The reproducibility crisis in science

PSYCH 490.012

2024-09-06

Fall 2024 ▪ MWF 3:35-4:20 PM

The reproducibility crisis in science

Much attention has focused on the reproducibility of research in psychology, but the challenges of producing robust and reliable knowledge extend to all disciplines, not just in science. In this seminar, we will discuss whether there is or is not a reproducibility crisis in psychology and in science more broadly. We will discuss how initiatives to make scientific research more open and transparent can also make it more reproducible and robust.

Instructor

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Schedule an appointment: https://doodle.com/mm/rickgilmore/book-a-time

Lab web site: https://gilmore-lab.github.io

Teaching Assistant

Adam Calderon
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Meeting time & location

Monday, Wednesday, & Friday, 3:35 PM - 4:20 PM
Cedar Building 134

Canvas site

We will use Canvas to submit assignments and grade them. The Canvas site may be found here: https://psu.instructure.com/courses/2350148.

Most of the course content will be found on this site.

Course structure

This is a discussion-focused course. On most days we will discuss readings assigned prior to class. On many Fridays and a few Mondays, we will work together or individually on the assigned exercises, the final project, or another assignment.

Schedule

Week 1: August 26-30

Monday, August 26

Introduction to the course: Why trust science?

- Read
  - (Recommended) Oreskes (2019), Chapter 1, pp. 55-68 | PDF on Canvas.
- (Extra credit) Complete Survey 01 on Trust in Science and Scientists
- Class notes

> **Tip**
>
> To earn 3 extra credit points for completing the survey, send the TA one of the following:
>
> 1. The date and time you completed the survey in the following format: "7/30/2024 12:20:23"
> 2. A special code or phrase that is likely to be unique to you but doesn't contain identifiable information.

Wednesday, August 28

- Wrap up on "Why trust science"

Don't Fool Yourself

- Read
  - Feynman (1974)
  - (Recommended) Sagan (1996), Chapter 12, The Fine Art of Baloney Detection. PDF on Canvas
- Class notes

Friday, August 30

Work Session: How to read a scientific paper

- Read
  - Carey, Steiner, and Petri (2020)
  - Ruben (2016) (for fun)
- Assignment
  - Exercise 01: Reading a scientific paper
- Class notes

Week 2: September 2-6

Monday, September 02

NO CLASS, LABOR DAY

Wednesday, September 04

How science works (or should)

- Read
  - Ritchie (2020), Chapter 1. Alternate link to PDF on Canvas.
  - 1. Alternate link to PDF on Canvas
- Assignment
  - Complete (anonymous, extra credit) survey on scientific norms and counter-norms. **No write-up**.
- Class notes

Friday, September 06

Work Session: Reading a paper; Evaluating its claims

- Due
  - Exercise 01: Reading a scientific paper
- Assignment
  - Exercise 02: Textbook Findings, due Friday, September 20
- Class notes, due

Week 3: September 9-13

Monday, September 09

Scientific norms and counter-norms

- Read
  - 2. PDF on Canvas.
  - 3. PDF on Canvas.
- Assignment
  - Complete (anonymous) survey on scientific norms and counter-norms. **No write-up**.
- Class notes

Wednesday, September 11

Adherence to norms and counter-norms

- Read
  - Kardash and Edwards (2012)
  - Macfarlane and Cheng (2008)
- Class notes

Friday, September 13

Work session: Norms and counter-norms

- Survey 02: From raw data to results
- Assignment
  - Exercise 03: Norms and counter-norms, due Friday, September 27
- Class notes

Week 4: September 16-20

Monday, September 16

A replication crisis (or not)

- Read
  - Ritchie (2020), Chapter 2. PDF on Canvas.
  - 4.
- Class notes

Wednesday, September 18

Replication attempt: The "Lady Macbeth Effect"

- Read
  - Zhong and Liljenquist (2006)
  - Earp et al. (2014)
- Class notes

Friday, September 20

Wrap-up on 'Macbeth effect' replication

- Read
  - Earp et al. (2014)
- Due
  - Exercise 02: Textbook Findings
- Class notes

