Open, transparent and reproducible science is stronger science

Natalie Meyers
Partnerships and Collaborations Manager, Center for Open Science
University of Notre Dame
Mission
Increase openness, integrity, and reproducibility of scholarly research.

Technology to enable change

Training to enact change

Incentives to embrace change
Infrastructure

Metascience

Community

COS by the Numbers

REPRODUCIBILITY PROJECT: cancer biology
29 active replications
2 accepted papers
WE NEED RESEARCHERS! JOIN A PANEL AND REVIEW cos.io/rpcb.

TOP GUIDELINES
752 journals
and 63 institutions
have signed on cos.io/top

OVER 12 MILLION RESEARCH EVENTS ACROSS 127 CONTENT PROVIDERS

PREREG CHALLENGE
278 preregistrations
689 eligible journals
learn more at cos.io/prereg
Incentives for individual success are focused on getting it published, not getting it right.

Nosek, Spies, & Motyl, 2012
CORRESPONDENCE

Believe it or not: how much can we rely on published data on potential drug targets?

Florian Prinz, Thomas Schlang and Khusru Asadullah

Many landmark findings in preclinical oncology research are not reproducible, in part because of inadequate cell lines and animal models.

Raise standards for preclinical cancer research

C. Glenn Begley and Lee M. Ellis propose how methods, publications and incentives must change if patients are to benefit.

http://127.0.0.1:8081/plosone/article?id=info:doi/10.1371/journal.pone.0010068
Scientific Ideals

- Innovative ideas
- Reproducible results
- Accumulation of knowledge

CORRESPONDENCE

Believe it or not: how much can we rely on published data on potential drug targets?

Florian Piriz, Thomas Schilz and Khizar Asadullah

A recent report by Arrowsmith noted that the success rate for new development projects in Phase II trials has fallen from 38% to 18% in to translate/marketable, and the financial costs of pursuing a fully blown drug discovery and development programme for a particular tar results that are published. However, there is an in this apparent widespread public recognition for error and an increasing awareness of the limitations of dealing with this to knowledge, so far there has in-depth, systematic and reproducible results with phew lab experiments replication and validation.

Early research in the field with a dedicated budget and expertise have shown the value of translational research. Cost-effective preclinical screening can be used to identify promising compounds for further development. However, the financial and regulatory challenges of translating preclinical findings into successful clinical trials can be significant. The need for accurate and reliable data on drug targets is crucial for the success of drug development programs.

Power failure: why small sample size undermines the reliability of neuroscience

Katherine S. Button1,2, John P. A. Ioannidis3, Claire Mokrysz4, Brian A. Nosek5, Jonathan Flint6, Emma S. J. Robinson7 and Marcus R. Munafò8

Abstract: A study with low statistical power has a reduced chance of detecting a true effect, but it is less well appreciated that low power also reduces the likelihood that a statistically significant result reflects a true effect. Here, we show that the average statistical power of studies in the neurosciences is very low. The consequences of this include overestimates of effect size and low reproducibility of results. There are also ethical dimensions to this problem as unreliable research is inefficient and wasteful. Improving reproducibility in neuroscience requires higher statistical power, which can be achieved through larger sample sizes.

Preclinical research findings on 10 neurotransmitters were analysed, with varying combinations of neurotransmitters, in 12 brain regions across the stage of research. The inaccuracy of the data was substantial, with low statistical power for detecting small effects and high statistical power for detecting large effects. The analysis showed that the average statistical power of these studies was very low, ranging from 0.05 to 0.25. This suggests that the findings from these studies may not be reliable.

In conclusion, improving statistical power in neuroscientific research is crucial for ensuring the reliability of findings and advancing our understanding of the brain.
What is reproducibility?

• **Computational Reproducibility:**
  – If we took your data and code/analysis scripts and reran it, we can reproduce the numbers/graphics in your paper

• **Empirical Reproducibility:**
  – We have enough information to rerun the experiment or survey the way it was originally conducted

• **Replicability:**
  – We use your exact methods and analyses, but collect new data, and we get the same statistical results
A popular concept in psychology is that your self-control is a limited resource that can be worn down.

Called ego-depletion, the idea has been enjoying success in the literature for over a decade now.

But when Martin Hagger and Nikos Chatzisarantis at Cuffin University in Australia gathered over two thousand participants across 23 labs to repeat a seminal ego-depletion experiment, they found...


