
# Week 10 Lecture - Introduction to Experiments

Undergraduate Research Methods in Psychology

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# 1 Last Unit Review & Announcements

## 1.1 Announcements and Due Dates

- Don't forget about the **reading evidence**!
- Make sure to be making consistent progress on your project work (**article critique and research proposal**) outside of class!
- I will have office hours again at 3:00pm - 6:00pm EST in AuSable 1307 on Friday 11/08/2024. Please consider coming if you have recently been struggling or would like to discuss the projects. I am available via email as well.

## 1.2 Last Unit Content

- We learned about multivariate correlational design appropriate for association claims and how some can approach causal claims
- We discussed longitudinal and multiple regression designs as being appropriate for establishing temporal precedence and investigating third variables, respectively
- We talked about the nuances of identifying parsimony and patterns that may point to a causal relationship by virtue of numerous correlational studies

# 2 Quiz 8 Review

## 2.1 Areas for Review

- In the case of having of wanting to plot the relationship between a categorical and a continuous variable - *I* recommend using a bar graph, instead of something like a split scatterplot.
- For outliers, I say to (generally) keep all of them in and work around them with analyses methods that are appropriate to dealing with them
  - Those outliers may represent genuine fluctuations in natural phenomenon, which we want to account for!
  - In the stats world, we usually call these *robust* or *non-parametric* analyses
- Question: "*An exam score has possible points of 0 to 100; attendance has possible levels of 0 to 10. My data has exam scores from 60 to 100 and attendance from 1 to 10 and my r = 0.38, 95% CI = [0.35, 0.41]. What problem am I likely dealing with here when I draw conclusions, based on the available information?*"
  - Confidence interval appears to be pretty narrow

  - Effect size (from r) would be considered moderate
  - In this text, there is not evidence presented which indicates curvlinearity
  - *However,* I only have exam scores representing a small part of the total values that could happen on the scale $\rightarrow$ restriction of range

- Internal validity is not applicable to association claims, specifically because we are not attempting to establish a causal link between our variables

# 3 Quiz 9

## 3.1 Quiz Content

- Covers all content from 10/29 class meeting, including but not limited to:
  - Chapter 9 of Morling Textbook
  - Lecture on Chapter 9
- *Any last minute questions?*

## 3.2 Quiz Rules

- *From the Syllabus:*
  - Each quiz is 10 multiple-choice questions, 1 point for each question
  - Quizzes will be taken at the start of the class period on the Blackboard LMS
  - Quizzes will be on content covered in the previous lecture and the associated reading for that lecture
  - Quizzes are timed, 23 minutes only (previously was 15 minutes). If you finish before time is up, please remain in class and find another activity to work on quietly
  - Quizzes are open-note and open-book, that is, you are allowed to use those resources during the quizzes. Thus, they reward good structure in thoughtfulness in your notes and preparation
  - You may not collaborate with others during the quizzes, or discuss questions with other students after the quiz. You cannot use AI tools or the internet to help you during the quiz
  - Quizzes and exam will be ended early if all students are clearly finished and content with their answers
  - Quizzes will be graded promptly and reviewed the following week

# 4 Learning Objectives

## 4.1 Textbook Objectives

- Apply the three criteria for establishing causation to experiments and explain why experiments can support causal claims.
- Identify an experiment's independent, dependent, and control variables.
- Classify experiments as independent-groups and within-groups designs and explain why researchers might conduct each type of study.
- Evaluate three potential threats to internal validity in an experiment— design confounds, selection effects, and order effects—and explain how experimenters usually avoid them.
- Interrogate an experimental design using the four validities.

## 4.2 Professor's Objectives

- Textbook objectives are actually comprehensive this time!

