

Psychology 2150
Principles of Experimental Design
Spring 2023
MWF 11:15 – 12:05 pm
Wilson Hall, Room 126

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Office Hours: The Teaching Assistants and Prof Polyn will hold weekly office hours, check Brightspace for their regular time slots. Meetings can also be made by appointment. Email to arrange a meeting outside of the regular time slot.

Course Summary: Knowledge acquired through scientific research is bounded by the conditions under which the research is carried out. Consequently, consumers of information must understand how scientific research is conducted in order to determine the extent to which the information is useful. This course provides an introduction to research methods in psychological science, experimental design, and data interpretation. Students will be trained to be critical – but not cynical – consumers of scientific results and learn to distinguish sound conclusions from those based on flawed research. Students in this course will gain real research experience by working in groups to design and conduct experiments of their own, present their results as a group, and write up the results individually in a research paper following the guidelines of the American Psychological Association (i.e., in APA style).

Course Objectives:

1. Learn how to turn an idea about people into an experiment in psychological science
2. Learn the importance of experimental design for validity and generalizability
3. Learn the strengths and weaknesses of several different styles of experimental design
4. Learn to use professional software to implement experiments and collect data
5. Learn how to follow the national ethical guidelines while conducting experiments
6. Learn how to write a scientific report in APA style

COURSE INFORMATION

Course Online Resources: All course information for PSY 2150 will be posted on Brightspace. Please log in to Brightspace frequently. We will post class announcements on Brightspace instead of by email.

Research tools: For this course, students will work in groups to implement experiments using online tools for data collection. We will be using a tool called REDCap. Because this is a fully online tool, the only software needed is a web browser. We will discuss, in detail, how to use the tool to create online experiments. To learn more, see:

<https://redcap.vanderbilt.edu/>

You will need to use other software for the class as well. Data organization and analysis will be demonstrated with JASP (<https://jasp-stats.org/>), though students may use any software of their own choice (e.g. SPSS, R, Stata). Group work will be conducted with Google Docs.

Other resources will be introduced as needed. For example, Prof. Polyn may create a Discord server to facilitate in-class questions and discussion. He may also create a Piazza discussion board to facilitate communications between students and Teaching Assistants about project-related questions.

File Format for Assignments: Completed assignments should be submitted through Brightspace in **PDF format**. If you are having trouble reading or creating these files, please ask a teaching assistant for help.

Course Readings

Required: RM = *Research Methods in Psychology*, 4th Edition (2018), B. Morling

ISBN: 978-0-393-893700

Available through Vanderbilt University Bookstore (Follett)

NOTE: The 3rd edition is acceptable but page ranges will not always match.

The 1st and 2nd editions are not recommended.

Optional: APA = *Publication Manual of the American Psychological Association*, 5th Edition

NOTE: The 6th edition is also acceptable.

PDF Required Reading: These articles are available on Brightspace as PDF files to download.

If you would like a paper copy of any of these readings, just ask the instructor or a TA.

Irie, N. & Hasegawa, T. (2012). Summation by Asian Elephants (*Elephas maximus*). *Behavioral Sciences*, 2, 50-56. Read pages 52 & 53 only (Methods section).

Lipton, P. (2005). Testing Hypotheses: Prediction and Prejudice. *Science*, 307, p. 219-221.

Lindsay (2015). Replication in Psychological Science, *Psychological Science*, 261, 1827-1832.

PDF Optional Reading:

APA Ethical Principles of Psychologists and Code of Conduct 2002, p. 1-16.

Open Science Collaboration. (2015). Estimating the reproducibility of psychological science. *Science*, 349, 943

Video Required Viewing:

Some videos will be required material for class. Before class, watch the video and take notes on the content so that you can contribute to class discussion.

The video URLs will be linked on Brightspace under Content/Lectures.

Optional Readings: The course website has links to other readings and websites that have interesting and relevant material. This content is not required material for the course.