Martin Hagger
RECKONING WITH THE PAST
February 29, 2016

https://osf.io/ezcuj/

Is this the end of science as we know it?

The short answer is "No."

Alex Holcombe at the University of Sydney makes it clear that this is a crisis of confidence, rather than a slip into some sort of scientific dark age.

We use the term "crisis" to refer to the collective and recent shift of scientists to begin rethinking with the problem.
An open investigation of the reproducibility of cancer biology research

Abstract It is widely believed that research that builds upon previously published findings has reproduced the original work. However, it is rare for researchers to perform or publish direct replications of existing results. The Reproducibility Project: Cancer Biology is an open investigation of reproducibility in preclinical cancer biology research. We have identified 50 high-impact cancer biology articles published in the period 2010-2012, and plan to replicate a subset of experimental results from each article. A Registered Report detailing the proposed experimental designs and protocols for each subset of experiments will be peer reviewed and published prior to data collection. The results of these experiments will then be published in a Replication Study. The resulting open methodology and dataset will provide evidence about the reproducibility of high-impact results, and an opportunity to identify predictors of reproducibility.

DOI: 10.7554/eLife.04333.001

TIMOTHY M ERRINGTON*, ELIZABETH JORNS, WILLIAM GUNN, FRASER ELISABETH TAN, JOELLE LOMAX AND BRIAN A NOSEK*

Software Preservation Necessary for Reproducibility
REFERENCES


https://osf.io/y9mpx/
daspos.org
Infrastructure

OSF
Technology to *enable* change

Open Science Framework

http://osf.io

free, open source
Put data, materials, and code on the OSF

Persistent Citable Identifiers

https://osf.io/ezcuj/
Connecting the workflow is critical to enabling change
API Docs
https://api.osf.io/v2/docs/
Problem

The gap between scholarly **values** and **practices**.

Promotes incentives that help **realign** values and practices
<table>
<thead>
<tr>
<th>Norms</th>
<th>Counternorms</th>
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<tbody>
<tr>
<td><strong>Communality</strong></td>
<td><strong>Secrecy</strong></td>
</tr>
<tr>
<td>Open sharing</td>
<td>Closed</td>
</tr>
<tr>
<td><strong>Universalism</strong></td>
<td><strong>Particularism</strong></td>
</tr>
<tr>
<td>Evaluate research on own merit</td>
<td>Evaluate research by reputation</td>
</tr>
<tr>
<td><strong>Disinterestedness</strong></td>
<td><strong>Self-interestedness</strong></td>
</tr>
<tr>
<td>Motivated by knowledge and discovery</td>
<td>Treat science as a competition</td>
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<tr>
<td><strong>Organized skepticism</strong></td>
<td><strong>Organized dogmatism</strong></td>
</tr>
<tr>
<td>Consider all new evidence, even against one’s prior work</td>
<td>Invest career promoting one’s own theories, findings</td>
</tr>
<tr>
<td><strong>Quality</strong></td>
<td><strong>Quantity</strong></td>
</tr>
</tbody>
</table>

**FIG. 3.** Norm versus Counternorm Scores: Percent with Norm > Counternorm (dotted), Norm = Counternorm (striped), Norm < Counternorm (solid).

Anderson, Martinson, & DeVries, 2007
FIG. 3. Norm versus Counternorm Scores: Percent with Norm > Counternorm (dotted), Norm = Counternorm (striped), Norm < Counternorm (solid).

Anderson, Martinson, & DeVries, 2007
Problems

- Flexibility in analysis
- Selective reporting
- Ignoring nulls
- Lack of replication


A reader quick, keen, and leery
Did wonder, ponder, and query
When results clean and tight
Fit predictions just right
If the data preceded the theory

Anonymous, quoted from Kerr (1998)
A Garden of Forking Paths

“Does X affect Y?”

Exclude outliers?
Control for year?
Median or mean?