Week 5: September 23-27

Monday, September 23

Priming effect: Original study

- Read
  - Bargh, Chen, and Burrows (1996); PDF on Canvas
- Class notes

Wednesday, September 25

Priming effect: Replication study

- Read
  - Doyen et al. (2012)
  - review Bargh, Chen, and Burrows (1996); PDF on Canvas
- Class notes

Friday, September 27

Work session: Scientific integrity & Final project proposals

- Assignment
  - Exercise 04: Violations of scientific integrity, due Friday, October 4
  - Final project proposals, due Friday, October 18.
- Due
  - Exercise 03: Norms and counter-norms write-up
- Class notes

Week 6: September 30 - October 4

Monday, September 30

Mind your p's

- Read
  - Denworth (2019)
- Class notes

Wednesday, October 02

Fraud & misconduct

- Read
  - Ritchie (2020), Chapter 3
  - Bhattacharjee (2013), PDF on Canvas
  - (Skim) Levelt, Drenth, and Noort (2012)
  - (Skim) Carpenter (2012)
- Class notes

Friday, October 04

Work session: P-hacking & Final project proposals

- Due
  - Exercise 04: Violations of scientific integrity
- Assignment
  - Exercise 05: P-hack your way to scientific glory write-up.
- Work session
  - Final project proposals, due Friday, October 18.
- Class notes

Week 7: October 7-11

Monday, October 07

Retraction and scientific integrity

On Zoom: https://psu.zoom.us/my/rogilmore. Check-in for attendance. Join from anywhere convenient to you.

- Read
  - Brainerd and You (2018)
- Class notes

Wednesday, October 09

NO CLASS

Friday, October 11

Questionable research practices

- Read
  - Simmons, Nelson, and Simonsohn (2011)
- Watch
  - Ngiam (2020)
- Bring
  - Draft Exercise 05: P-hack your way to scientific glory for discussion.
- Class notes

Week 8: October 14-18

Monday, October 14

Work Session: P-hacking and Final Project Proposals

- Due
  - Exercise 05: P-hack your way to scientific glory write-up.
- Work session
  - Final project proposals, due Friday, October 18.
- Class notes

Wednesday, October 16

Prevalence of QRPs

- Read
  - John, Loewenstein, and Prelec (2012)
- Class notes

Friday, October 18

File drawer effect & Work Session: Alpha, Power, Effect Sizes, & Sample Size

- Read
  - (Skim) Rosenthal (1979). PDF on Canvas
  - (Optional) Franco, Malhotra, and Simonovits (2014)
- Assignment
  - Exercise 06: Alpha, Power, Effect Sizes, & Sample Size, final version due Wednesday, October 30
- Due
  - Final project proposal
- Class notes
- Self Test 01

Week 9: October 21-25

Monday, October 21

Negligence

- Read
  - Nuijten et al. (2015)
  - (skim) Szucs and Ioannidis (2017)
- Class notes

Wednesday, October 23

Hype

- Watch & discuss
  - Cuddy (2012)
- Read
  - Carney, Cuddy, and Yap (2010), file on Canvas
  - (Optional) Ranehill et al. (2015), file on Canvas
- Class notes

Friday, October 25

Hype, continued

- Discuss Cuddy (2012), Carney, Cuddy, and Yap (2010), and Ranehill et al. (2015)

Work session: Alpha, Power, Effect Sizes, & Sample Size & Replication

- Discuss draft
  - Exercise 06: Alpha, Power, Effect Sizes, & Sample Size write-up
- Assignment
  - Exercise 07: Replication, due Friday, November 8
- Class notes

Week 10: October 28 - November 1

Monday, October 28

Solutions

- Read
  - Munafò et al. (2017)
  - Begley (2013)
- Class notes

Wednesday, October 30

Changing journal policies

- Read
  - B. A. Nosek et al. (2015)
  - Gilmore et al. (2020)
  - SRCD (2019)
- Class notes
- Final version due
  - Exercise 06: Alpha, Power, Effect Sizes, & Sample Size write-up

Friday, November 01

Large-scale replication studies

- Read
  - Collaboration (2015)
- Class notes
- Complete (extra credit)
  - Questionnaire based on Chopik et al. (2018).