GRADING POLICIES

Enrollment represents your acknowledgment and acceptance of the following non-negotiable grading policies
Vanderbilt's Honor Code governs all work in this course

Assignment of Grades. Students earn points with each part of the course as follows:

Exam 1	10 pts	
Exam 2	30 pts	
Exam 3	30 pts	Exams are cumulative
Problem Sets	20 pts (5 pts each)	
Skills Workshops	20 pts (5 pts each)	
Project Writing Assignments	20 pts (10 pts each)	
Project Group Assignments	10 pts (5 pts each)	
Project Research Report	40 pts	
Project Peer Evaluation	10 pts	
Attendance	10 pts	

Total Points	200 points maximum	

NOTE THAT THERE IS NO FINAL EXAM IN THIS COURSE

Final grades are based on the total points earned throughout the semester. The 200 points are converted to a percentage score with letter grades assigned using a distribution similar to the one shown below:

A	92.5–100%	C	72.5–77.5%
A-	90.0–92.5%	C-	70.0–72.5%
B+	87.5–90.0%	D+	67.5–70.0%
B	82.5–87.5%	D	62.5–67.5%
B-	80–82.5%	D-	60.0–62.5%
C+	77.5–80.0%	F	0–60.0%

Examinations (70 points). Exams will be administered through Brightspace during class time on an exam day. Exams are open-book and open-note. All examinations will cover material from lectures, demonstrations, videos, and the required readings. The exams will consist of multiple-choice items, phrases/concepts requiring brief definitions, and short essays. Expect that some of the exam questions may require you to integrate and reason flexibly about material from the lectures and the readings.

Missed Exams. In cases of missed exams, students must contact Prof. Polyn within 24 hours of the exam date to request a make-up exam. The specific time of a make-up exam is at Prof. Polyn's discretion. Any exam that is missed and not made up after 1 week from the exam date will be given zero points.

Problem sets (20 points) and Writing Assignments (20 points). They must be saved as a PDF file and uploaded with the appropriate link on Brightspace. At the top the first page, put your name, "PSY2150" and for group work, your group's letter or number. If there is an upload error, please print out your assignment and submit the paper copy in class. Although many aspects of the course are conducted in groups, problem sets and writing assignments are **individual work**, not group work. Students may not share answers or any written material in these assignments. All homework is governed by the Vanderbilt Honor Code.

Late Assignment Policy. Late assignments will be penalized 20% if not submitted by the time class starts, plus additional 20% with every 24-hours late (including weekend days). For example, an assignment due on Monday that is worth 5 points, submitted on Monday after class starts and any time before 11:05am on Tuesday, would be given 1-point deduction. Submissions between 11:05am Tuesday and 11:05am Wednesday would be given a 2-point deduction. No points will be given to assignments submitted 6 days late. Submit late assignments by uploading on Brightspace. If the upload fails, submit a paper copy to Prof. Polyn in class. Emailed assignments will not be accepted.

Attendance (10 points). This class requires a considerable amount of group work and coordination with the course instructors on the group projects. Attendance in class is important to maintain appropriate communication on these projects. In person discussion of ideas is essential. Please prioritize class time as a time to get work done in the classroom. However, please do not come to class if you are experiencing symptoms of illness (i.e., congestion, cough, headache, fever, nausea). If you are experiencing minor symptoms of illness, please wear a mask to class. Students may inform Prof. Polyn of an absence by email before class. A doctor's note or Dean's note is not required (and will not be accepted). Students with athletics, job interviews, or other conflicts should also inform Prof. Polyn by email. Please, also, let your group members know when you will be absent. Attendance will not be taken every class session. Attendance will always be taken on group-work days, and will sometimes be taken on other class days. A half point (0.5 points) will be deducted for an unexcused class absence on days when attendance is taken.

Information for Students with Physical or Learning Disabilities. If you need course accommodations due to a disability, if an emergency medical condition arises, or if you need special arrangements in case the building must be evacuated, please make an appointment with Prof. Polyn within the first week of classes to discuss your needs. Also, you should contact the Student Access office (SA). The SA typically handles arrangements for students with physical or learning disabilities to take examinations under appropriate conditions. See <https://www.vanderbilt.edu/student-access/>

Extra Credit. You can earn a *maximum of three extra-credit points* by submitting written summaries from either participating in a psychology experiment or attending a psychology research talk. Each summary can earn 1 point. See Brightspace: Extra Credit for more information about the Extra Credit Policy. There are two options for extra credit:

Experiment Participation: You can earn extra credit by participating in an experiment and writing a short summary of the study. You can get information about the experiments and get access to the sign-up system (SONA) at: <http://sitemason.vanderbilt.edu/psychology/subjectpool> Only experiments that offer SONA credits can count for extra credit. You will need to create an account and fill out a simple screening for inclusion/exclusion in certain experiments. Note that extra credit points for this course are counted in terms of the number of summaries written and not counted in hours. It doesn't matter how long the experiment takes – whether it is half hour, an hour or two hours – you'll write one summary to earn 1 point. Summaries are expected to describe the experiment in terms of what has been covered in the course material – *that is, we will expect more detailed summaries from you later in the semester.* See Brightspace for more details.

