Week 10 Lecture - Introduction to Experiments

Undergraduate Research Methods in Psychology

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1 Week Overview

1.1 Learning Objective(s)

- 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.

1.2 Week 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 _____ and difficult studies, with lots of required resources

2 Experimental Variables

2.1 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)

Discuss: What word in the prior example should really cue you to this being a casual claim?

- *Review:* a manipulated variable is one that we can directly influence and _____, to have a hypothesized impact on our measured variables
- *Review:* measured variables will be things like self-reports or _____ measures

2.2 Independent & Dependent

- An **independent variable** is one that we can change "independent" of other factors, i.e., it does not _____ 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, similar to a multiple regression design
- Often, the _____ variable will be categorical/grouped and the dependent variable will be continuous - but this is not a hard and fast rule

? I am looking at whether depression symptoms are improved more by psychotherapy or medication treatments - what construct is being treated as dependent?

- (●) A) Depression symptoms
- ( ) B) Medication
- ( ) C) psychotherapy
- ( ) D) None of these

Explanation:

2.3 Control

- **Control variables** are those that are _____ held at the same level across participants, to prevent it from having an impact on the outcome

Discuss: What do we call some value that does not change values in our data?

- 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.

? What do we call a variable that interferes with internal validity, like in the prior example?

- (●) A) A sample
- ( ) B) A covariate
- ( ) C) A third variable
- ( ) D) A criterion

Explanation:

3 Why are Experiments Causal?

3.1 Overview

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

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

3.2 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 them

? What source of information did we explicitly say lacks comparison groups, early in the semester?

- (●) A) Research
- ( ) B) Personal experience
- ( ) C) Authority
- ( ) D) Intuition

Explanation:

- We may use specific labels for types of comparison groups:
  - **Control group:** One that receives no or _____ 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 _____ treatment
- Covariance is _____ as important as the other causal criteria → 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.

3.3 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

3.4 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 _____ 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
- Experiments can implement _____ controls that prevent confounds.

Discuss: Previously, we discussed a design that gives a statistical control, in contrast to the design control we discuss now - what design was that, and in what context did that control work?

3.4.1 Variability

- _____ **Variability** is when a confound changes in a _____ a predictable manner *with* the independent variable
- **Unsystematic Variability** is when a confound changes in some way _____ 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.

> Discuss: Based on our discussions in this lecture so far, which of these seems worse for us, and why?

3.4.2 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 variable 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 of the IV
- Using **matched groups** is another method to reduce the _____ of selection effects
  - This is where participants are measured on some third variable that may confound and ranked. Then each _____ is randomly placed in an alternating group
  - A major difficulty of this method is you must accurately identify what _____ should be matched on.

