Open Science

Open Science Movement

Sometimes labelled **"the reform movement"** -- (psychological) scientists trying to address problems in the field identified as part of the replication crisis.

(Note, these are not distinct periods of history, nor are either of them considered over.)

Within psychology, much of the force behind this movement has been driven by social and personality psychologists.

- **Open** because one of the primary problems of the replication crisis was the lack of transparency. Everyone did work in private; kept data secret; buried, hid, lost key aspects of research. Opaque was normal.

Dates

2011-2012 -- Bem ESP paper, False Positive Psychology paper, Diederik Stapel fraud case, Hauser fraud case, Sanna fraud case, Smeesters fraud case.

2013 -- Center for Open Science is founded

2016 -- Innagural meeting of the Society for the Improvement of Psychological Science.

Goals of open science

- Change incentive structure
- Improve training and research practices of the next generation (YOU)
- Empirically test the state of the field (meta-science)
- Develop new tools to enable better scientific research

Open science values

Tal Yarkoni (July 13, 2019)

I hate open science

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Now that I've got your attention: what I hate—and maybe *dislike* is a better term than *hate*—isn't the open science *community*, or open science *initiatives*, or open science *practices*, or open *scientists*... it's the *term*. I fundamentally dislike the term *open science*. For the last few years, I've deliberately tried to avoid using it. I don't call myself an open scientist, I don't advocate publicly for open science (per se), and when people use the term around me, I often make a point of asking them to clarify what they mean.

- **Reproducibility** -- are other people able to obtain your same result with your same data?
- **Accessibility** -- is work publicly available?
- **Incentive alignment** -- do the policies of the field encourage good science or something else entirely?
- **Openness of opinion** -- is criticism of work distinguished from criticism of people?
- **Diversity, equity, and inclusion** -- Are there barriers to being a scientist, reading science, being helped by science?
- **Meta-science and informatics.** -- How are we diagnosing the field? How do we determine the quality of a study?

Reproducibility vs Replicability

Condon, Graham, & Mroczek, 2018; psyarxiv.com/2fn5x

	Same Data	Different Data
Same Methods	Reproducibility	Generalizability
Different Methods	Sensitivity	Full Generalizability / Conceptual Replicability / Other Research

(New) tools

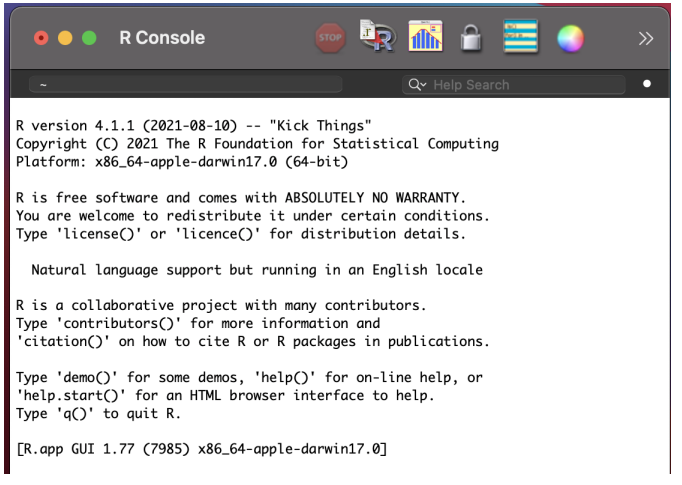
This is an exciting time to be a psychological researcher, because new tools for making work reproducible, accessible, open, and inclusive are being developed every day.

It's just a lot easier to meet these standards today than it was 10 years ago.

Let's discuss some new(ish) tools for ensuring your work is reproducible and robust.

R (not new)

- Use of scripts -- data analysis is **reproducible**
  - Don't be your own worst collaborator
- Software is open-source
  - **Equity** in terms of who can use the software
  - **Equity** in terms of who can build the software!
  - Available right away



RMarkdown (Not that new)

Combination of two languages: **R** and Markdown.

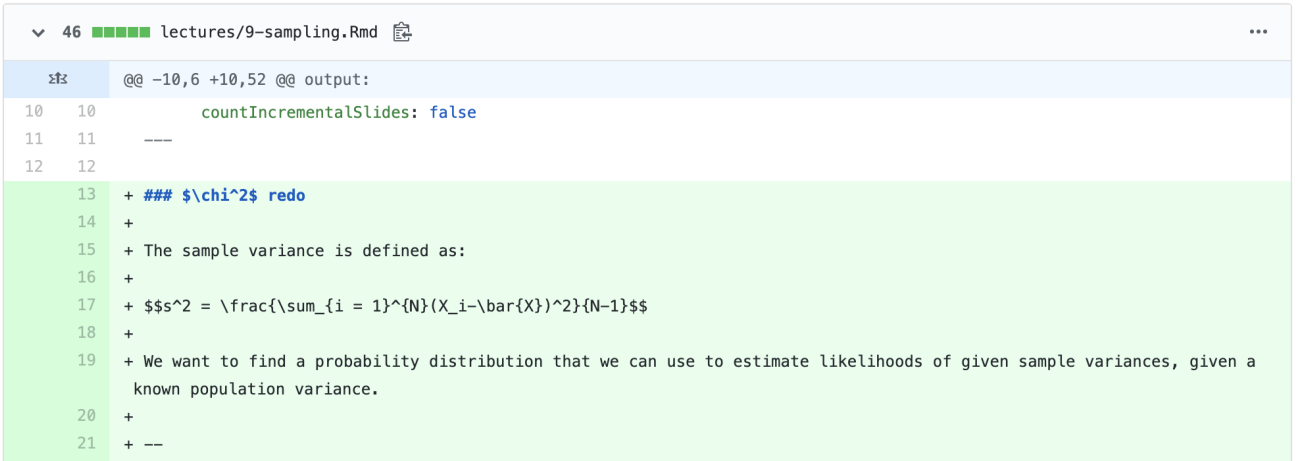
Markdown is a way of writing without a WYSIWYG editor -- instead, little bits of code tell the text editor how to format the document.

