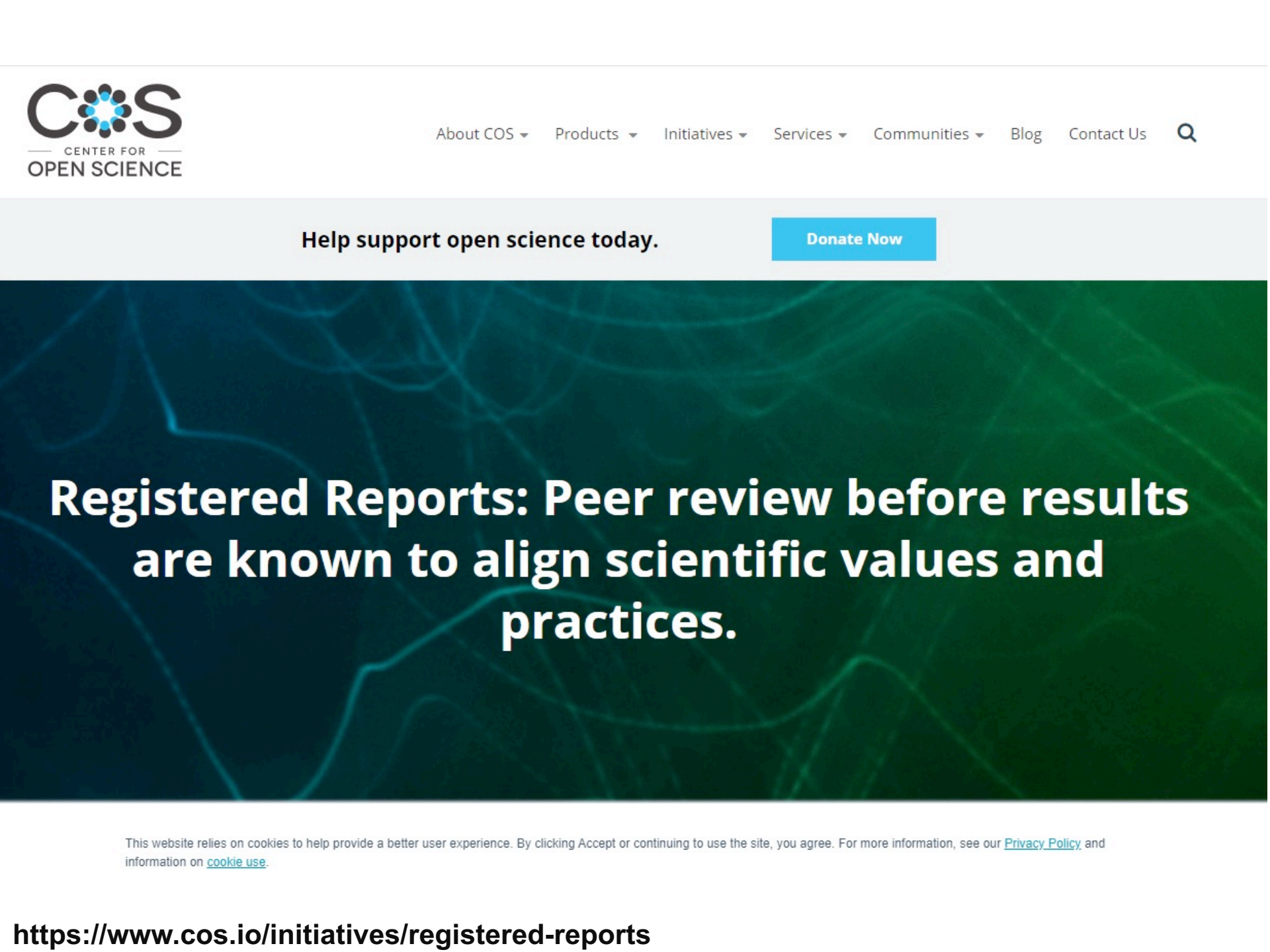
Your study doesn't go the way it was supposed to….

- **Make pre-reg amendment. Even if you have seen the data, still provides documentation of your original pathway**

- **NOTE: buffer against this with:**
  1) early (blind) analyses to set-up your final experiment

  2) tiered or incremental pre-registration

  3) pre-register a decision tree (i.e., series of if, then.. statements)



https://www.cos.io/initiatives/registered-reports

How do Registered Reports work?

Stage 1 Peer Review

- Are the hypotheses well founded?
- Are the methods and proposed analyses feasible and sufficiently detailed?
- Is the study well powered? (≥90%)
- Have the authors included sufficient positive controls to confirm that the study will provide a fair test?

If **YES**, then the study is granted "in principle acceptance" (IPA), a promise to publish regardless of outcome.

Stage 2 Peer Review

- Did the authors follow the approved protocol?
- Did positive controls succeed?
- Are the conclusions justified by the data?

https://doi.org/10.1093/braincomms/fcac322 BRAIN COMMUNICATIONS 2023: Page 1 of 16 | 1

BRAIN COMMUNICATIONS

REVIEW ARTICLE

Establishing ground truth in the traumatic brain injury literature: if replication is the answer, then what are the questions?