4 Independent-groups Design

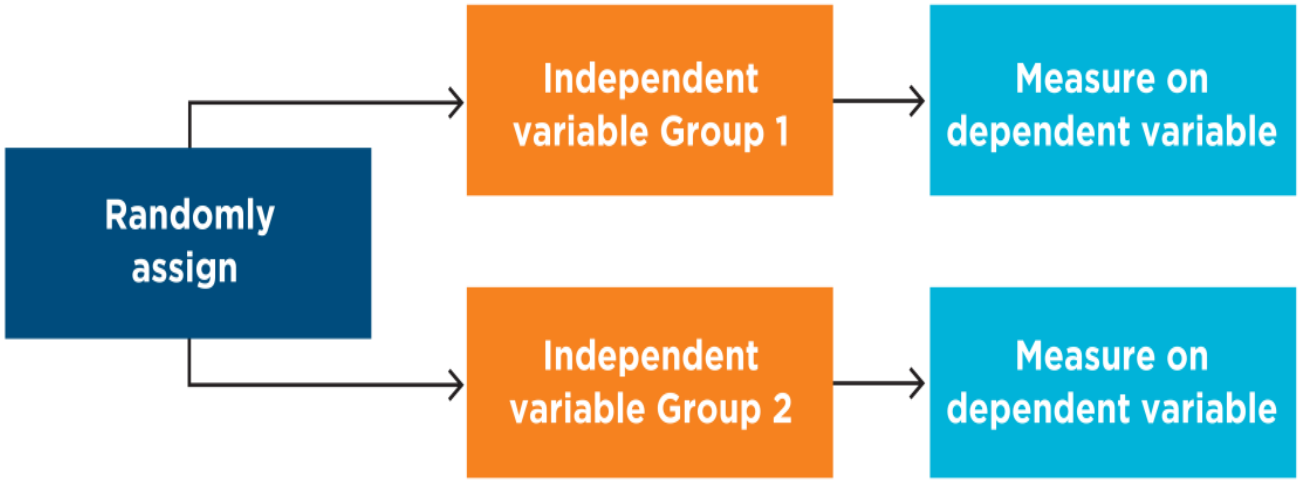
4.1 Overview

- **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

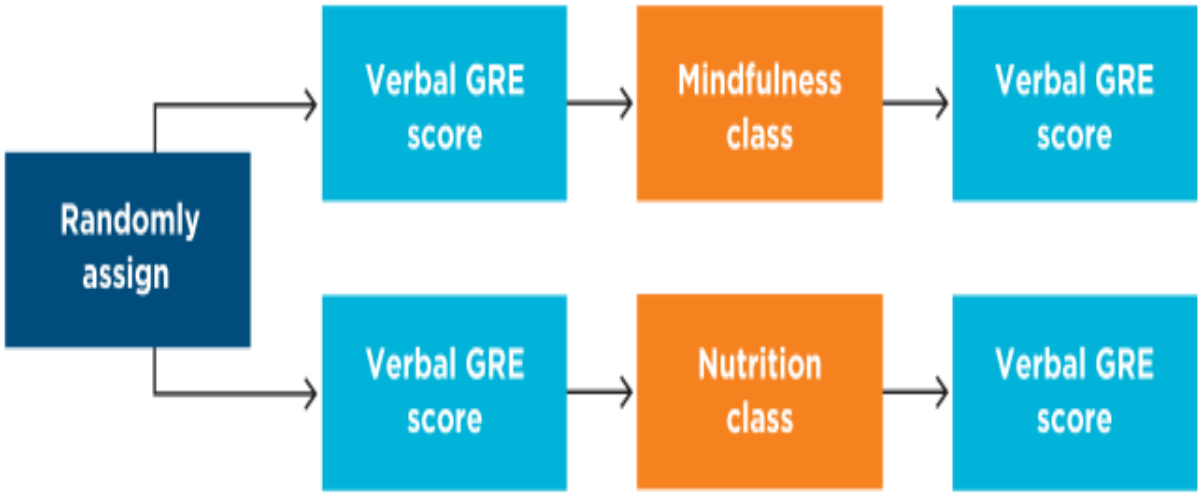
4.2 Posttest-only

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



4.3 Pretest/Posttest

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



4.4 Comparison

- Both the posttest-only and the pretest/posttest designs are perfectly _____ 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 _____ and data - but we may use posttest-only for practicality

? I measure a sample of folks on their extraversion and happiness using two continuous measures and then measure them again in a year - what design is this?

- (●) A) Pretest/Posttest
- ( ) B) Bivariate correlational
- ( ) C) Posttest-only
- ( ) D) Multivariate correlational

Explanation:

