Our mission is to increase openness, integrity, and reproducibility of scholarly research.
OPEN, TRANSPARENT, AND REPRODUCIBLE SCIENCE IS STRONGER SCIENCE

- COS founded in 2013 by UVA professors Brian Nosek and Jeffery Spies
- We provide expertise, tools, and training to help researchers create and promote open science within their teams, institutions & publishers
- Promoting these practices within the research funding and publishing communities accelerates scientific progress
What is open science?

Openness and reproducibility means research is openly shared and distributed. Knowledge accumulates by sharing information and independently reproducing results.
**Why is this important?**

- Incentives for individual research success are focused on getting it published, *not* getting it right.
- Science moves forward when others can verify and build on results. Trust in scientific results is reduced when it can’t be reproduced.
- Organizations that fund research, as well as the scientific community, are pushing for impact AND reproducible results more quickly for others to build on and extend.
Our goal is to nudge incentives to align scientific practices with scientific values.
So...if reproducible science is stronger science, how do we work together to produce more research that can be confirmed?
Show your work.
Share.
**Ideals vs Reality**

**Communality**
Open sharing

**Universalism**
Evaluate research on own merit

**Disinterestedness**
Motivated by knowledge and discovery

**Organized skepticism**
Consider all new evidence, even against one’s prior work

**Quality**

**Secrecy**
Closed

**Particularism**
Evaluate research by reputation

**Self-interestedness**
Treat science as a competition

**Organized dogmatism**
Invest career promoting one’s own theories, findings

**Quantity**
Knowledge gaps create issues

- Missing data
- P-hacking
- HARKing
- Missing protocols
- Poor transparency on process
- Failure to replicate
IS THERE A REPRODUCIBILITY CRISIS?

- 52% Yes, a significant crisis
- 38% Yes, a slight crisis
- 7% No, there is no crisis
- 3% Don't know

1,576 researchers surveyed
HAVE YOU FAILED TO REPRODUCE AN EXPERIMENT?

Most scientists have experienced failure to reproduce results.

- **Chemistry**
- **Biology**
- **Physics and engineering**
- **Medicine**
- **Earth and environment**
- **Other**

Colors indicate:
- Red: Someone else’s
- Pink: My own
Research evaluates scientific ideas. We evaluate research.

- Reproducibility Project: Cancer Biology (RP:CB)
  - Initiative to conduct direct replications of 50 high-impact cancer biology
  - [https://cos.io/our-services/research/rpcb-overview/](https://cos.io/our-services/research/rpcb-overview/)
- Reproducibility Project: Psychology (RP:P)
  - Collaborative community effort to replicate published psychology experiments from three important journals
  - [https://osf.io/ezcuj/wiki/home](https://osf.io/ezcuj/wiki/home)

Predictors of reproducibility
Common obstacles to conducting replications
How current scientific incentive structure affects research practices
Implications?

“Replicating a study...[is] like trying to play a complicated board game without all the instructions or even all the parts.”

• Replication is hard, but critically important. The variability in results show that.
• Limited information drastically reduces ability to replicate.
• Openness and transparency are critical to moving research forward. Getting the models to work is a big challenge - disease states are hard to copy!
• Preregistration of research is critical to the replication process.
• Publication is a starting point, not an end point. Science is connected. Every discovery is part of a bigger story.
Meeting researchers where they are

- Researchers & Scientists
  - COS maintains free, easy-to-adopt tools, services, and communities for scientists who wish to develop research practices that make their work more accessible and reproducible.

- Research Institutions
  - COS provides tools and training to institutions to help them implement open and transparent practices.

- Publishers & Societies
  - COS maintains a variety of integrated, powerful tools and services for journals, societies, and funders to minimize complexity and encourage openness and preregistration.

- Software Developers
  - COS builds open source web apps, connects via API with other services, and actively supports open projects.
We build scientific communities

• Communities help us learn what products, services and policies are most important to their research
• Training and presentations with them help spread the adoption of open research practices
• The more researchers and institutions that use open science ideas and products or follow open guidelines, the more efficient research becomes
HOW WE DO THAT

• We develop software that researchers can use to organize their work better, so others can see what they did and try it themselves

• We teach researchers how to design projects that others can easily understand and try themselves

• We encourage the people creating the pressure to reward curiosity as much as the outcome
Research culture change

- Policy
- Incentives
- Communities
- User Interface/Experience
- Infrastructure

Make it required
Make it rewarding
Make it normative
Make it easy
Make it possible
Research culture change

- Policy: Make it required
- Incentives: Make it rewarding
- Communities: Make it normative
- User Interface/Experience: Make it easy
- Infrastructure: Make it possible
Open source research workflow & collaboration tools

- **Structured projects**: Manage files, data, code, and protocols in one centralized location and easily build custom organization for your project.

- **Controlled access**: Control which parts of a project are public or private, making it easy to collaborate and share with the community or just the team.