The problem with *Science by Volume*…

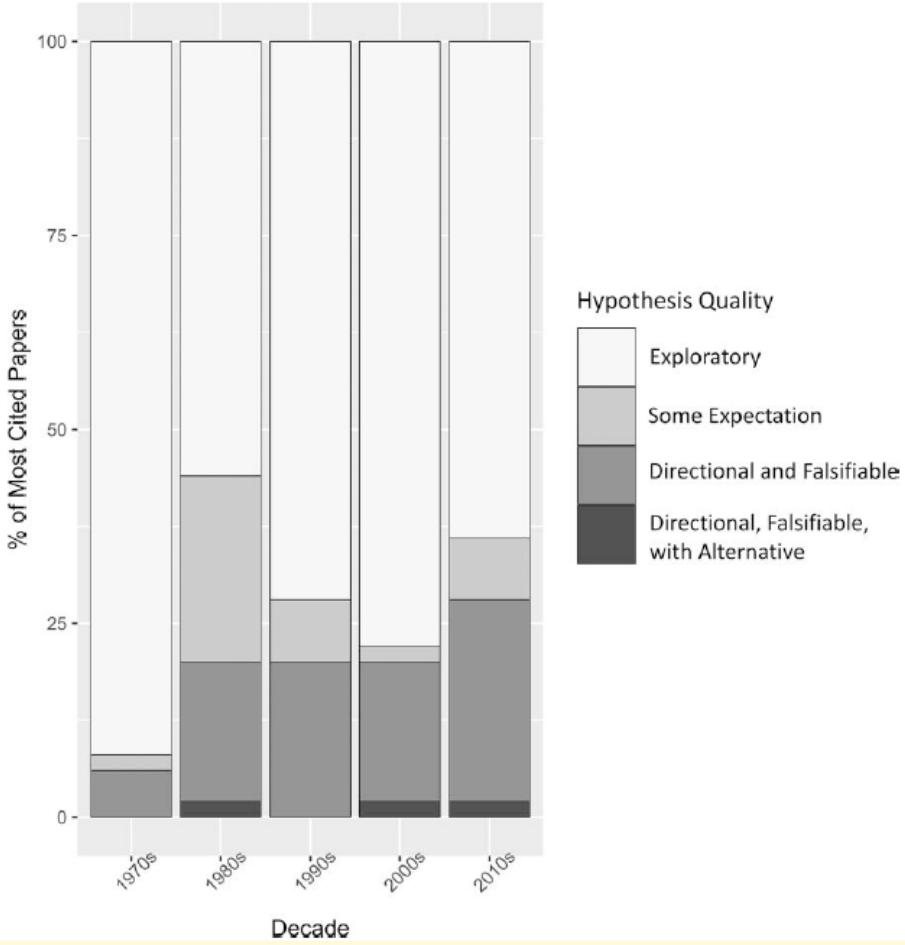


Figure 4 Trends in the strength of TBI hypotheses by decade. The y-axis is the percentage of the top 50 papers in each decade and the x-axis is the decade in which they were published based upon the WoS data set. The data are graphed by binning the top 50 most cited empirical TBI papers per decade from 1970 to 2019, for a total of $n = 250$ records. NOTE: papers that included more than one hypothesis were categorized based upon their *strongest* hypothesis so that they were not overrepresented in the graph.

Data collected from Web of Science using the following search terms: [neuro* OR brain OR cognition OR cerebr*] revealed 1,711,888 papers dating back to 1900 and then sorted by year. y-axis is % of total number of papers and x-axis is the year published.(See Priestley et al., 2022).

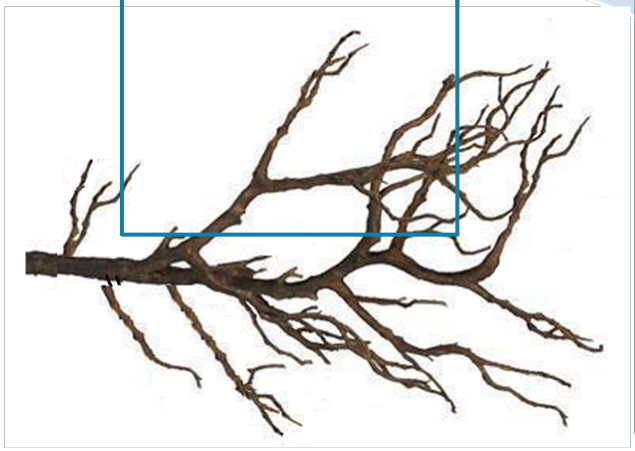
Pre-registered hypotheses that falsify…

Exploratory Stage

Idea generation

Theory Building

Inclusive to possible explanations



Proliferation of theories/explanations

Confirmatory Stage

Falsification

Theory testing and refinement

Identify mechanisms

Prune theories explanations

Pruning possible theories

Replication

Test parameters of fittest hypotheses

Test generalizability of mechanisms

Examine robustness and reproducibility

Applied Stage

Application of most highly supported theories

Goal:
Generalize theory

Test across species/samples

Rerutn to Confirmatory Stage as needed

Selection from fittest

https://psyarxiv.com/5fb7h/

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"If you want to be one year behind don't read BioArxiv"