# 5 Chapter Overview

## 5.1 Chapter Overview

- Experiments are _____ investigations that are supportive of _____ claims.
- They tell us about _____ influence that one variable has upon another
- They also tend to be the most rigorous and difficult studies, with lots of required resources

# 6 Experimental Variables

## 6.1 Overview

- Experiments will have at least one measured variable and at least one _____ variable
- *Example (from the first test):* Changing pillow type (manipulated variable) results in change in sleep quality (measured variable)

- *Review:* a manipulated variable is one that we can directly influence and change, to have a hypothesized impact on our measured variables
- *Review:* measured variables will be things like self-reports or _____ measures
- Often, the independent variable will be categorical/grouped and the dependent variable will be continuous - but this is not a hard and fast rule

## 6.2 Independent & Dependent

- An **independent variable** is one that we can change "independent" of other factors, i.e., it does not depend on something else
  - The manipulated variable
  - It levels (i.e., possible values) are called _____
- A **dependent variable** is one that is somehow hypothesized to be connected to or _____ upon the condition or state of the independent variable
  - The measured variable
  - It may also be referred to as an outcome variable
- *Example:* Medication vs Therapy for depression. Type of treatment (meds or therapy) is the independent variable; depression level is the dependent variable

## 6.3 Control

- **Control variables** are those that are intentionally held at the same level across participants, to prevent it from having an impact on the outcome
- *Review:* What do we call some value that does not change? Not a variable, but a c_____
- The purpose of keeping these still is to effectively _____ the effect of the independent variable(s), so that it does not confound our causal link.
- *Example:* I am looking at whether more exercise leads to an increase in energy. However, I suspect that caffeine level could confound this relationship, so I instruct participants to not take any caffeine. Caffeine level across participants is consistently 0, therefore it is a control variable and constant.

# 7 Why are Experiments Causal?

## 7.1 Overview

- *Review:* Recall our three causal criteria
  - _____

  - Temporal precedence
  - Internal validity
- Finally, with experiments we have a method by which to definitively establish all of these

## 7.2 Covariance

- If our separate _____ see differences in the outcome variable (i.e., mean differences on a continuous outcome), we would say there is covariance between the independent and dependent variables
- We have to distinguish what conditions we may assign or manipulate participants to:
  - **Comparison groups:** We have at least _____ conditions or levels in our independent variable, so that we can compare?
  - *Review:* What source of information did we explicitly say lacks comparison groups? _____
- We may use specific labels for types of comparison groups:
  - **Control group:** One that receives no or minimal intervention
  - **Treatment group:** One that receives the intervention or change of interest
  - **Placebo group:** A type of control, that is exposed to an inert or inactive treatment
- Covariance is _____ as important as the other causal criteria $\rightarrow$ no difference between conditions = no causation
- *Example:* I try two different teaching styles between classes to deliver a particular lesson. I take a test at the end of the class on the content. If there is a difference in test scores between the teaching styles, there is covariance.

## 7.3 Temporal Precedence

- By _____ the independent variable prior to measuring the dependent variable, we establish that it came prior and that we have temporal precedence.
- We will discuss how exactly to implement time in our discussions on the design types shortly

## 7.4 Internal Validity

- This is the most _____ and core feature that sets experiments apart from other designs, and satisfies the last criteria for causality
- Put simply, we must rule out other reasonable and theoretically-salient _____ for the effects that we see in the outcome variable

- **Confounding variables/confounds:** Those that offer alternative explanation for the effects seen in an outcome.
  - Often we will try to _____ possible confounding variables
  - When a confound results from poor planning in the research design $\rightarrow$ **design confound** $\rightarrow$ poor internal validity

### 7.4.1 Variability

- _____ **Variability** is when a confound changes in a consistent a predictable manner *with* the independent variable
- **Unsystematic Variability** is when a confound changes in some way separate or indifferent to the independent variable. It may occur in a seemingly random fashion.
  - The result is that there may be variability in the outcome, but if it happens _____ across all the conditions, it is not as much a concern.

### 7.4.2 Selection Effects

- **Selection Effects** occur when there is systematic variance of some factor across the conditions of the independent variable
  - This ends up being a confound $\rightarrow$ is the change in outcome due to this variance of a third factor or because of the condition? We _____ know
  - *Example:* In a treatment study on memory treatments, we assign some people to treatment A and some to treatment B. However, the group with treatment A comprises of mostly older individuals, whereas group B is mostly younger. Age may play a role in resulting memory impairment.
- This can be largely prevented by using **random assignment**, where members of the _____ are sort at random into conditions
- Using **matched groups** is another method to reduce the threat of selection effects
  - This is where participants are measured on some third variable that may confound and ranked. Then each rank is randomly placed in an alternating group
  - A major difficulty of this method is you must accurately identify what variables should be matched on.

