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Social Science Research Methods

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Overview

- Measurement Theory
- Research Design
- Internal Validity
- External Validity
- Research Design Principles
- Experimental Validity
  - Internal, External, Construct, Statistical Conclusion

Research Design

- Research Design is the plan and structure of investigation
  - Framework
  - Organization
  - Configuration of elements
- Research Design has two purposes
  - To answer research questions
  - To control variance
    - Experimental
    - Extraneous
    - Error

Research Design

- Research Design tells us
  - What observations to make
  - How to make them
  - How to analyze their quantitative representations
- Recall that *power* = 1 – *Beta risk* = probability of correctly rejecting a false null hypothesis

Research Design

- Example of detecting admissions discrimination
  - Simple design randomly assigns males or females to colleges and compares admission rates
  - Factorial design crosses Gender with three levels of Ability (in this case both active variables) and tests *interaction*
  - Note that parallel tests at different levels of ability would not be as clear evidence

Research Design

- Maxmincon
  - Maximize systematic variance
  - Minimize error variance
  - Control extraneous variance

- *N.B. Here we are considering the variance of the dependent variable*

Research Design

- Experimental variance
  - Design plan and conduct research so that the experimental conditions are as different as possible
- Extraneous variance
  - Choose participants that are as homogeneous as possible on extraneous independent variables
  - Whenever possible, assign subjects to experimental groups and conditions randomly, and assign conditions and other factors to experimental groups randomly
  - Control extraneous variables by building them into the design
  - Match participants and assign them to experimental groups at random
- Error variance
  - Reduce errors
  - Increase reliability of measures

Research Design

- Experiment
  - In an experiment, the researcher manipulates or controls one or more of the independent variables
- Nonexperiments
  - In nonexperimental research the nature of the variables precludes manipulation (e.g., sex, intelligence, occupation)
- “The ideal of science is the controlled experiment” (K&L, p. 467)

Research Design

- Four “faulty” designs
  - Notation:
    - X
      - X is manipulated
    - ~X
      - X is not manipulated (i.e., subject not given X)
    - (X)
      - X is not manipulated but measured or imagined

Research Design

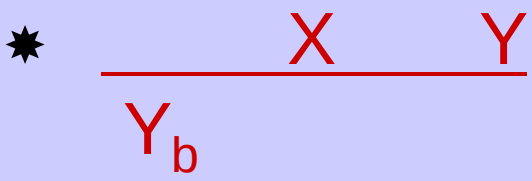
- Design 19.1: One Group
  - (a) X Y (Experimental)
  - (b) (X) Y (Nonexperimental)
- "One Shot Case Study"
- *Scientifically* worthless

Research Design

- Design 19.2: One Group, Before – After (Pretest – Posttest)
  - (a) Y_b X Y_a (Experimental)
  - (b) Y_b (X) Y_a (Nonexperimental)
- Group is compared to itself
- Measurement, history, maturation, regression

Research Design

- Design 19.3: Simulated Before – After



- Here we cannot tell whether the two groups were equivalent before X

Research Design

- Design 19.4: Two Groups, No Control
  - (a) X Y (Experimental)
    ~X ~Y
  - (b) (X) Y (Nonexperimental)
    (~X) ~Y
- Groups are assumed equal on all other variables

Research Design

- Criteria
  - Does the design adequately test the hypothesis
  - Does the design adequately control independent variables
    - Randomize whenever possible
      - Select participants at random
      - Assign participants to groups at random
      - Assign experimental treatments to groups at random
    - Control independent variables so that extraneous unwanted sources of systematic variance have minimal opportunity to operate
  - Generalizability

Research Design

- Internal and External Validity
  - Campbell 1957, Campbell and Stanley 1963
  - The primary yardsticks by which the quality of research contributions is judged
  - These goals can and do conflict with each other
- Internal Validity
  - Did the experimental manipulation really make a significant difference?

Internal Validity

- Threats / alternative explanations
  - Measurement
    - Measuring participants changes them
  - History
    - Events occurring in the specific experimental situation may have influenced the outcome
  - Maturation
    - Subjects generally may have changed or grown over time
  - Statistical Regression
    - Regression towards the mean
  - Instrumentation
    - Changes in the measurement device, instrument or process
  - Selection
    - Characteristics of the subjects selected could have influenced the outcome
  - Attrition / experimental mortality
    - Loss of subjects in some treatments or with certain characteristics
  - Interaction

Internal Validity

- In a longitudinal study, we take repeated measurements of subjects at different points in time
  - What are the strengths and weaknesses of such studies as regards internal validity?