-Jeff Leek; @jtleek

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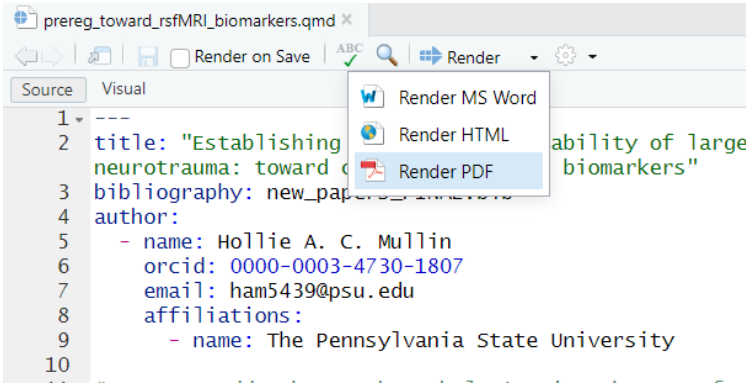
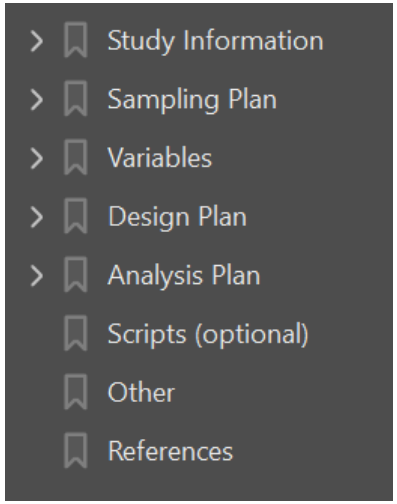
Pre-registration: where to start

Pre-registration Creation

- Can also be referred to as a registered report
  - See this website for more details on journal requirements
- See OSF and its templates. Pre-reg can be submitted at any time
- Best practices for pre-reg creation
  - Can use templates on OSF
  - However, Quarto can be used to create reproducible papers
  - Essentially an expansion of R Markdown
  - Quarto reproducible document example
    - Also see slides from this bootcamp's R Markdown and Quarto Workshop
  - See my pre-reg template for Quarto here





Indices

Reliability will be measured using the intraclass correlation coefficient (ICC). ICCs are the proportion of total measured variance (e.g., variability between people, sessions, etc.) that can be attributed to variability between people (Noble, Scheinost, and Constable 2019). Within-session reliability will be defined as the mean ICC value between the back-to-back resting-state runs within the same scanning session, within the same individual. Between-session reliability will be defined as the mean ICC between the back-to-back resting-state runs over the two-year time period, within the same individual. We will utilize the ICC (3,1) by Shrout and Fleiss (1979). The between-subjects mean square is represented by BMS, EMS represents error mean square, and k is the number of raters or scanning sessions. See formula below:

$$ICC(3,1) = \frac{BMS - EMS}{BMS + (k-1)EMS}$$

Correlation matrices, which include Pearson correlation coefficients describing the relationship between each resting-state brain region, will be Fisher r-to-z transformed for each subject.

Graph theory metrics are described below:

- Degree: The number of brain regions that the current region is connected to. These connections are also known as edges.
- Clustering Coefficient: The proportion of connected brain regions across all neighboring regions. This is the fraction of a region's neighbors that are neighbors of each other. The clustering coefficient is synonymous with the term local efficiency.

References with https://www.zotero.org/


```
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title: "OSF Preregistration Templ

#make sure that your references
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bibliography: references.bib
```

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This criteria is based on @birn_effect_2013,
y tend to drop off after 9 minutes.
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ode network (DMN), motor/sensory network
 most reliable [@buckner_brains_2008]. W
oh theory metrics, which include:
```

Note that References will not populate unless they are cited in within your Quarto .qmd file!

References

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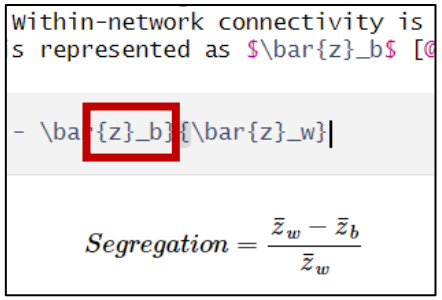
More Quarto Resources

Quarto subscript documentation is not accurate; you may need to explore Latex documentation for proper formatting!



- See introduction video about what Quarto is
- See video on how to use Zotero
- Quarto syntax options (italics, bold, etc.)
- Can see Latex syntax as well (subscript options, Quarto uses '~~' in documentation, which doesn't work in mathematical formulas. Use '_')
- See Quarto options for rendering word, html, pdfs, etc.