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Experimental Research

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1

Types of Group Comparison Research

- Review
  - Causal-comparative
    - AKA Ex Post Facto (Latin for after the fact).
    - Researcher does not form the groups.
    - Groups to be compared are formed before the study begins. A pre-existing variable defines the group.
  - Causal-Comparative mini-proposal observations

2

Types of Group Comparison Research

- Lecture Topic
  - Experiment
    - Researcher forms the groups .
    - Quasi Experiment
      - Intact groups are randomly assigned to a treatment condition.
    - True Experiment
      - Individuals are randomly assigned to a treatment condition.

3

Experimental Research

- Designed to test hypotheses and document cause-effect relationships.
- Two types of variables
  1. Treatments or causes (the variable hypothesized to have a measureable effect)
     - What is this variable called?
  2. Measures, criterions, effects, or posttests (the variable that measure effect)
     - What is this variable called?
     - Dependent Variable (DV)
       - AKA the dependent measure

4

Experimental Research

- IV is the ***variable to be manipulated*** (again, in the case of causal-comparative research, it is the variable used to form groups)
  - e.g., participation in a training program
  - Other examples?
- DV is the ***variable used to assess or measure group differences*** thought to be due to (or caused by) the presence (or absence) of the IV.

5

Portfolio Activity #8
Mini-proposal 4

- Briefly describe an experimental research project relevant to one of your identified research topics.

6

The Experimental Process

The research proposal

Parallels the Research Report

- Select and define a problem/question.
  - Introduction
    - Develop hypotheses
- Select participants and measures.
  - Method
    - Experimenter controls selection (via random sampling)
- Design the study and collect data
  - Method
    - Experimenter controls assignment of participants to treatment conditions.
    - Involves the comparison of 2 or more groups.
- Analyze the data
  - Results
- Formulate conclusions
  - Discussion

7

Types of Experiments

1. Comparison of two different IVs (or treatments)
   - Whole language vs. phonics based instruction.
2. Comparison of an established IV to an new IV (established practice or treatment vs. new practice or treatment)
   - Traditional math instruction vs. new math instruction.
3. Comparison of different amounts of the same IV (or treatment)
   - 10 hours vs. 40 hours of instruction

- Activity: Identify an example of each of the 3 type of experiments. Which best describes your mini-proposal.

8

Group Labels

- Experimental or Treatment Group vs. Control Group
- Comparison Groups

- Discussion: What do these group labels imply? What best describes the groupings in your mini-proposals? Provide examples of the appropriate use of these labels

9

Common Terms and What They Mean

- Manipulation
  - Selecting the number & type of treatments (IVs) to & to randomly assign participants to treatments (IVs)
- Control
  - Efforts to remove the influence of any extraneous variable (other than the IV) that might affect the DV.
  - "The researcher strives to ensure that the characteristics and experiences of the groups are as equal as possible on all important variables *except the independent variable.* If relevant variables can be controlled, group differences on the dependent variable can be attributed to the independent variable." (Gay & Airasian, 2006, p. 236, emphasis added).

10

Threats to Validity

Within the study / Outside of the study

- Internal (within the study) Validity
  - Confounds
  - Changes in the DV are due to factors other than the IV.
  - The observed effect (the DV) may not be due to the hypothesized cause (the IV).
- External (outside of the study) Validity
  - The extent to which results can be generalized back to the population participants were drawn from.

11

Threats to Internal Validity: Confounds

- Changes that occur with the **passage of time**

1. History
   - ***External*** environmental changes other than the IV that occur during the study affect the DV.
   - Greater pre to posttest intervals increase the risk of this confound.
2. Maturation
   - ***Internal*** changes (growth) other than the IV that occur during the study affect the DV.
   - Times of rapid development (infancy) increase the risk of this confound.

12

Threats to Internal Validity: Confounds

3. Pretesting
   - Pretest used to document baseline performance on the DV sensitizes participant to important DV variables.
   - AKA practice effect.
4. Pretest-Treatment Interaction
   - As a result of having been pretested, participants respond differently to the treatment.
     - Something about the pretest changes response to the treatment (e.g., being observed changes behavior).
   - Unobtrusive measures reduce the risk of this confound.

13

Threats to Internal Validity: Confounds

5. Measuring Instruments
   - Changes in the measuring instruments (e.g., observations) over time affect the scores obtained by the DV. The dependent measure itself changes.
     - For example, observers may become less attentive, more familiar with the environment, and less observant of detail as a study progresses.
   - Reliability checks help to minimize this confound
6. Regression to the Mean
   - Extreme scores are statistically less likely to be replicated. Thus, if a sample is selected on the basis of very low or high scores, it is possible that at least part of the DV scores are due to chance.

