Psychology as a Robust Science
Dr Amy Orben
Lent Term 2020

When: Lent Term 2020;
   Wednesdays 2-4pm (Weeks 0-6; 15.1.2020 – 26.2.2020),
   Mondays 2-4pm (Week 7; 2.3.2020)

Where: Lecture Theatre, Experimental Psychology Department, Downing Site

Summary: Is psychology a robust science? To answer such a question, this course will encourage you to think critically about how psychological research is conducted and how conclusions are drawn.

To enable you to truly understand how psychology functions as a science, however, this course will also need to discuss how psychologists are incentivised, how they publish and how their beliefs influence the inferences they make. By engaging with such issues, this course will probe and challenge the basic features and functions of our discipline. We will uncover multiple methodological, statistical and systematic issues that could impair the robustness of scientific claims we encounter every day. We will discuss the controversy around psychology and the replicability of its results, while learning about new initiatives that are currently reinventing the basic foundations of our field. The course will equip you with some of the basic tools necessary to conduct robust psychological research fit for the 21st century.

The course will be based on a mix of set readings, class discussions and lectures. Readings will include a diverse range of journal articles, reviews, editorials, blog posts, newspaper articles, commentaries, podcasts, videos, and tweets. No exams or papers will be set; but come along with a critical eye and a willingness to discuss some difficult and controversial issues.

Core readings

Structure
Below you will find the rough outline of each session of this course. Some sessions (e.g. the first and last) will abide by a different format.

1. Pre-session assignment – Before every session you will find an assignment in this syllabus which you should complete
2. Lecture – Introduction to the session’s topic; overview of core papers and discussions; appraisal of initial arguments
3. Discussion – Short class discussion about key questions highlighted in the lecture
4. Tea/coffee break
5. Case Study – Presentations on set pieces of work (papers, commentaries, blog posts) by members of the class
6. Discussion – Longer class discussion about themes highlighted by this week’s lecture and case studies
Overview of course structure

Week 1 – Introduction
Overview of the course contents and aims; the scientific process; Merton’s norms; the replication crisis and how it began; defining Open Science

Week 2 – Replications
Replications and why they started a crisis; understanding replications; backlash and counter-backlash; replications in other disciplines; the Many Labs movement

Week 3 – Questionable Research Practices
Defining and discussing Questionable Research Practices and their influence on scientific inference in psychology; false-positive psychology and researcher degrees of freedom; multiverse approaches

Week 4 – Preregistration and Registered Reports
Pre-registration and Registered Reports; the split between exploratory and confirmatory hypothesis testing; arguments for and against the drive towards preregistration; scientific creativity; blinded analyses

Week 5 – Fraud, Errors and Scientific Self-Correction
Understanding what makes fraud different from errors; methods used to detect errors; whether scientific self-correction is myth or reality; scientific errors and debates about how to address them

Week 6 – The Statistics Wars (+ Power)
Error Rates; Null-Hypothesis Significance Testing; \( p \)-values; power; Bayesian methods (estimation and Bayes Factors); ‘Redefine Significance’ vs ‘Justify your Alpha’

Week 7 – Journals, Publishing and Computational Reproducibility
Introduction to the for-profit publishing model; new forms of publishing; pre-prints; Open Access; peer review; Open Data and computational reproducibility

Week 8 – Psychology as a Robust Science
What makes robust inferences; triangulation and causality; theory and measurement; Psychological Science Accelerator; incentives and next steps
Week 1 – Introduction

Overview of the course contents and aims; the scientific process; Merton’s norms; the replication crisis and how it began; defining Open Science

Assignment and readings
Before coming to this lecture, please complete the following three assignments:

1. Watch the following TED talk by Naomi Oreskes, *Why we should trust scientists*, May 2014 (https://www.ted.com/talks/naomi_oreskes_why_we_should_trust_scientists?language=en)
2. Listen to the following podcast by BBC Radio 4, *Analysis: The Replication Crisis*, November 2018 (https://www.bbc.co.uk/sounds/play/m00013p9)