# 8 Independent-groups Design

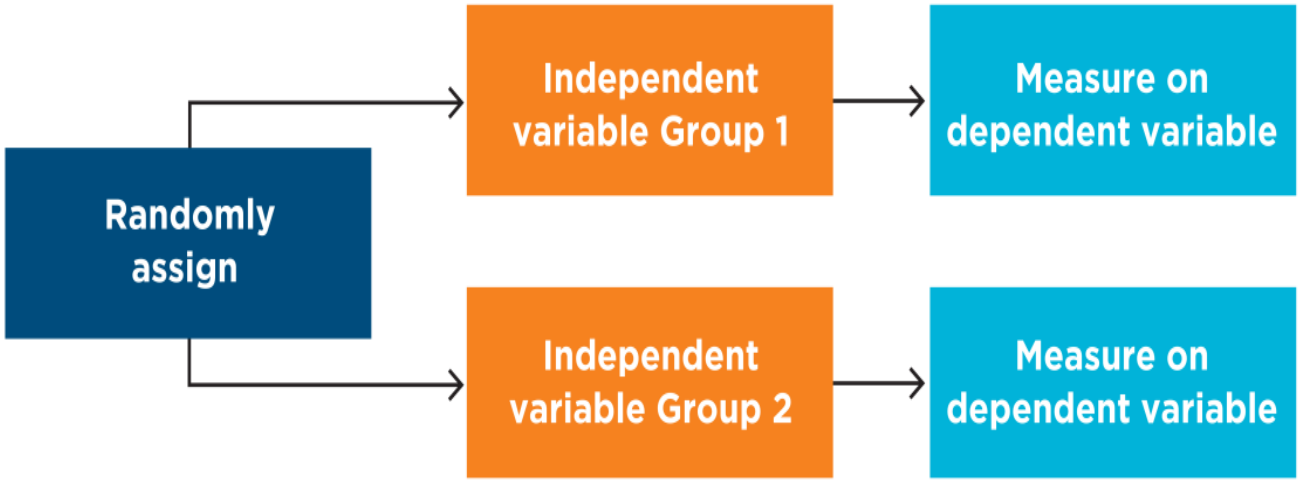
## 8.1 Overview

- **Independent-groups designs** are those in which the participants of each condition are entirely _____ from one another