14

Threats to Internal Validity: Confounds

7. Differential Selection of Subjects
   - Groups differ prior to the start of the study.
   - Most likely to occur in a quasi-experiment (WHY?).
   - Pretests assess this confound (but introduce what other confounds?).
8. Experimental Mortality
   - Differential loss of participants over time.
   - Different levels of motivation to participate in the study increase the risk of this confound.
   - Control group members are more likely to leave the study.
9. Selection-Maturation / Selection-History / Selection-Testing Interaction
   - If already formed groups are used, one group may profit more (or less) from the IV (or treatment) because of maturation, history, or testing factors.

15

Threats to Internal Validity: Confounds

- Discussion
  - What are some possible confounding variable in your mini proposals?

16

Threats to External Validity: Limited Generalizability

- What does it mean when we say:
  - *"This study lacks (or has questionable) external validity?"*

17

Threats to External Validity: Limited Generalizability

1. **Pretest-Treatment Interaction**
   - ***Pretest makes subjects different from the target population***
     - The pretest sensitized participants to aspects of the treatment making the treatment effect different than if they had not been pretested.
       - Treatment effects, therefore, can only be generalized back to a population that has also been pretested.

18

Threats to External Validity: Limited Generalizability

2. Multiple-Treatment Interference

- ***The IV makes subjects different from the target population.***
  - When participants receive more than one treatment (e.g., IV_1 > DM > IV_2 > DM), the effect of prior treatment can affect or interact with later treatments, limiting generalizabilty.
    - ❶Corporal punishment (IV) ❷class behavior (DV) ❸PBI (IV) ❹class behavior (DV).
  - Carry over affects from the earlier treatment may make it difficult to assess the effectiveness of the later treatment.
  - The effects can only be generalized back to a population that has also been presented with the earlier treatment (IV).

19

Threats to External Validity: Limited Generalizability

3. Selection-Treatment Interference

- Selection: Participants selected for a treatment may not be representative of the larger population.
  - A particular problem in quasi-experimental research (because, for example, the groups were developed for specific/unique reasons).
- Treatment: Actual participants (sample) react differently to the treatment than potential (population) participants.
  - The effects of the treatment can only be generalized back to members of the population that are similar to the sample.
- Sample selection is very important. How participants were obtained and how representative they are of the larger population is important to document.

20

Threats to External Validity: Limited Generalizability

4. Specificity of Variables

- Poorly operationalized variables make it difficult to identify the setting and procedures to which the variables can be generalized
  - Exactly what was manipulated (IV)?
    - phonics instruction vs. Reading Mastery
  - Exactly how were the effects measured (DV)?
    - reading achievement vs. word attack skill
  - Without clear operational definitions of these variables, generalizations is problematic.
  - These definitions describe what is being generalized.

21

Threats to External Validity: Limited Generalizability

5. **Treatment Diffusion (Groups have contact)**
   - The experiment's different groups communicate with each other and adopt pieces of each other's treatment, altering the initial status of the treatments comparison.
   - Treatment groups have contact with each other and share treatment effects = Loss of treatment integrity.
6. **Experimenter Effects**
   - Conscious or unconscious actions of the research affects participant's performance/response.
     - Passive (physical characteristics and/or personality traits) = *Personal-attributes effects*
       - Who you are affects the IV/DV (e.g., teacher style)
     - Active (expectations affect experimenter behavior) = *Bias effects*
       - What you do affects the IV/DV

22

Threats to External Validity: Limited Generalizability

7. **Reactive Arrangements**
   - AKA: Participant Effects (Study participation effects behavior.)
   - Knowledge of being studied and/or being in a specific treatment group changes participants such that they are no longer typical of the population to which the researcher wishes to generalize study results.

1. Hawthorne effect
   - Any situation in which participants' behavior is affected not by the treatment per se, but by their ***knowledge of participating in a study***.
2. John Henry effect
   - The ***control group is informed that they will be in the control group*** for a new, experimental method. As a result of this knowledge they perform atypically.

23

Threats to External Validity: Limited Generalizability

7. **Reactive Arrangements** (continued)

3. Placebo effect
   - Educational implications = all groups should appear to be treated the same, i.e., receive some type of treatment - although control group treatment will not be hypothesized to have an effect on the DV.
4. Novelty effect
   - Changes in behavior simply because you are doing something new.

- Addressing confounds: Double Blind and Placebo Control
  - Both experimenter (individuals evaluating the DV) and participants do not know what group participants are in.

24

Threats to External Validity: Limited Generalizability

- Discussion
  - What are some possible challenges to generalization in your mini proposals?