Internal & External Validity

- "Campbell and Stanley (1963) say that internal validity is the *sine qua non* of research design, but that the ideal design should be strong in both internal and external validity, even though they are frequently contradictory." (K&L, p. 477)

External Validity

- To what populations can the conclusions from an experiment be generalized
  - Representativeness
    - Ecological representativeness
    - Variable representativeness
- Threats
  - Reactive / interaction effects of *testing*
  - Interaction effects of *selection biases*
  - Reactive effects of *experimental arrangements*
  - *Multiple-treatment* interference

  could all have influenced outcomes and therefore compromise generalizability beyond the subjects actually studied

Research Design Principles

- Design is data discipline
- A design is formally a subset of the Cartesian product of the independent variable(s) and the dependent variable
- A complete design is based on a cross-partition of the independent variables
- We will not discuss incomplete designs
- Analysis of variance is a statistical technique appropriate for experimental designs that is not appropriate if participants cannot be assigned at random and there are unequal numbers of cases in the cells of the factorial design

Research Design Principles

- Design 20.1: Experimental Group – Control Group: Randomized Participants

  - [R] X Y (Experimental)
    ~X Y (Control)

- "Best" for many purposes

Research Design Principles

- Control group
  - Formerly meant exclusively the group that did not receive a treatment
  - This is less obvious when there are multiple levels of treatment
  - More generally, now, it means the particular group against which comparisons are made

Research Design Principles

- Design 20.2: Experimental Group – Control Group: Matched Participants

  - [M_r] X Y (Experimental)
    ~X Y (Control)

- Participants are matched on one or more attributes and randomly assigned to the two groups

Research Design Principles

- Matching versus Randomization
  - Randomization is preferred
  - In practice, matching may be necessary
    - Matching by equating participants
    - Frequency distribution matching method
      - Can be tricky with multiple variables
    - Holding variables constant
    - Incorporating nuisance variables into the research design
    - Participants acting as own controls
  - Matching is only relevant when the variables are correlated with the dependent variable

Research Design Principles

- Design 20.3: Before and After Control Group (Pretest – Posttest)

  - (a) [R] $\underline{Y_b \quad X \quad Y_a}$ (Experimental)
    $Y_b \quad \sim X \quad Y_a$ (Control)

  - (b) [M_r] $\underline{Y_b \quad X \quad Y_a}$ (Experimental)
    $Y_b \quad \sim X \quad Y_a$ (Control)

Research Design Principles

- Design 20.3 supplies a control group against which the difference $Y_a - Y_b$ can be checked
- However, difference scores are problematic unless the experimental effect is strong
- In addition, the pretest can have a sensitizing effect on participants, which decreases both internal and external validity
  - Pretests should be avoided when the testing procedures are unusual

Research Design Principles

- Difference scores can be problematic - differences may be small compared to the error of measurement
- Residualized scores may be used instead
  - Predict posttest scores from pretest scores based on correlations (regression)
  - Subtract predicted posttest scores from actual posttest scores

Research Design Principles

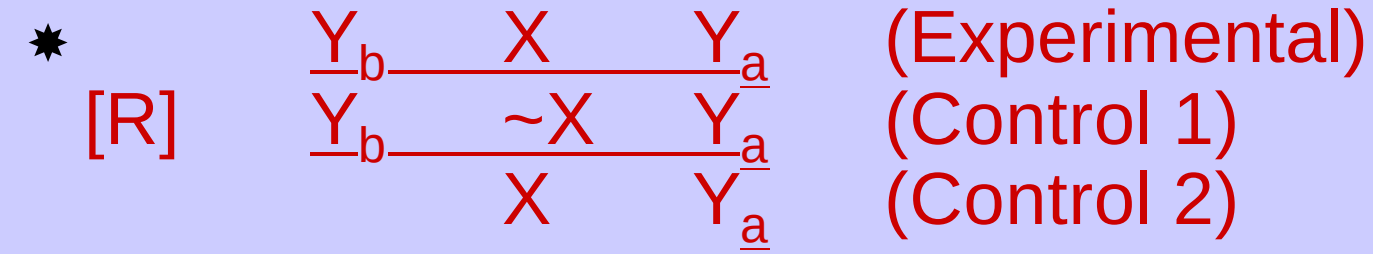
- Design 20.4: Simulated Before – After, Randomized