– A.K.A. as between-subject or between-groups

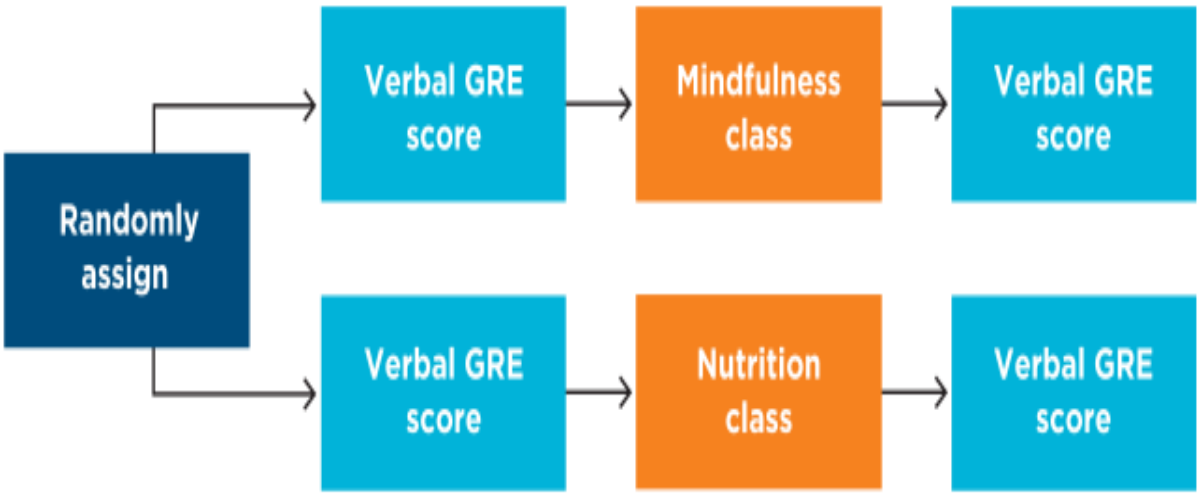
## 8.2 Posttest-only

- **Posttest-only design:** Separate groups of participants, assigned to different conditions, are measured only after the assignment and _____ has occurred.




## 8.3 Pretest/Posttest

- **Pretest/Posttest design:** Separate groups are tested on the outcome after the random assignment, but before *and* after the intervention



## 8.4 Comparison

- Both the posttest-only and the pretest/posttest designs are _____ experimental designs to investigate causal claims
- The primary difference is:
  - Posttest-only _____ that random assignment produces equivalent groups prior to interdention
  - Pretest/Posttest does not make this assumption and gives measures to validate
- Ideally, pretest/posttest is the “better” design as it provides more validation and data - but we may use posttest-only for practicality

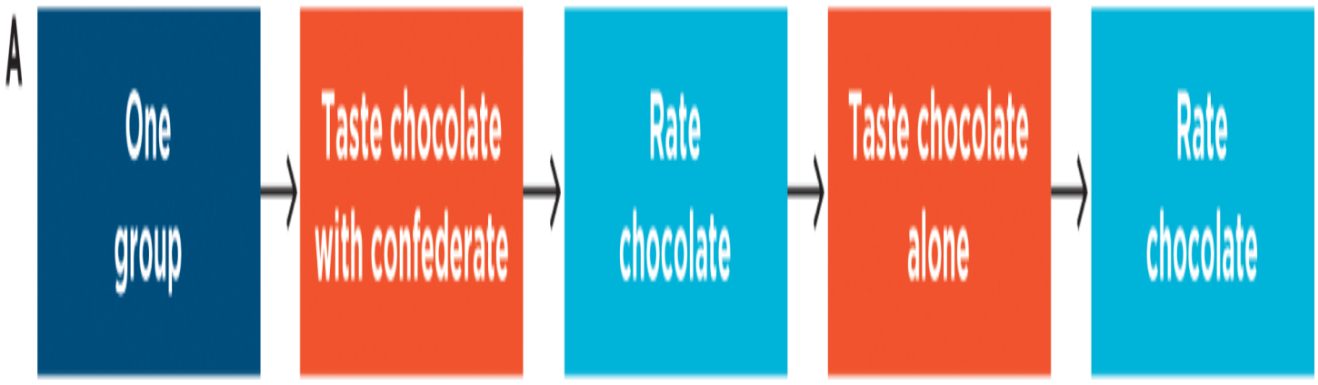
# 9 Within-groups Design

## 9.1 Overview

- **Within-groups designs** are when the _____ group of individuals is exposed to each condition
  - This is in contrast to the separate groups of the prior design

## 9.2 Repeated Measures

- As the name would suggest, **repeated-measures** is when measurement on the outcome(s) of interest is taken after exposure to each condition, which happens _____