5 Within-groups Design

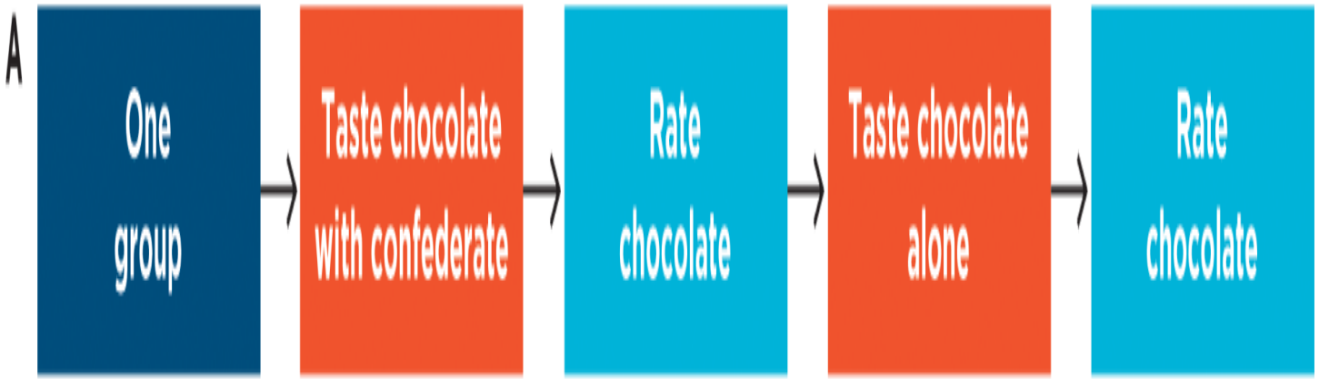
5.1 Overview

- **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 designs

5.2 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

_____



5.3 Concurrent Measures

- **Concurrent measures** is when both "conditions" are displayed to the participant at the _____ 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

5.4 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

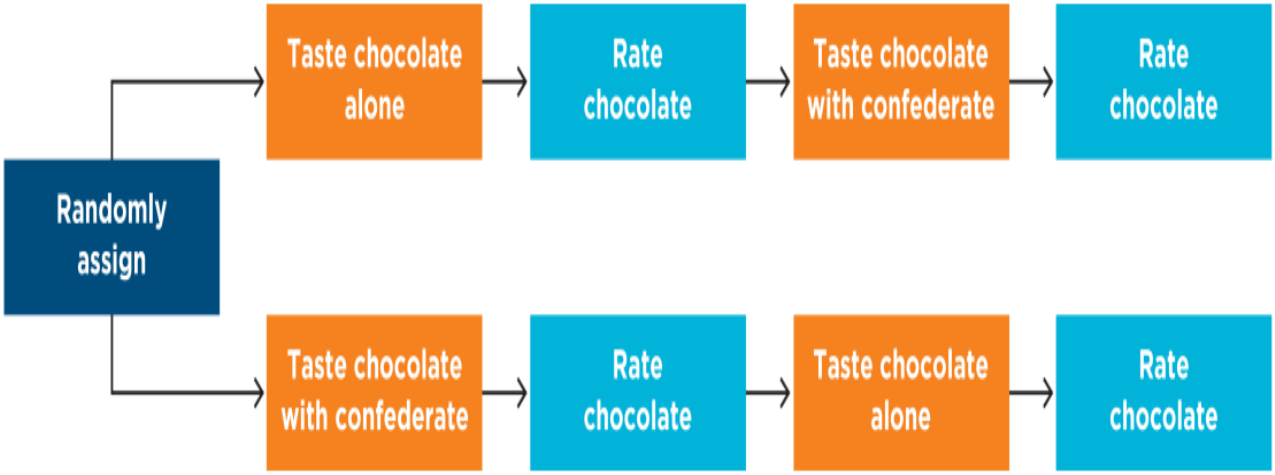
5.4.1 Internal Validity

- 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 _____ 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 _____ 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

> Discuss: Give an example of a situation where you think practice effects could occur on a certain measure

- Order effects are best prevented by **counterbalancing**, that is assigning some individuals to one _____ 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



5.5 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 _____ sample sizes for adequate power