Work Session: Final Projects

Week 11: November 4-8

Monday, November 04

Meta-analysis

- Read
  - Wilson (2014)
- Class notes

Wednesday, November 06

Many analysts

- Read
  - Silberzahn et al. (2018)
- Class notes

Friday, November 08

Work Session: Final Projects

- Due
  - Exercise 07: Replication
- Class notes

Week 12: November 11-15

Monday, November 11

Preregistration

- Read
  - Brian A. Nosek et al. (2018)
  - Ledgerwood (2018) or Goldin-Meadow (2016)
  - (Optional) Claesen et al. (2021)
- Explore
  - clinicaltrials.gov
- Class notes

Wednesday, November 13

Data sharing

- Read
  - Houtkoop et al. (2018)
  - Tenopir et al. (2020)
  - (Optional) Gilmore and Adolph (2017)
  - (Optional) Meyer (2018)
  - (Optional) National Institutes of Health (n.d.)
- Class notes

Friday, November 15

Work Session: Final Projects

- Final project survey
  - Please complete the final project survey by Friday, November 22
- Class notes

Week 13: November 18-22

Monday, November 18

Materials, code, & protocol sharing

- Read
  - Soska et al. (2021)
  - Gilroy and Kaplan (2019)
- Explore
  - protocols.io
  - Journal of Visualized Experiments (JOVE)
- Class notes

Wednesday, November 20

Open science tools

- Read
  - Kathawalla, Silverstein, and Syed (2021)
  - Chopik et al. (2018)
  - (Optional) Crüwell et al. (2019)
- Explore
  - "FORRT - Framework for Open and Reproducible Research Training" (n.d.)
- Complete (optional)
  - Questionnaire based on Chopik et al. (2018). Results are here.
- Class notes

Friday, November 22

Work session: Data sharing & Final Projects

- **Hybrid session**: In-person and on Zoom (https://psu.zoom.us/my/rogilmore)
- Assignment distributed
  - Exercise 08: Data and materials sharing
- Final project survey
- Class notes

November 25-29 *Thanksgiving Break*

Week 14: December 2-6

Monday, December 2

In-class final project work day

- Class notes

Wednesday, December 4

In-class final project work day

- Class notes

Friday, December 6

Project presentations

- Schedule
- Assignment Due
  - Exercise 08: Data and materials sharing
- Class notes

Week 15: December 9-13

Monday, December 9

Project presentations

- Schedule
- Class notes

Wednesday, December 11

Project presentations

- Schedule
- Class notes

Friday, December 13

Our open science future

- Class notes

Finals Week: December 16-20

Wednesday, December 18

- Due
  - Final project write-ups due 5:00 PM.

Student Evaluation

Elements

Component	Description	Points
Attendance	You will receive 1 point for each class you attend up to a maximum of 40.	40
Exercises	There will be eight (8) exercises that you must work on. Each exercise is worth 10 points. The top four (4) count toward your final grade.	40
Final project	You will complete a final project, either on your own, or with a small group of 3 or less. Your final project is worth 40 points.	40
	TOTAL POINTS POSSIBLE	120
Extra Credit	If you submit more than four exercise write-ups, you may earn up to 10 extra credit points.	

Grading Scheme

Percent	Points	Grade
94+	113	A
90-93	108-112	A-
87-89	104-107	B+
84-86	100-103	B
80-83	96-99	B-
77-79	92-95	C+

Percent	Points	Grade
70-76	84-91	C
60-69	72-93	D
<59	<=71	F

Important deadlines

This page summarizes some of the key deadlines in the course.

Date	What's due/happening
2024-09-06	Exercise 01
2024-09-20	Exercise 02
2024-09-20	Exercise 03
2024-10-04	Exercise 04
2024-10-14	Exercise 05
2024-10-18	Final project proposal due
2024-11-01	Exercise 06
2024-11-08	Exercise 07
2024-11-22	Final Project Presentation Schedule Survey
2024-12-06	Exercise 08
2024-12-18	Final project writeup due

Course policies

Academic Integrity

Students with questions about academic integrity should visit http://www.la.psu.edu/current-students/undergraduate-students/education/academic-integrity.

Penn State defines academic integrity as the pursuit of scholarly activity in an open, honest and responsible manner. All students should act with personal integrity, respect others dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts (Faculty Senate Policy 49-20). Sanctions for academic misconduct can include a grade of F for the course as well as other penalties.