## 9.3 Concurrent Measures

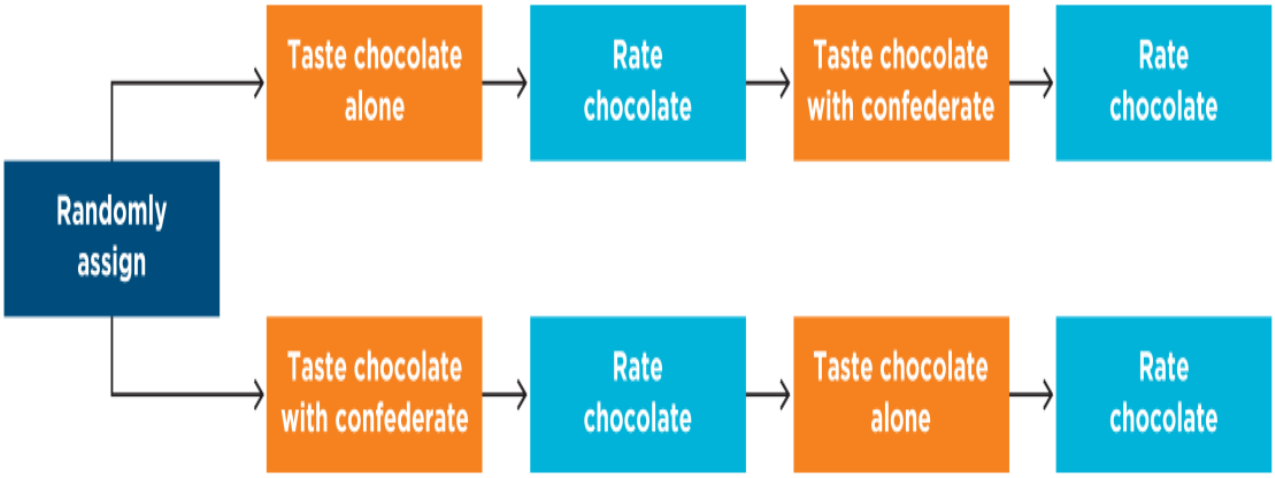
- **Concurrent measures** is when both "conditions" are displayed to the participant at the same time and the measure of interest is some function of the behavior or affect towards the conditions
  - *Review:* Remember Harlow's _____ ?
- Depending on the conditions, this may not be a viable strategy

## 9.4 Causal Criteria in Within-Groups

- Do we have covariance?
  - Manipulate and measure two separate variables to see their _____
- Do we have temporal precedence?
  - Each measure comes _____ the intervention or manipulation

### 9.4.1 Internal Validity

- Participants "_____ " for themselves, i.e., random assignment isn't necessary
  - Because the individual is the same across conditions, we don't need to ensure they are equal on some variable like with between groups
- However, we do need to be concerned with **order effects**, where exposure to one condition can have an _____ on the next reaction to a different condition
  - **Practice effects:** When someone becomes more _____ at a task due to practice on the prior conditions
  - **Fatigue effects:** When someone becomes less skilled at a task due to tiring from repeated testing
  - **Carryover effects:** When the effect of the previous condition is still _____ at the start of the next condition
- Order effects are best prevented by **counterbalancing**, that is assigning some individuals to one order of conditions, and assigning the others to a separate order
  - **Full counterbalancing:** when _____ possible orders are done
  - _____ **counterbalancing:** when only some possible orders are represented




## 9.5 Advantages

- The “groups” are naturally equivalent, as the conditions are tested upon the same individual!
  - I.e., no concern for _____ effects, like in between-groups
  - We are able to express a strong _____ over all the various personal characteristics that could vary unsystematically
- Also requires smaller sample sizes for adequate power