Attend a Research Talk: Throughout the semester, there will be many research talks around campus on some aspect of psychology. To earn one point of extra credit, you can attend a talk and write up a brief, well-articulated summary of what you learned. Upcoming talks are announced on the Psychological Sciences webpage in the Events Calendar. Some of the talks may be quite technical and the research topic may be a bit esoteric, so you should not expect to understand many of the details. Write a brief summary (1-2 pages) of the research and then feel free to comment on any aspects of the talk that you found interesting or confusing. Keep in mind that the intended audiences for many of these talks are professors and research scientists, not

undergraduate students. We will not be grading you on how accurately you portrayed the content of the talk, but on how well you are able to articulate what you learned by attending the talk. We will expect written summaries to reflect what has been taught about experimental design in the course – *that is, we will expect more detailed summaries later in the semester.* See Brightspace for more details.

You cannot double-count experiment participation or attending a research talk in more than one class. Submitting the same work to two classes is a violation of the Vanderbilt Honor Code.

GROUP WORK AND GROUP PROJECT

Overview. There are two kinds of group work in PSY 2150: Skills workshops (mostly during the first half of the semester) and the group experiment project (mostly during the second half of the semester). The Skills workshops are (usually) contained to a single class session and involve working together with a small group of your classmates on an interactive assignment designed to give you some hands-on experience on some aspect of experimental design or some helpful tool for analyzing data.

The group experiment project is a major component of the course. This project will require you to work with small groups of your fellow students to plan, implement, and carry out a psychological experiment of your own design. Several class days during the semester will be devoted to planning elements of the experiment with your group. See classes marked “**Project**” on the course calendar. These will not be sufficient for you to complete all the group work, however, so group meetings outside class will also be necessary. The group experiment project culminates with *each individual student* turning in a Research Report, which is a paper describing the experiment written according to APA manuscript guidelines. In other words, you design and carry out the experiment together, but write it up separately. The rest of these headings give more detail about the group experiment project.

Research Topic. Your research project will investigate an idea created by yourself or a fellow student. As a class, we will brainstorm several ideas, spanning across several domains of psychology from perception to personality.

Limitations. There will be restrictions on the types of experiments that will be allowed, because of technical, ethical and practical constraints. For example, there are certain kinds of experimental manipulations that would require obtaining approval from the Institutional Review Board for the Protection of Human Subjects, thereby making such experiments entirely off limits. These restrictions exclude experiments that involve the consumption of any illegal or potentially dangerous substance, such as drugs or alcohol, any audio or video recording of participants, manipulations that involve any deception, such as lying to or withholding certain information from participants. In addition, your research project must test healthy adult volunteers; not animals, nor special populations (e.g., children, the elderly, or medical patients).

Research Groups. We will generate a list of psychology experiments based on class discussions. We will ask you to give us a rank ordering of the experiments that you might like to research. From the rankings, we will form research groups based on common interests. It might be possible to coordinate your rankings to be more likely to be placed in groups with friends. We encourage you not to do this! You may learn more from others with different perspectives. Given the constraints of figuring out these groups, typically, less than half the class gets their first choice, about a third get their second choice and some get their third or fourth choice. But hopefully you are interested in enough of the experiments that these are all good outcomes! Make your rankings based on your interest in the

topics. If you have concerns about any members of your research group, you should talk with the instructor or one of the teaching assistants as soon as possible.

Group Advisor. The class instructor and teaching assistants will serve as your group's advisors throughout the semester. We will meet with groups from time-to-time during class, as well as schedule meetings outside of class, when needed.

Group Assignments (10 points; 5 points each). Twice during the term homework will be assigned related to the group projects. Note that these assignments are interleaved with, rather than serially assigned with, other assignments, so you may have a Problem Set and a Group Assignment due the same week. For these two assignments, each group will submit one assignment for all group members.