5.6 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

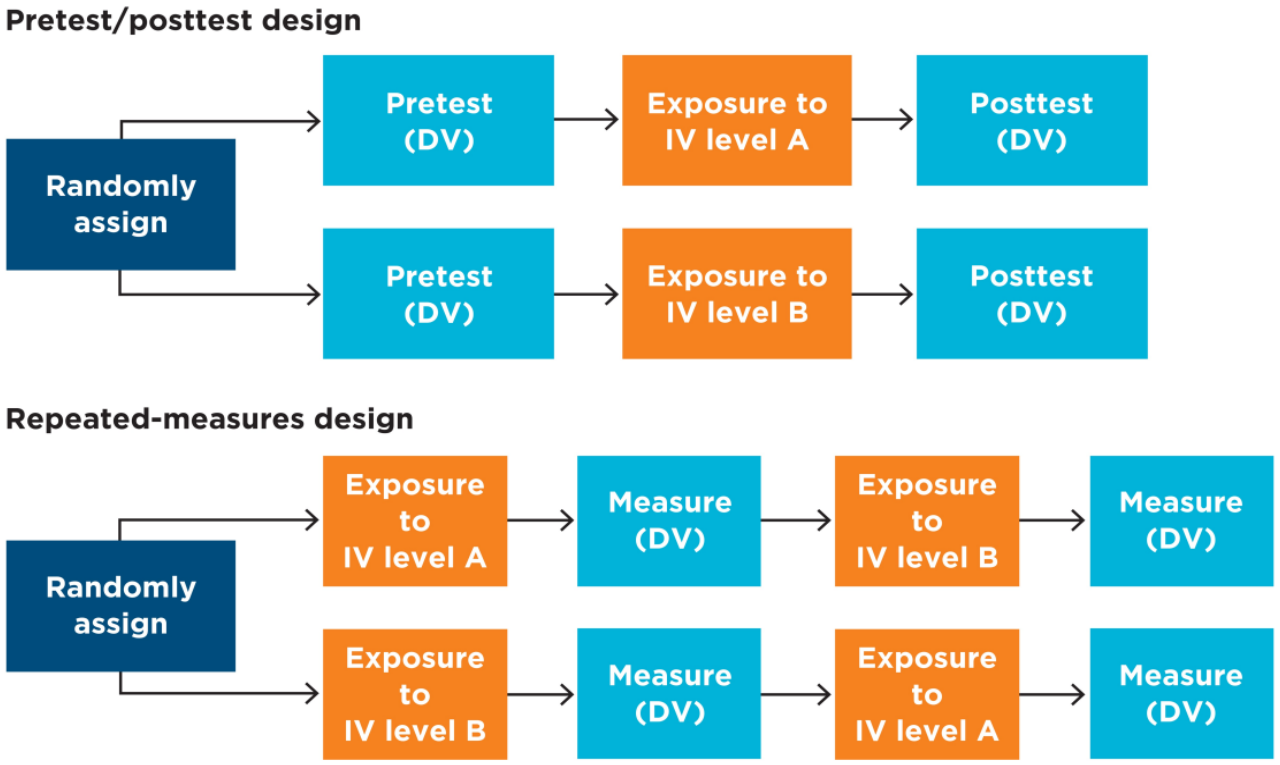
? What validity is a demand characteristic a threat to?

- (•) A) Construct validity
- ( ) B) Internal validity
- ( ) C) External validity
- ( ) D) Statistical validity

Explanation:

5.7 Pretest-posttest vs Repeated Measures

- The important difference is that whether conditions are _____ to different groups or the same people!



6 Four Validities Critique

6.1 Construct Validity

- Dependent variables are likely to be _____ the same way we have previously discussed self-report and observational measures.

> Discuss: What were the 3 primary threats to observational design? Briefly describe them

- Independent variables are often based, at least initially, on whether they are _____ valid.
  - We may use a **manipulation check**, or an additional measure meant to ensure that the intervention had the _____ 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 → we must assess whether the variables represent the constructs of the theory well

6.2 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 - the results aren't applicable to "normal" life - but they may be _____ with strong correlational designs (i.e., longitudinal or multiple regression) to help with this

> Discuss: What about sample sizes? What role will they play in external validity or the other validities?

6.3 Statistical Validity

- Just like previous statistical validity discussion, we are concerned with 4 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 _____.
  - Significance: Were these results just a fluke of _____?

6.4 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?"