- **Enhanced workflow**: Automate version control, get persistent identifiers for projects and materials, preregister research, generate preprints, and connect your favorite third-party services directly to OSF.

- **Dependable Repository**: OSF's Preservation Fund preserves and maintains read access to any hosted data on OSF. This fund is sufficient for 50+ years of read access hosting at present costs.

https://osf.io
What do Open Workflows do?

- Foster **collaboration**
- Foster **inclusivity**
- Increase **process transparency**
- Increase **accountability**
- Facilitate **reproducibility**
- Facilitate **metascience**
- Foster **innovation**
- Protect against lock-in
  - **Open + Accessible**
One platform, many tools that enhance research productivity and visibility of research outputs
Research culture change

- Policy
  - Make it required
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  - Make it rewarding
- Communities
  - Make it normative
- User Interface/Experience
  - Make it easy
- Infrastructure
  - Make it possible
• Connecting the workflow is critical to enabling transparency
• Research project management tools reduce burden
• Storage and connectivity enhance collaboration
• Sharing and pre-publication ensure transparency
• Institutional project management drives adoption
• Open source prevents lock-in
Incorporate data, materials, and code from anywhere.
Check out “Fish Guy’s” Story: http://www.wired.com/2016/01/print-an-army-of-giant-articulated-fish-from-this-3-d-database/
Research culture change

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Community and training

- Webinars to introduce basic reproducible practices
- Consulting on methodological best practices and to improve research planning
- Workshops and training to teach tools, how to apply them, and reveal best practices for research
- Ambassador Program to provide local resources for open science information and practices

https://cos.io/our-services/training-services/
Research culture change

- Policy
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- Infrastructure

Make it required
Make it rewarding
Make it normative
Make it easy
Make it possible
Making Behaviors Visible Promotes Adoption

OPEN DATA

OPEN MATERIALS

PREREgistered
Open Science Badges

Open Data Badge
• A URL, doi, or other permanent path for accessing the data in a public, open-access repository
• Sufficient information for an independent researcher to reproduce the reported results

Open Materials Badge
• A URL, doi, or other permanent path for accessing the materials in a public, open-access repository
• Sufficient information for an independent researcher to reproduce the reported methodology

Preregistered Badge
• URL, doi, or other permanent path to the registration in a public, open-access repository
• An analysis plan registered prior to examination of the data or observing the outcomes
• Any additional registrations for the study other than the one reported
• Any changes to the preregistered analysis plan for the primary confirmatory analysis
• All of the analyses described in the registered plan reported in the article
Registered Reports

DEVELOP IDEA

DESIGN STUDY

COLLECT & ANALYZE DATA

WRITE REPORT

PUBLISH REPORT

Stage 1
Peer Review

Stage 2
Peer Review
Research culture change

Policy: Make it required
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Transparency & Openness Guidelines

• Transparency, open sharing, and reproducibility are core values of science, but not always part of daily practice.
• Journals, funders, and scholarly societies can increase reproducibility of research by adopting the TOP Guidelines.
• 749 Journals and 63 organizations have already become signatories of the TOP Guidelines.

https://cos.io/our-services/top-guidelines/
TOP Guidelines

1. Data citation
2. Design transparency
3. Research materials transparency
4. Data transparency and accessibility
5. Analytic methods (code) transparency
6. Preregistration of studies
7. Preregistration of analysis plans
8. Replication
Some TOP Signatory Organizations

- AAAS/Science
- American Academy of Neurology
- American Geophysical Union
- American Heart Association
- American Meterological Society
- American Society for Cell Biology
- Association for Psychological Science
- Association for Research in Personality
- Association of Research Libraries
- Behavioral Science and Policy Association
- BioMed Central
- Committee on Publication Ethics

- Electrochemical Society
- Elsevier
- Frontiers
- MDPI
- Nature-Springer
- PeerJ
- Pensoft Publishers
- Public Library of Science
- The Royal Society
- Society for Personality and Social Psychology
- Society for a Science of Clinical Psychology
- Ubiquity Press
- Wiley
• Funders incentivized and rewarded open science?
• Institutions recognized open science contributions, preprints, and preregistrations as valid scientific output?
• Journals encouraged/required open data and materials?
What can institutions do?

• Set up OSF Institutions
• Affiliate ongoing research at your institution
• Promote OSF
• Train your research community
• See the impact of research
• Share the outputs of conferences and meetings
What can researchers do?

- Use OSF
- Conduct Reproducible Analyses
- Preregister your studies
- Signal Open Practices
- Share your presentations, materials, and data
What can societies & publishers do?

- Adopt the Transparency and Openness Promotion (TOP) Guidelines
- Signal open practices with badges
- Increase your conference's reach with OSF Meetings
- Adopt Registered Reports
What can funders do?

• Encourage and signal preference for open data and materials as part of any funding commitment
• Host and share results from their funded research on open repositories
• Encourage and signal preference for preregistered studies and requests
• Support replication studies as part of the scientific record.
Thanks!

Rusty Speidel
434-284-3403
rusty@cos.io