Project Research Report (40 points). The research report is the largest single piece of work you will be responsible for. Although this Project is planned and executed as a group endeavor, the Research Report **must be written individually**. Consulting with your fellow group members is encouraged, but all the written work must be your own. See the Vanderbilt Honor Code on plagiarism for more specifics about differentiating your work from others in your group and ask Prof. Polyn if you need guidance. These papers will be written in APA style, which will be described in class and in the readings. Research Reports are due the last day of classes.

Draft version: You will have the opportunity to submit a draft of the whole paper to receive comments and suggestions for improving the paper. Drafts will only be accepted if they are submitted by the draft deadline and are complete drafts. Partial drafts will not be accepted. Drafts themselves do not contribute to your grade, so they are optional. However, students who submit drafts often get better grades on their Research Reports than ones who do not, because they had the opportunity to get feedback about their Research Report. Only one draft per student will be accepted. Students who miss the draft deadline may bring a draft to class for discussion with the TAs and fellow students in class.

Group Peer Evaluations (10 points). At the end of the group experiment project, we will ask you to grade the other members of your groups on their cooperation, quality of ideas, effort, and reliability. We will talk with groups several times to detect problems during in the semester – if a group member is not contributing to a project, please let us know as soon as possible so that we can work out a solution that is satisfactory to everyone. In addition, your group advisor (TA) will assign each student a grade based on the quality of interactions during group meetings in class, the ability to reach goals and meet project deadlines, the ability to maintain professional discourse within the group, and a general evaluation of the quality of the group portion of the research project. The group advisor's grade will be combined with the grades assigned by the other group members to determine each student's Group Peer Evaluation grade. It is not possible to participate in group discussions if you are not in class or do not attend meetings outside of class. Regularly missing group meetings in class and outside of class can adversely affect your peer evaluations. Group work is a substantial component of the class.

COURSE TOPIC OVERVIEW

This is not a comprehensive listing of course coverage, but it will give you a good idea of what topics we will cover. See Brightspace for detailed information about the course calendar.

Introduction to the course. Overview of the contents of the course, including the research project.

Reading:

PDF: PSY 2150 Information about Statistics Prerequisite

RM Chapter 1, *Psychology is a Way of Thinking*

Optional Reading:

Review RM appendix sections, *Statistics Review*, p. 457–504

Importance of being a critical consumer of information. Why should we believe scientists? Producers and Consumers of Research. Experience vs Evidence. Theories and hypotheses. The Structure of True Experiments

Reading:

RM Chapter 2, *Sources of Information*, p. 25–38

Video: Why we should believe in science, TED talk by Naomi Oreskes

The Publication Process. Evaluating sources of scientific research. Navigating online publications. How to find and evaluate scientific articles.

Reading:

RM Chapter 2, *Finding and Reading Research*, p. 39–53

RM “Presenting Results”, p. 523–528, APA Style and “Introduction”

Introduction to REDCap; How to use REDCap to make a survey

Video: REDCap: Summary of Basic Features and Functionality

Defining Variables; Frequency, Association and Causal Claims; Operational definitions

Readings:

RM Chapter 3: *Three Claims, Four Validities*, p. 54–66

Four Big Validities: Construct, Internal, External, and Statistical; Prioritizing validities; Writing a research hypothesis and Methods section

Readings:

RM Chapter 3: *Three Claims, Four Validities*, p. 66–85

RM “Presenting Results”, p. 529–531 “Method”

How are scientific theories tested? Prediction versus accommodation. Operational Definitions for surveys; Formats; Well-Worded Questions

Readings:

PDF: Lipton, P. (2005). Testing Hypotheses: Prediction and Prejudice. *Science*, 307, p. 219-221.

RM Chapter 6, *Surveys and Observations: Describing What People Do*

Pages 153–165 only, “Construct Validity of Surveys and Polls”

History of Ethical Violations; Ethical Principles; Guidelines for Psychologists; How to pass the CITI online course on the protection of human participants

Readings:

RM Chapter 4: *Ethical Guidelines for Psychology Research*, p. 89–115

Optional: APA Code of Conduct 2002, p. 1-16.