Unless you are told otherwise, you must complete all course work entirely on your own, using only sources that have been permitted by your instructor, and you may not assist other students with papers, quizzes, exams, or other assessments. If I allow you to use ideas, images, or word phrases created by another person (e.g., from Course Hero or Chegg) or by generative technology, such as ChatGPT, you must identify their source.

When you complete assignments, remember the **ABC**s to avoid plagiarism: **A**lways place copied information within quotation marks, include information about the quoted or paraphrased source in a **B**ibliography, and **C**ite the source in the body (in the text) of your paper immediately after the quoted or paraphrased information. When in doubt, cite in the text and include the source in a bibliography.

Students with questions about academic integrity should ask me or the TA before submitting work.

Students facing allegations of academic misconduct may not drop/withdraw from the affected course unless they are cleared of wrongdoing (see G-9: Academic Integrity). Attempted drops will be prevented or reversed, and students will be expected to complete course work and meet course deadlines. Students who are found responsible for academic integrity violations face academic outcomes, which can be severe, and put themselves at jeopardy for other outcomes which may include ineligibility for Dean's List, pass/fail elections, and grade forgiveness. Students may also face consequences from their home/major program and/or The Schreyer Honors College.

Absences or late assignments

Absence from class

Your absence from class may be excused under unusual circumstances such as (a) an interview for graduate school or a job, (b) illness, (c) religious observance, (d) the death of a family member, or (e) any other event recognized by the university as a valid excuse for absence from class.

If you must miss class, you must contact the instructor and the TA **in advance**.

Up to three (3) excused absences will be permitted.

Late exercises

Exercises submitted after the published deadlines will not be eligible for full credit unless the instructor has given specific permission.

Late final projects

Final projects submitted after the published deadline will not be eligible for full credit unless the instructor has given specific permission.

Accommodation for persons with disabilities

Penn State welcomes students with disabilities into the University's educational programs. Please refer to the information provided by Student Disability Resources (SDR) at http://equity.psu.edu/student-disability-resources/ for information about the procedures required to obtain reasonable accommodations in this course. Students should discussSDR-approved accommodations with their instructor as early in the semester as possible, even if they have taken another course with the instructor. Please note: students are not required to provide their instructor with information about the nature of their condition.

Penn State students are also welcome to contact other units for assistance with personal concerns that interfere with academic progress, including: Counseling and Psychological Services (CAPS; http://studentaffairs.psu.edu/counseling/), the Office of Student Affairs (http://studentaffairs.psu.edu/), Career Services (http://studentaffairs.psu.edu/career/), the Center for Women Students (http://studentaffairs.psu.edu/womenscenter/), the LGBTQA Student Resource Center (http://studentaffairs.psu.edu/lgbtqa/), the Office of Sexual Misconduct Prevention and Response (http://titleix.psu.edu/), Penn State Educational Equity (http://equity.psu.edu/), the Multicultural Resource Center (http://equity.psu.edu/mrc), and University Health Services (http://studentaffairs.psu.edu/health/).

Nondiscrimination Statement

The Pennsylvania State University is committed to equal access to programs, facilities, admission and employment for all persons. It is the policy of the University to maintain an environment free of harassment and free of discrimination against any person because of age, race, color, ancestry, national origin, religion, creed, service in the uniformed services (as defined in state and federal law), veteran status, sex, sexual orientation, marital or family status, pregnancy, pregnancy-related conditions, physical or mental disability, gender, perceived gender, gender identity, genetic information or political ideas.
Discriminatory conduct and harassment, as well as sexual misconduct and relationship violence, violates the dignity of individuals, impedes the realization of the University's educational mission, and will not be tolerated.

Direct all inquiries regarding the nondiscrimination policy to:

Dr. Kenneth Lehrman III Vice Provost for Affirmative Action Affirmative Action Office The Pennsylvania State University 328 Boucke Building University Park, PA 16802-5901 Email: kfl2@psu.edu Tel (814) 863-0471

Diversity Statement

This classroom is a place where you will be treated with respect. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other

member of the class.
Penn State is committed to creating an educational environment which is free from intolerance directed toward individuals or groups and strives to create and maintain an environment that fosters respect for others as stated in Policy AD29 Statement on Intolerance.