Increased flexibility: Markdown can be used to create

- presentations (this one!)
- manuscripts
- CVs
- books
- websites

Git (not new)

Git is a version control system. Think Microsoft Track Changes for your code.



```
46 lectures/9-sampling.Rmd
@@ -10,6 +10,52 @@ output:
10 10         countIncrementalSlides: false
11 11   ---
12 12
13 + ### $\chi^2$ redo
14 +
15 + The sample variance is defined as:
16 +
17 + $$s^2 = \frac{\sum_{i = 1}^{N}(X_i-\bar{X})^2}{N-1}$$
18 +
19 + We want to find a probability distribution that we can use to estimate likelihoods of given sample variances, given a
    known population variance.
20 +
21 + --
```

- Allows multiple collaborators to contribute code to the same project
- If you want to go into industry, you 100% need to know this
- Want to learn more? Oh Shit, Git

GitHub (also not new)

- GitHub is one site that facilitates the use of Git
- Repositories can be private or public -- allow you to share your work with others (reproducible)
- GitHub also plays well with the Markdown language, which is what you're using for your homework assignments.
    - You can link GitHub repositories to R Projects for near seamless integration.
    - Pair GitHub and R to make websites!

(Interested? Have 4 hours to kill? I recommend looking through Alison Hill's workshop on blogdown and the tutorial prepared by Dani Cosme and Sam Chavez).

Open Science Framework (OSF.io)

- Another repository, also includes version control
  - Reproducibility
- Doesn't use code/terminal to update files
  - Drag and drop, or linked with other repository (Dropbox, Box, Google Drive, etc)
- Also great for collaborations
- Easy to navigate
- Can be paired with applications you (should) already use


NeuroVault
figshare
DRYAD
OJS
ubiquity press
VIVO
zenodo
Dataverse
Project
MENDELEY
TEX
Publish Report
Search / Discovery
Develop Idea
Design Study
Collect Data
Store Data
Analyze Data
Write Report
R
Galaxy
DMPTool
Bitbucket
GitHub
EVERNOTE
Fedora
GitLab
ownCloud
Dropbox
PsychoPy
amazon web services
box
OneDrive
Google Drive

Future

PsyArXiv

- preprint = the pre-copyedited version of your manuscript
- journals have different policies regarding what you can post. It's always a good idea to check.

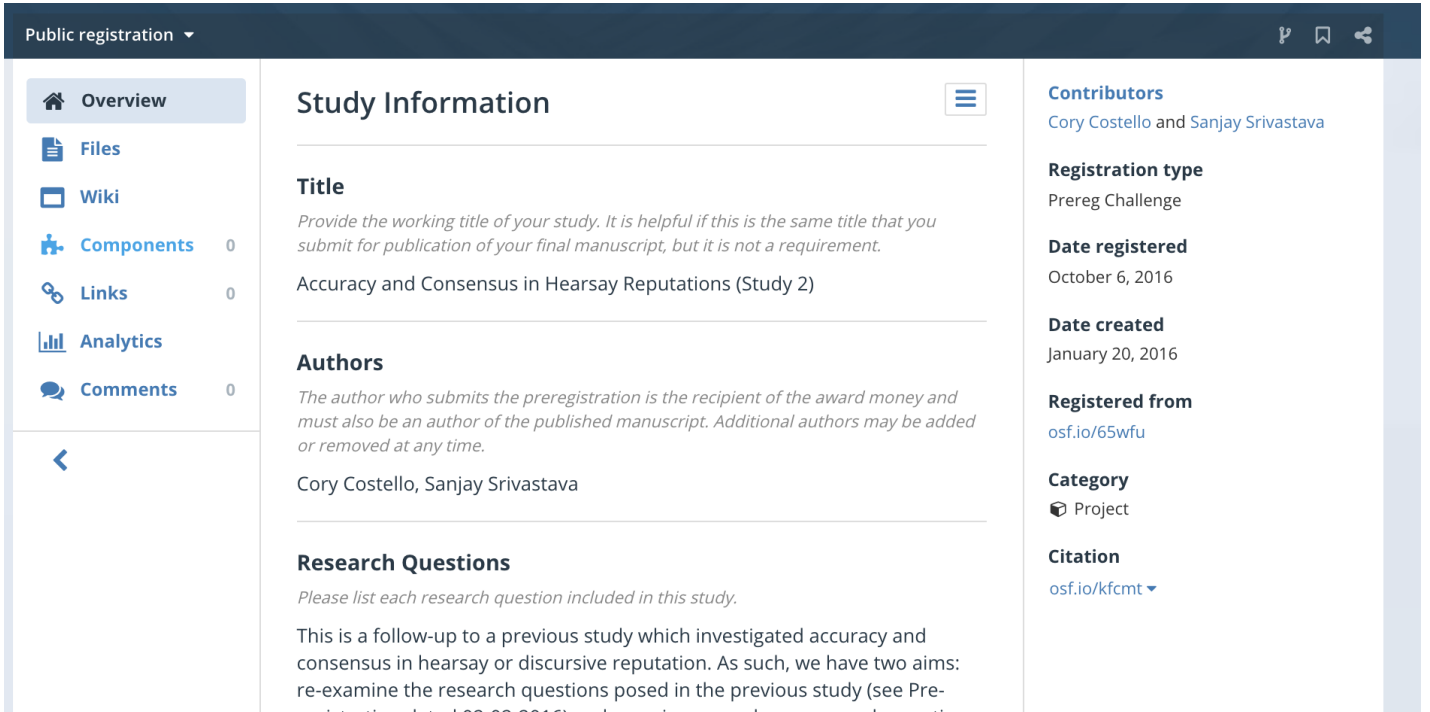
OSF connects to PsyArXiv, which is the primary preprint server for psychology