Core references
Merton, Robert K. ‘The Normative Structure of Science’, 1942. https://www.panarchy.org/merton/science.html. (or see this YouTube video for explanation: https://www.youtube.com/watch?v=00btFojQPiU&list=PLAKyhL4GNnqMVIdZDvSt3bqlHFJVRNOsF&index=2)


Frank, M. What is Open Science Movement (twitter thread): https://twitter.com/mcxfrank/status/1044254887075147776


Just to mention...
If you are interested in further understanding philosophy of science in relation to psychology, I would recommend

- Paul Meehl’s recorded 1989 lectures, *Philosophical Psychology* at the University of Minnesota. Find them here: http://mehl.umn.edu/talks/philosophical-psychology-1989
- To learn more about Early Career Researchers in this area, why not listen to this ReproducibiliTea podcast: https://soundcloud.com/reproducibilitea/episode-11-ivan-flis
Week 2 – Replications

Replications and why they started a crisis; understanding replications; backlash and counter-backlash; replications in other disciplines; the Many Labs movement

Assignment and readings
Before coming to this lecture, please do the following to get a better understanding of both the Open Science Collaboration and the Many Labs studies:

1. Listen to the following podcast by NPR Planet Money, *The experiment experiment* [audio podcast], January 2019 (https://www.npr.org/sections/money/2016/01/15/463237871/episode-677-the-experiment-experiment)


Case study
There will be two 5-minute presentations about key replication attempts in psychology from members of the class [no more than 4 slides]:


After a short discussion of these two high-profile non-replications, we will examine the debate about the value of direct replications by listening to two additional 5-minute presentations [no more than 2 slides] about the opinions voiced in the following commentaries from the same issue of *Perspectives in Psychological Science*:


For those interested, the following paper gives a good overview about the debate around replication, while the second one gives some suggestions about how to conduct replications in future:


Core references


The ‘Many Labs’ studies


Just to mention…
To find out more about current initiatives to look at the large-scale replicability of research, have a listen to a recent Everything Hertz podcast episode interviewing Fiona Fidler:
https://everythinghertz.com/94
Week 3 – Questionable Research Practices

Defining and discussing Questionable Research Practices and their influence on scientific inference in psychology; false-positive psychology and researcher degrees of freedom; multiverse approaches

Assignment and readings
Before coming to this lecture, please do the following assignments:


2. Read the following article by Regina Nuzzo published in Nature, How scientists fool themselves – and how they can stop, October 2015 (https://www.nature.com/news/how-scientists-fool-themselves-and-how-they-can-stop-1.18517)

3. Play around with the p-hacking simulator: https://fivethirtyeight.com/features/science-isn't-broken/

Case study
We will listen to two 10-minute presentations about two papers that further developed ideas regarding flexibility in analytical choices [no more than 4 slides]:


Core references

Gelman, A., & Loken, E. (2013). The garden of forking paths: Why multiple comparisons can be a problem, even when there is no “fishing expedition” or “p-hacking” and the research hypothesis was posited ahead of time. Unpublished manuscript. http://www.stat.columbia.edu/~gelman/research/unpublished/p_hacking.pdf


*Just to mention…*
If you are interested in trying out some multiverse approaches yourself I would recommend having a look at the following package currently being developed by Phillip Masur and Michael Scharkow: https://twitter.com/MasurPhil/status/1208084330779750400

Furthermore here are some more papers to have a look at:

Week 4 – Preregistration and Registered Reports

Pre-registration and Registered Reports; the split between exploratory and confirmatory hypothesis testing; arguments for and against the drive towards preregistration; scientific creativity; blinded analyses

Assignments and readings
For this lecture please read the following two articles:

3. Furthermore, if you are interested in learning about the experience of one of the first PhD students to write a Registered Report, I would suggest you listen to the ReproducibiliTea podcast episode interviewing Hannah Hobson: https://soundcloud.com/reproducibilitea/episode-18-hannah-hobson

Case study
There will be four short (max. 5 minute) presentations without slides. The first two presenters will prepare by reading Sophia Scott’s commentary about Registered Reports/preregistration: one will present her arguments again preregistration while the other will present possible counterarguments to her concerns. The second two presenters will prepare by reading Susan Goldin-Meadow’s APS presidential column about Registered Reports/preregistration and the comments left underneath it. Again, the first presenter will cover her arguments, while the other will cover potential counterarguments. Please note that both authors’ definitions of preregistration can be confusing and include some concepts of Registered Reports.