Jorge Luis Borges; Gelman and Loken

Hypothetico-deductive scientific method

Read more: osf.io/8mpji
Registered Reports

PEER REVIEW

Design → Collect & Analyze → Report → Publish

PEER REVIEW

Registered Reports

Design → Collect & Analyze → Report → Publish

PEER REVIEW
Registered Reports

- AIMS Neuroscience
- Attention, Perception, & Psychophysics
- Cognition and Emotion
- Comprehensive Results in Social Psychology
- Cortex
- Drug and Alcohol Dependence
- eLife
- Euro Journal of Neuroscience
- Experimental Psychology

- Journal of Accounting Research
- Journal of Business and Psychology
- Journal of Personnel Psychology
- Journal of Media Psychology
- Nutrition and Food Science Journal
- Perspectives on Psych. Science
- Royal Society Open Science
- Social Psychology
- Stress and Health
- Work, Aging, and Retirement

http://osf.io/8mpji
Who Publishes Registered Reports?

(just to name a few)

See the full list of journals at osf.io/8mpji

Incentives to *embrace* change
The $1,000,000 Preregistration Challenge

Endorse TOP Guidelines
Badges for Open Practices
Registered Reports

https://cos.io/prereg

The $1,000,000 Preregistration Challenge

Preregistration increases the credibility of hypothesis testing by confirming in advance what will be analyzed and reported. For the Preregistration Challenge, one thousand researchers will win $1,000 each for publishing results of preregistered research.

Share this handout for a brief overview and links to more information, and begin your preregistration today!
TOP Guidelines

1. Data citation
2. Design transparency
3. Research materials transparency
4. Data transparency
5. Analytic methods (code) transparency
6. Preregistration of studies
7. Preregistration of analysis plans
8. Replication
# Transparency & Openness Promotion Guidelines

<table>
<thead>
<tr>
<th>Eight Standards</th>
<th>Three Tiers</th>
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<tbody>
<tr>
<td>1. Data citation</td>
<td>1. Disclose</td>
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<td>2. Design transparency</td>
<td>2. Require</td>
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<td>4. Data transparency</td>
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## Signatories
- 752 Journals
- 63 Organization

Learn more at [http://cos.io/top](http://cos.io/top)

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**Signals: Making Behaviors Visible Promotes Adoption**

![Signals: Making Behaviors Visible Promotes Adoption](images/signals.png)
This Week in Psychological Science (TWIPS)

The links below take you to the journal via the APS website. If not already logged in, you will be redirected to log-in using your last name (Nosek) and Member ID (16345).

Call for Editor Nominations

Psychological Science in the Public Interest

The Pen is Mightier Than the Keyboard: Advantages of Longhand Over Laptop Note Taking

Finn A. Mueller and Daniel M. Oppenheimer

It’s becoming more and more common for students to type their notes on laptops rather than writing them out by hand. In the first of several studies, the authors examined the effects of laptop note taking by having participants take notes on a TRD talk using a laptop computer or a notepad. Thirty minutes later, the participants answered factual-recall and conceptual-application questions about the lecture. Those who took notes on laptops performed worse on conceptual-application questions – but not on factual-recall questions. Follow-up studies indicated that although people with laptops take more notes, they tend to copy the information verbatim and therefore process the information less than do longhand note takers.

Gratitude: A Tool for Reducing Economic Impatience

David DeSteno, Wei Li, Lisa Dickerson, and Jennifer S. Lerner

It is well known that people are generally impatient and prefer immediate rewards to future rewards. To examine whether certain emotions could reduce peoples’ economic impatience, researchers asked participants to recall events that made them feel

Case Study: Psychological Science

Percentage of Articles with Open Data


Independent Repository, Badge
Independent Repository, No Badge
PSDI Supplement, Badge
PSDI Supplement, No Badge
Independent Website, Badge
Independent Website, No Badge
Personal Website, No Badge

0% 25% 50% 75% 100%

Percentage of Articles with Open Data


Independent Repository, Badge
Independent Repository, No Badge
PSDI Supplement, Badge
PSDI Supplement, No Badge
Independent Website, Badge
Independent Website, No Badge
Personal Website, No Badge

0% 25% 50% 75% 100%
Training to *enact* change

Meet researchers where they are and help them find *immediate benefit* in training
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We answer questions and provide training on open and reproducible tools, methodologies, statistics, and workflows to help researchers improve the reproducibility and rigor of their work.

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Free training on how to make research more reproducible
http://cos.io/stats_consulting
Issues Arising from Underpowered Studies
Courtney Soderberg
Center for Open Science
Statistical and Methodological Consultant

Consequences of Low Statistical Power

Find this presentation at https://osf.io/hgjyz/

Questions: natalie@cos.io