- Make your work available to the public (equity and inclusion)
- Post reports of work that can't get published (avoid the file drawer, improve everyone's work)
- Even citable in journals

Preregistration

OSF also allows you to preregister a project.

Preregistration is creating a time-stamped, publicly available, frozen document of your research plan prior to executing that plan.



Goal: deter p-hacking and harking

- Did the researcher preregister 3 outcome variables and only report one?
- Did the research *actually* believe this correlation would be significant?

Goal: distinguish data-driven choices from theory based choices

- Was some other variable included because of theory or based on descriptives?

Goal: correctly identify confirmatory and exploratory research

- Exploratory research should be OK!
- Protection against editors and reviewers

Preregistration

Misconception: Preregistration does **not** tie your hands

1. Encourage researchers to plan out analysis and choices before they see the data, and

2. Create a verifiable record of when analytic decisions were made, which will

3. Allow researchers to calibrate their confidence in results accordingly.

Preregistration also provides a check on the file-drawer problem.

Enhances the reproducibility, replicability, and transparency of research.

Preregistration

Preregistration is great. But it's not a blanket protection. **Crappy science can still be preregistered.** Really good science doesn't have to be preregistered. It's a tool in your toolbelt.

The most important aspect is **TRANSPARENCY**. That's it. It can come in the form of any of the tools we've just talked about, ideally some combination of those. It can also be a well-maintained lab notebook. As long as you are transparent, you're doing your best.

Registered reports

Registered reports (RR) are a special kind of journal article

image credit: Doropthy Bishop

Registered reports

Goal: uncouple incentive (publication) from study result

- New incentive is now doing a high-quality study

Changes the researcher's goal; also changes the reviewer's focus

- No longer evaluate whether or not result was "statistically significant" -- instead, evaluate whether this is a good test of the research question.

Many journals now allow RRs, and even RRR (registered **replication** reports)

Challenges

Some challenges with preregistration and registered reports:

- Difficult to do with longitudinal data
- Controversy over pre-existing data (secondary data analysis)
- Preregistration needs to be specific, otherwise it doesn't work

Meta-science tools

New methods of conducting science on science -- often developed to find fraud, but super useful for detecting errors

- Granularity-related inconsistency of means (GRIM) test -- is the mean mathematically possible given the sample size?
- Sample Parameter Reconstruction via Iterative TEchniques (SPRITE) -- given a set of parameters and constraints, generate lots of possible samples and examine for common sense.
- StatCheck -- upload pdfs and word documents to look for inconsistencies (e.g., statistic, df)

Science is becoming more collaborative

MIND ✓ FACT CHECKED

The Psychological Science Accelerator: Building A "CERN For Psychology"

By: Chris Chartier, Nicholas Coles and Hans IJzerman | February 5, 2019

Traditional status hierarchies are being upset. Many early career researchers have contributed to open science, even as graduate students.

Criticisms

Some argue that open science methods are broadly harmful: stifle creativity, slow down research, incentivize *ad hominem* attacks and "methodological terrorists", and encourage data parasites.

It is worth admitting that, unless incentive structures don't change, there can be harm done with adoption of these methods. But part of the goal is to change the overall system.

More legit concern: adoption of these methods can fool researchers into believing that all research using these methods is "good" and all research not using them are "bad."

Example: "Preregistration is redundant, at best." (Oct 31, 2019), Szollosi et al

Next time...

All that being said, we're still going to use NHST for most of this sequence and most of your stats journey will include NHST. 🤷

Chi-squared tests