Core references


Just to mention…
Find a list of all journals offering Registered Reports here: https://cos.io/rr/

Also, this might be a good starting point if you are looking to write your own high-quality preregistration: Veer, Anna Elisabeth van ’t, and Roger Giner-Sorolla. ‘Pre-Registration in Social Psychology—A Discussion and Suggested Template’. *Journal of Experimental Social Psychology, Special Issue: Confirmatory*, 67 (1 November 2016): 2–12. https://doi.org/10.1016/j.jesp.2016.03.004.

If you are interested in preregistering an analysis of pre-existing data, have a look at these recent papers:


There have been recent debates about the value of preregistration both generally and in cognitive modelling specifically. These are three references for those interested in this:


If you are interested in the debate around creativity and open science, these are two great papers to start with:

Week 5 – Fraud, Errors and Scientific Self-Correction

Understanding what makes fraud different from errors; methods used to detect errors; whether scientific self-correction is myth or reality; scientific errors and debates about how to address them

Assignment and readings
I have set three newspaper and magazine articles for this week. The first gives you an insight into a ‘pizza paper’ scandal, while the other two will form the basis of our case studies this week. Please read them all carefully, especially the 2nd and 3rd piece, as they will form a crucial part of our discussion.


Case studies
Our case studies will focus on the process of pointing out scientific errors and what counts as bullying. I set two articles which you all read before coming to this session. The first is an article about Amy Cuddy who was a proponent of ‘power posing’ a concept heavily criticised for scientific errors and low-quality science. The second blog post argues against the first, making the case that criticising others’ work is not bullying. 1-2 students who have volunteered will prepare to lead and chair our discussion about error correction in science: reading the articles in detail, preparing questions, encouraging and leading the debate.

Core references
Quintana, Dan, and Heathers, James. ‘74: Seeing Double (with Elisabeth Bik)’. https://everythinghertz.com/74. (also see Elisabeth Bik’s blog: https://scienceintegritydigest.com/2019/11/23/scanning-for-duplications/)


Heathers, James (Twitter): https://twitter.com/jamesheathers/status/845696144999137280

Week 6 – The Statistics Wars (+ Power)

Error Rates; Null-Hypothesis Significance Testing; \( p \)-values; power; Bayesian methods (estimation and Bayes Factors); ‘Redefine Significance’ vs ‘Justify your Alpha’

Assignment and readings
In this lecture we will be covering the difference between Null Hypothesis Significance Testing and Bayesian methodology. Furthermore we will be examining the importance of power. To prepare for this lecture please read the following papers:


2. Please have a look over the two papers we will discuss in the case study

Case study
In the case study we will be looking at the debate between ‘Redefine Significance’ and ‘Justify Your Alpha’. Two groups of volunteers will act in a mock debate about ‘This lecture theatre believes that significance levels should be adjusted to \( p < 0.005 \)’, having prepared at least three arguments to present for their ‘side’ [no slides] reading the following papers:


Note: This is also an interesting panel session and discussion between EJ Wagenmakers (pro-Bayes/redefine statistical significance), Daniel Lakens (pro-NHST/ justify your alpha) and Simine Vazire (pro-redefine statistical significance) held in 2017 at the BITSS Annual Meeting where they went head-to-head in the ‘Redefine Statistical Significance’ vs. ‘Justify Your Alpha’ discussion (~ 1 hour): https://youtu.be/41gSVxkXMaM?t=2102

Core references


Just to mention…
If you are interested in a better understanding of some core statistical issues in psychology and how you could perform better statistical inferences I highly recommend Daniel Laken’s freely accessible Coursera course, Improving your statistical inferences: https://www.coursera.org/learn/statistical-inferences#syllabus
Due to the success of this course Daniel Lakens has now recorded a second course, *Improving your statistical questions*, which you can access here: https://www.coursera.org/learn/improving-statistical-questions