Good measurement practice. Reliability of Measures; Correlation coefficient “ r ”; Conducting correlations

Readings:

RM Chapter 5, *Identifying Good Measurement*, p. 117–132

Validity of Measurement; Peer evaluation of Operational Definitions

Readings:

RM Chapter 5, *Identifying Good Measurement*, p. 133–149

Behavioral Observations; Observations are better than self-report; Observer bias and reactivity;
Summation by *Elephas Maximus*

Readings:

PDF: Irie & Hasegawa (2012) – page 52 & 53, Methods section only

RM Chapter 6, *Surveys and Observations: Describing What People Do*

Pages 166–177, “Construct Validity of Behavioral Methods”

Recruiting and Generalizability; External Validity; Representative and Biased Samples; Pitfalls of
Sampling

Readings:

RM Chapter 7, *Sampling: Estimating the Frequency of Behaviors & Beliefs*

Data analysis of survey results; Correlation as description; Continuous and Categorical data;
Statistical Validity Questions; Pitfalls of interpreting correlation

Readings:

RM Chapter 8, *Bivariate Correlational Research*

Optional: RM Chapter 9: Ruling out Third Variables with Multiple-Regression, p. 248–259

Writing Results and Discussion sections; Avoiding Plagiarism; APA Writing Style and Citation Style

Readings:

RM “Presenting Results”, sections on “Results”, “Discussion”, and “References”, p. 531–536

Longitudinal Designs; Multivariate approach to correlational data

Readings:

RM Chapter 9, *Multivariate Correlational Research*, p. 241-249 and 260-269

Causal Claims; Experimental Variables; Controls; Design Confounds; Selection effects; Random
Assignment

Readings:

RM Chapter 10, *Introduction to Simple Experiments*, p. 277–295

Independent-Groups Designs; Matched Groups; Value and cost of a Pretest; How to Deal with
confounds

Video: Battling bad science, TED talk by Ben Goldacre

Within-Groups Designs; Repeated Measures; Advantages and Disadvantages

Readings:

RM Chapter 10, *Introduction to Simple Experiments*, p. 295–302

Order effects; Counterbalancing, Latin Square; Assessing Validities of Causal Claims; Manipulation
checks; Pilot Studies; Generalizing; Statistical Significance and Effect size

Readings:

RM Chapter 10, *Introduction to Simple Experiments*, p. 303–321

Factorial Designs; Differences in differences; Testing Limits and Hypotheses

Readings:

RM Chapter 12, *Experiments with More than One IV*, p. 363–372

Factorial Designs: Main effects and interactions; Interpreting Results

Readings:

RM Chapter 12, *Experiments with More than One IV*, p. 372–381

Factorial Designs: Factorial Variations

Readings:

Threats to Internal Validity

Readings:

RM Chapter 11, *More on Experiments*, p. 323–341

Interpreting Null Results; Ceiling and floor effects; Obscured differences

Readings:

RM Chapter 11, *More on Experiments*, p. 342–361

Controversy over Replication in Psychological Science

Readings:

PDF: Lindsay (2015). Replication in Psychological Science, *Psychological Science*, 261, 1827-1832.

Optional reading PDF: Open Science Collaboration. (2015). Estimating the reproducibility of psychological science. *Science*, 349, 943.

Video:

Is there a reproducibility crisis in science? – Matt Anticole, TEDEd Lesson

Quasi-Experimental Designs

Readings:

RM Chapter 13, *Quasi-Exp and Small N Designs*, p. 401–418

Small N Designs

Readings:

RM Chapter 13, *Quasi-Exp and Small N Designs*, p. 418–435

Replication and Meta-Analysis; Replication Debate; Replication Projects

Readings:

RM Chapter 14, *Replicability, Generalizability and the Real World*; “Replication” p. 437–447

External Validity recap; How to Generalize without over-extending

Readings:

RM Chapter 14, *Replicability, Generalizability and the Real World* “Research Transparency and Credibility” p. 448 – 466

Bringing it all together: What Psychological Research is and is not.

Video:

TED talk by Robin Ince: Science vs wonder?

How to write a PSY research report; How to make figures; Making graphs with Custom Error Bars using MS Excel.

Readings:

RM: *Presenting Results*, Example paper, p. 545 – 559

(Optional: APA Chapter 2, pp. 31-76 and Chapter 5 pp. 283-320)