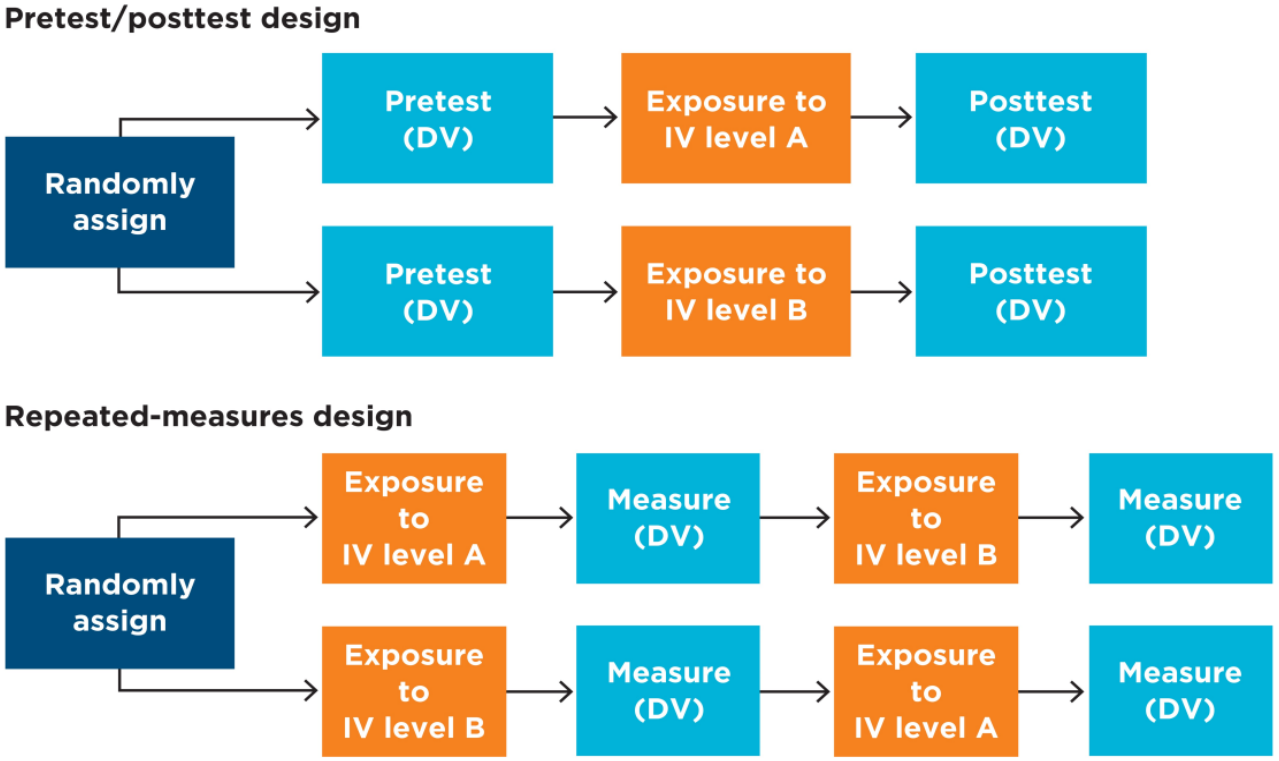
## 9.6 Disadvantages

- As previously discussed, *counterbalancing* is necessary in order to _____ order effects from occurring
- We must attempt to “return” to baseline after each condition - but some interventions may have a _____ or prolonged effect on the participants, confounding the next condition
- We have to contend with the possibility that a participant _____ the hypothesis of a study, by virtue of seeing all the conditions, and changes their behavior in relation to this knowledge.
  - This is called a **demand characteristic**
  - *Review:* This is almost similar to “_____ ”, as we discussed with self-report measures

## 9.7 Pretest-posttest vs Repeated Measures

- The important difference is that whether conditions are applied to different groups or

the same people!




# 10 Four Validities Critique

## 10.1 Construct Validity

- Dependent variables are likely to be assessed the same way we have previously discussed self-report and observational measures.
  - *Review:* What types of self-report questions are there? What are there relative strengths and weaknesses?
  - *Review:* What are the three threats to observational measures?
- Independent variables are often based, at least initially, on whether they are _____-valid.
  - We may use a **manipulation check**, or an addition measure meant to ensure that the intervention had the intended effect
  - This can be a good use for a **pilot study**
- All choices of variables to measure and manipulate should be guided by an understanding of the existing _____ in the area $\rightarrow$ we must assess whether the variables represent the constructs of the theory well

## 10.2 External Validity

- As previously discussed, sample _____ is the primary factor to consider in whether a sample is representative a specified population, and thus, whether results are generalizable.
- Extrapolating results to other, similar situations, requires _____ research
- Typically, experimental research tends to have worse external validity due to tight controls and smaller samples - but they may be _____ with strong correlational designs (i.e., longitudinal or multiple regression) to help with this

## 10.3 Statistical Validity

- Just like previous statistical validity discussion, we are concerned with 3 aspects:
  - Effect _____ : magnitude of effect
  - Precision: What confidence do we have that this effect falls in a narrow range of values
  - Replication: When a study is replicated, are statistics _____ .

## 10.4 Internal Validity

- Covered, in the previous sections, but this is the key question:
  - “Are the effects found here some _____error, a third variable, or genuinely the intervention?”