Mandated Reporting Statement

Penn State's policies require me, as a faculty member, to share information about incidents of sex-based discrimination and harassment (discrimination, harassment, sexual harassment, sexual misconduct, dating violence, domestic violence, stalking, and retaliation) with Penn State's Title IX coordinator or deputy coordinators, regardless of whether the incidents are stated to me in person or shared by students as part of their coursework. For more information regarding the University's policies and procedures for responding to reports of sexual or gender-based harassment or misconduct, please visit http://titleix.psu.edu.

Additionally, I am required to make a report on any reasonable suspicion of child abuse in accordance with the Pennsylvania Child Protective Services Law.

Zoom

At some point in the semester, I may decide to use Zoom to allow students who are unable to attend class in person to participate.

While you are on Zoom, keep in mind that this is a classroom environment and others should be treated with respect. Please keep your microphone muted unless you want to ask a question or interact with someone. If your microphone is not muted, the entire class will be able to hear what is going on in your environment. As an instructor, I personally like to see people's faces. As a participant, I am more involved when I have my camera on. I realize, however, that there are many reasons why you might not want to turn on your camera such as poor internet connection, joining via phone, or other privacy concerns. It is your choice as to whether you would like to have the camera on or not.

Values

Penn State Principles

The Pennsylvania State University is a community dedicated to personal and academic excellence. The Penn State Principles were developed to embody the values that we hope our students, faculty, staff, administration, and alumni possess. At the same time, the University is strongly committed to freedom of expression. Consequently, these Principles do not constitute University policy and are not intended to interfere in any way with an individual's academic or personal freedoms. We hope, however, that individuals will voluntarily endorse

these common principles, thereby contributing to the traditions and scholarly heritage left by those who preceded them, and will thus leave Penn State a better place for those who follow.

I will respect the dignity of all individuals within the Penn State community. The University is committed to creating and maintaining an educational environment that respects the right of all individuals to participate fully in the community. Actions motivated by hate, prejudice, or intolerance violate this principle. I will not engage in any behaviors that compromise or demean the dignity of individuals or groups, including intimidation, stalking, harassment, discrimination, taunting, ridiculing, insulting, or acts of violence. I will demonstrate respect for others by striving to learn from differences between people, ideas, and opinions and by avoiding behaviors that inhibit the ability of other community members to feel safe or welcome as they pursue their academic goals.

I will practice academic integrity. Academic integrity is a basic guiding principle for all academic activity at Penn State University, allowing the pursuit of scholarly activity in an open, honest, and responsible manner. In accordance with the University Code of Conduct, I will practice integrity in regard to all academic assignments. I will not engage in or tolerate acts of falsification, misrepresentation or deception because such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others.

I will demonstrate social and personal responsibility. The University is a community that promotes learning; any behaviors that are inconsistent with that goal are unacceptable. Irresponsible behaviors, including alcohol or drug abuse and the use of violence against people or property, undermine the educational climate by threatening the physical and mental health of members of the community. I will exercise personal responsibility for my actions and I will make sure that my actions do not interfere with the academic and social environment of the University. I will maintain a high standard of behavior by adhering to the Code of Conduct and respecting the rights of others.

I will be responsible for my own academic progress and agree to comply with all University policies. The University allows students to identify and achieve their academic goals by providing the information needed to plan the chosen program of study and the necessary educational opportunities, but students assume final responsibility for course scheduling, program planning, and the successful completion of graduation requirements. I will be responsible for seeking the academic and career information needed to meet my educational goals by becoming knowledgeable about the relevant policies, procedures, and rules of the University and academic program, by consulting and meeting with my adviser, and by successfully completing all of the requirements for graduation.

Penn State Values

Integrity: We act with integrity and honesty in accordance with the highest academic, professional, and ethical standards.

Respect: We respect and honor the dignity of each person, embrace civil discourse, and foster a diverse and inclusive community.

Responsibility: We act responsibly, and we are accountable for our decisions, actions, and their consequences.

Discovery: We seek and create new knowledge and understanding, and foster creativity and innovation, for the benefit of our communities, society, and the environment.

Excellence: We strive for excellence in all our endeavors as individuals, an institution, and a leader in higher education.

Community: We work together for the betterment of our University, the communities we serve, and the world.

References

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