25

Validity

- The validity of an experiment is a direct function of the degree to which internal **and** external variables are controlled.
- Experiments aim to control extraneous variables that make it difficult to assess the effects of independent variables.

26

Addressing Threats to Validity: Control Procedures

- Randomization
  - The **best single way** to simultaneously control for many extraneous variables (but requires all members of the population to have had a chance of selection).
  - What are the challenges to using simple random sampling?
- Matched Pair Design
  - Systematically select participant pairs who are similar in all important ways other than the independent variable.
- Homogenous Grouping
  - With the exception of the independent variable (group membership) make sure that participants in both groups are very similar in all important ways. Limits generalizability.

27

Addressing Threats to Validity: Control Procedures

- Participants as Their Own Controls
  - Subject participants to different treatments one treatment at a time.
  - Problem = carryover effects.
  - Multiple treatment interference.
- Analysis of Covariance
  - Statistical control
  - Adjusts scores on the dependent variable for initial differences on some other variable related to the dependent variable (e.g., based on pretest results adjust posttest scores).

28

Types of Group Designs/Experiments

- Manipulate and control
  - Pre-experimental
    - One group
    - No real control of extraneous variables.
  - True Experiments
    - Two or more groups
    - Provide control of extraneous variable.
  - Quasi Experiments
    - Used when individual random assignment is not possible.

29

Pre-Experimental

- Design 1.One-Shot Case Study

Treatment	*Observation*
X (SIW)	*O*

- Can't make any conclusion about the effect of X on O.
- O may have been due to something other than X
- Why would you conduct such a study?

30

Pre-Experimental

- Design 2. One-Group Pretest-Posttest Design

Pretest	*Treatment*	*Posttest*
O_1	*X*	O_2

- Don't know if variables other than X may have resulted in O2.
- What might some of these other variables be?

31

Pre-Experimental

- Design 3. Static Group Comparison

	Treatment	*Posttest*
Experimental Group	*X*	*O*
Control Group		*O*

- Bold line indicates intact groups are used.
- Lack of random assignment = don't know about pre-test comparability.

32

True Experiment

(labels to use in Mini proposals)

- Design 4. Pretest-Posttest Control Group Design

	Random Assignment	*Pretest*	*Treatment*	*Posttest*
Experimental Group	*R*	O_1	*X*	O_2
Control Group	*R*	O_1		O_2

- Can take into account any pretest initial differences by analyzing the posttest score by means of an analysis of covariance.
- Addresses pretest differences confounds.

33

True Experiment
(labels to use in Mini proposals)

- Design 5. Posttest-Only Control Group Design

	Random Assignment	*Treatment*	*Posttest*
Experimental Group	*R*	*X*	*O*
Control Group	*R*		*O*

- Powerful for situations in which genuine random assignment has taken place.
- Controls for any potential pretest/treatment interaction.

34

True Experiment
(labels to use in Mini proposals)

- Design 6. Solomon Four-Group Design

	Random Assignment	*Pretest*	*Treatment*	*Posttest*
Experimental Group	*R*	O_1	*X*	O_2
Control Group	*R*	O_1		O_2
Experimental Group	*R*		*X*	O_2
Control Group	*R*			O_2

- A combination of designs 4 and 5. Has the advantages of both.
- Disadvantage is that is requires more subjects.

35

Quasi-Experiment
(labels to use in Mini proposals)

- Design 7. Nonequivalent Control Group Design
  - The most commonly used in educational research

	Pretest	*Treatment*	*Posttest*
Experimental Group	O_1	*X*	O_2
Control Group	O_1		O_2

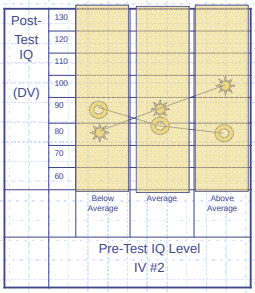
- Example:
  - Student teachers in 1996 vs. student teachers in 1997. Pretest differences can be handled via analysis of covariance.
  - Similar to design 4. Difference = use of intact groups.
  - Similar to design 3. Difference = use of a pretest

36

Factorial Designs

- Make use of two or more IVs, at least one of which is manipulated by the experimenter

IV #1
IQ Builder +
Smart Child



37

Data Analysis

- Descriptive Statistics
  - Mean
  - Standard Deviation
- Inferential Statistics
  - t-test
    - The difference between 2 dependent measure means
  - ANOVA
    - The difference between 3 or more dependent measure means
  - Chi Square
    - The difference between the frequency of occurrence of the dependent measure.

38

Next Week

- Data Analysis: Descriptive Statistics
- Read *Educational Research* Chapter 18.

39