If you are interested in Bayesian methods I would recommend the following:


Lastly, if you want to learn more about R, I would recommend Wickham and Grolemund (2017), *R for Data Science*, O’Reilly. The book is available online (in full!) on the author’s website: https://r4ds.had.co.nz/

Furthermore you can look at some of the amazing *Software Carpentry* courses on R:
http://swcarpentry.github.io/r-novice-gapminder/
http://swcarpentry.github.io/r-novice-inflammation/
Week 7 – Journals, Publishing and Computational Reproducibility

Introduction to the for-profit publishing model; new forms of publishing; pre-prints; Open Access; peer review; Open Data and computational reproducibility

Assignment and readings

Case studies
We will all read the following paper, and six volunteers will present its core recommendation during the class [5 minutes each, no more than 2 slides]. Each of the volunteers will cover one of the following: data management, software, collaboration, project organization, keeping track of changes, manuscripts.


Core references


This whole issue of AMPPS has some great discussions and tutorials about data sharing:
https://journals.sagepub.com/toc/ampa/1/1


*Just to mention…*

If you are interested in learning how to use version control software I would look at this very good course from *Software Carpentry*: http://swcarpentry.github.io/git-novice/

Lastly, if you are thinking about preprinting your work, but want to make your manuscript look prettier (instead of using horrible APA formatting), have a look at Brenton Wiernik’s great Word preprint templates that liken popular journals: https://osf.io/hsv6a/

If you want to make a website for yourself:
https://twitter.com/dsquintana/status/993410504570888192
https://debruine.github.io/tutorials/webpages.html
Week 8 – Psychology as a Robust Science

What makes robust inferences; triangulation and causality; theory and measurement; Psychological Science Accelerator; incentives and next steps

Assignment and readings
This week’s assignments are a bit more extensive and challenging. If you struggle with any one of these, feel free to move on and we can discuss them in the lecture:


Case studies
This week we will all take a couple of minutes to read the blog post below in the tea break. We will then discuss and examine its claims around incentives. This will lead us into a discussion about the current incentives in the field:


Core references


*Just to mention…*

If you are interested in staying involved in the Open Science community or learning more skills here are some suggestions:

- Follow people and accounts on Twitter like APS, SIPS, PSA, Center for Open Science, Brian Nosek, Simine Vazire, Chris Chartier, Dorothy Bishop, Daniel Lakens, Anne Scheel, Katie Corker, Tal Yarkoni, EJ Wagenmakers, Marcus Munafò, Jessica Flake, Eiko Fried, Julia Rohrer, James Heathers etc.
- Do Daniel Laken’s online courses or the Open Science MOOC (https://opencours.eu)
- Listen to Podcasts like Everything Hertz, ReproducibiliTea or Black Goat Pod
- Join the Society for the Improvement of Psychological Science (SIPS) and go to the SIPS Conference
- Keep your eyes peeled for events from the UK Reproducibility Network (UKRN)
- Have a look at ReproducibiliTea and join the Cambridge journal club: reproducibilitea.org
- Don’t be worried about implementing everything at once, many people say Open Science is like a buffet where you can choose what is best for you and always go back to get more
- Email me if you have any questions, queries or ideas: aco35@cam.ac.uk

If you are interested in learning more about causality and causal claims, I would recommend the following books and papers:

Acknowledgements
I would like to thank Simine Vazire, Katie Corker, David Funder and Benjamin Le whose syllabi on the Open Science Framework both guided and inspired me (https://osf.io/vkhbt/). I also thank Marcus Munafo, Lisa DeBruine, Chris Chambers, Laura Fortunato, Dorothy Bishop, Jackie Thompson, Jon Tennant, Christina Riesenweber, Daniel Lakens, Julia Rohrer, Dominique Heinke, Kate Button, Verena Heise and Kirstie Whitaker whose slides made available on the OSF or Figshare helped influence and improve some of my lectures.