Overview of Design: Choosing a Design

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PSY 6217 - Research Design

Research Design

- Plan for the research process
- Structure the process of data collection
- Organize the presentation of findings
- Guide statistical analysis of the data
  - Relation between knowledge of statistical procedures for data analysis and good design

Characteristics of Correlational Research

- Data consist entirely of observations or measurements
- No direct manipulation of variables
- No clear “independent” and “dependent” variables
  - Criterion (Target) Variable
  - Predictor Variables
- Problems in the interpretation of findings
  - Missed relations: the third variable problem
  - Directionality problem (ambiguous interpretation of relations)

Characteristics of Experimental Research

- Clear identification of independent variables (IVs) as potential causal agents
- Direct manipulation of independent variables
- Control of extraneous variables to eliminate rival explanations
  - Hold the extraneous variable constant
  - Manipulate the variable as another IV
  - Randomize the effects of the variable across conditions
- How important is the random selection of participants?
- Random selection versus Random assignment

Types of Design & Research Questions

- Correlational Designs
  - Descriptive research (Naturalistic Observations)
  - Development of Predictive Models
    - Multiple regression and other correlational methods
- Naturally Occurring Manipulations
  - Ex post facto designs
  - Quasi-experimental designs
- Experimental Research
  - Identify causal relations between variables

Validity of Research

- Internal Validity
  - Does this design provide an unambiguous answer to the research question?
  - Elimination of alternative (rival) explanations
- External Validity
  - Generalizability of conclusions based on the research
  - Are these findings likely to be replicated?
  - Will these variables have the same effect in other situations?
Criteria for Credible Arguments (Abelson, 1995)

- **Magnitude**
  - Size of the effects produced
- **Articulation of Findings**
  - Level of detail and specificity used in describing the effects
- **Generality**
  - Breadth and applicability of the conclusions
- **Interestingness**
  - Theoretical interest: potential to change belief
  - Importance of the issues addressed
- **Credibility**
  - Sound methodology - Internal validity
  - Theoretical coherence

Relation between Smoking & Lung Cancer

- **Multiple sources of converging evidence in support of this relationship**
  - Effects of duration of exposure
  - Dose effects
  - Reduction of risk with smoking cessation
  - Pattern of the location & types of cancer
  - Association with other respiratory diseases (common mechanism - similar effect)
  - Effects of different types of exposure (cigars, pipes, second-hand smoke, etc.)

Why Research Claims Might not be Persuasive

Failure to meet two or more of Abelson's criteria:

- Poorly run procedures (or too small samples) fail to produce significant effect sizes
- Inadequately detailed analysis of findings
- Methodological problems - problems with internal validity
- Lack of credibility for research procedures as manipulations or measures of theoretical variables
- Claims run counter to strongly-held theory or common sense
  - Claim based on an artifact produced by confounding or other design flaws?
  - Burden of proof is on the investigator

Impurities in Procedures

- **Correlational studies**
  - Mediating variables (another variant of the third variable)
  - e.g., correlation between picnics and red welts (mediating variable - mosquito bites)
  - Note how an experiment can solve this problem
- **Experimental studies**
  - Confounded variables
  - Requires a new study in which the confounded variable is adequately controlled
  - False confounds can be dealt with logically
    - "smoking doesn’t cause cancer, tar does"
    - "guns don’t kill people, bullets (people with guns) do"
- **Procedural biases**
  - Experimenter effects
  - Demand characteristics

Third Variable Problem

- Primarily a problem in correlational research
- Failure to make observations on a critical variable associated with the system under study
- Converging operations - coping with the third variable problem
  - Multiple procedures for examining the relation all point to the same interpretation
  - Web of evidence in support of the relation develops explanatory coherence
  - Catalog of potential third variables becomes so extensive and arbitrary that it loses its power as a counterargument

Threats to Internal Validity
(Campbell & Stanley, 1963)

- **History**
- **Maturation**
- **Testing (effects of a pretest)**
- **Instrumentation (calibration issues)**
- **Statistical Regression**
- **Selection Bias**
- **Differential Mortality**
Statistical Regression
- Artifact associated with the effects of random error on means of small samples
- Designs are vulnerable to regression artifacts whenever groups are created based on scores on a pretest
  \[ \text{Test score} = \text{True Score} + \text{Error} \]
- Groups created on the basis of extreme scores on a pretest will tend to obtain similar scores on the post-test (even in the absence of a treatment)

Threats to External Validity
- Reactive Effects of Testing
  - Pretest reactivity
- Reactive Effects to Experimental Arrangements
  - Psychosocial effects of the experimenter
  - Experimenter expectations
  - Demand characteristics
  - Bias associated with stimulus materials or procedures
- Interaction between selection bias and effects of the IV
  - Effects are limited to the individuals in the sample
- Multiple treatment interference
  - Exposure to one treatment condition alters response to later conditions (carry over effects)

Research Settings
- Laboratory Experiments
- Simulated Environments
- Field Experiments
- Naturalistic Observations
- Realism (Aronson & Carlsmith, 1968)
  - Mundane realism
  - Experimental realism