  - [R] $\underline{\qquad X \qquad Y_a}$
    Y_b

- Improves Design 19.3 by adding randomization, but is still fairly weak

Research Design Principles

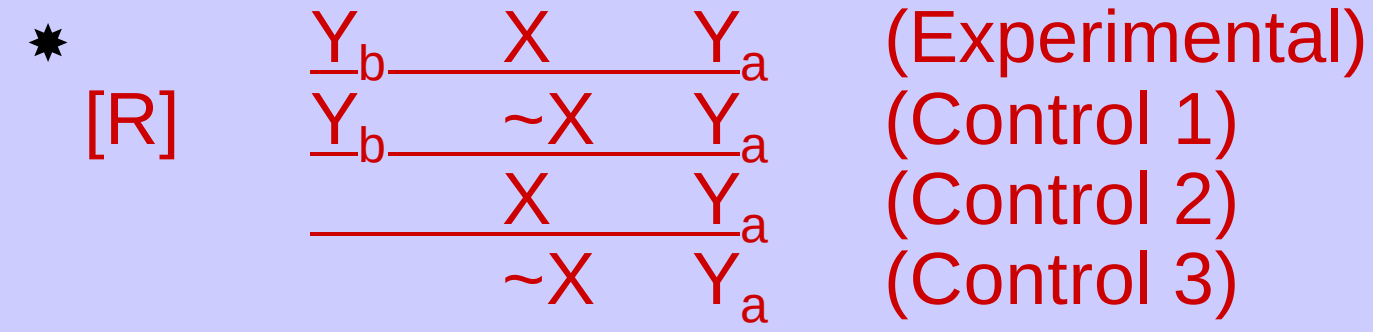
- Design 20.5: Three Group, Before – After



- Improves on Design 20.3 by adding a way of avoiding confounding effects of pretest

Research Design Principles

- Design 20.6: Three Group, Before – After



- Strong, satisfying, potent controls, combines best designs so far (20.1 and 20.3), somewhat impractical, incomplete

Research Design Principles

- We can think of Design 20.6 as a factorial design, crossing the experimental manipulation with pretest – no pretest
- A factorial design is the structure of research in which two or more independent variables are juxtaposed in order to study their independent and interactive effects on a dependent variable
- For those who want to read more, Chapter 21 gives more examples, and also considers alternative designs such as correlated group designs, repeated trials designs, analysis of covariance

Experimental Validity

- Internal Validity
- External Validity
- Construct Validity
- Statistical Conclusion Validity

Experimental Validity

- Internal validity: additional threats (see Cook and Campbell, 1979)
  - Ambiguity regarding causal influence
    - A causes B or B causes A?
  - Diffusion of treatments
    - Experimental and control groups share treatment information
  - Compensatory equalization of treatments
    - Administrative and constituency reluctance to tolerate inequity
  - Compensatory rivalry by respondents
    - Social competition reduces or reverses treatment differences
  - Resentful demoralization
    - Outcomes affected by reaction to *not* receiving desirable treatment
  - Local history effects

Experimental Validity

- Construct validity: threats
  - Inadequate preoperational explication
    - Operationalization not appropriate
  - Mono-operation bias
    - Only one exemplar and / or measure used
  - Mono-method bias
    - All manipulations represented or measures recorded in the same way
  - Hypothesis-guessing
    - Subjects behave as they believe experimenters want
  - Evaluation apprehension
    - Respondents attempt to present themselves as competent and healthy
  - Experimenter expectancies
    - Data obtained can be biased by the experimenters expectancies
  - Confounding constructs and levels of constructs
    - In testing whether A affects B, limited levels of A varied and few levels of B measured
  - Interactions
  - Restricted generalizability across constructs
    - Results apply to constructs examined not to related but distinct constructs

Experimental Validity

- Statistical conclusion validity: threats
  - Low statistical power
  - Violation of assumptions of statistical test
  - “Fishing” and error rates
  - Reliability of measures
  - Reliability of treatment implementation
  - Random irrelevancies
  - Random heterogeneity of respondents

Experimental Validity

- Generally trade-offs must be made between the different kinds of validity
- Precedence
  - For theory-building
    - Internal, Construct, Statistical Conclusion, External
  - Applied research
    - Internal, External, Construct (effect), Statistical Conclusion, Construct (cause)

Experimental Validity

- Classic text:
  "Quasi-Experimentation"
  Cook & Campbell
  Houghton Mifflin 1979
- New Edition:

  "Experimental and Quasi-Experimental Designs for Generalized Casual Inference"
  Shadish, Cook & Campbell
  Houghton Mifflin 2002