

Experimental Design

- Subjects & conditions are manipulated by the investigator
 - ▣ Sample
 - ▣ Treatment group
- Considered more powerful than nonexperimental studies in uncovering causal relationships among variables
- Confounding of subject characteristics can be handled by
 - ▣ Randomly assigning subjects to groups
 - ▣ Choosing subjects at the same level of the confound variable
- Confounding of treatment variables can be handled through careful design and planning of the study

Nonexperimental Design

- Investigator may identify conditions
- Subjects are not assigned; rather, they naturally fall into conditions
- Differs from experimental designs only in the amount of manipulation of subject and conditions
 - ▣ Can cause problems in the interpretation of results
 - ▣ Unable to assure extraneous factors are properly controlled
- When subject assignment doesn't occur, the study is nonexperimental even if a treatment is created

Variables

- Qualitative or quantitative entity that can vary or take on different values
- For convenience, the distinction between independent and dependent variables is often made
- Multiple independent variable study is most common, though multiple dependent variable study is increasingly popular
- 4 levels of measurement: nominal, ordinal, interval, ratio

Measurement error

- Random error: nonsystematic, as frequently in one direction as the other
- Bias: error more often in one direction than the other
 - ▣ Distortions in procedures
 - ▣ Characteristics of instruments, observers, and investigators
- Multiple measures of a characteristic is a common means to address error

Reliability

- Reliability: consistency of a measuring device
- Increased by the use of multiple measurement or multiple measures
- Test-retest
- Equivalent forms

Validity

- An instrument measures what it is supposed to measure
- Validity and reliability go hand-in-hand
 - ▣ Instrument can be reliable but not valid
 - ▣ To be valid, an instrument must be reliable
- Internal validity, external validity
- Convergent validity, divergent validity

Control

- Cornerstone of experimental design
- Holding constant, or varying systematically, variables in order to
 - ▣ Remove their effects
 - ▣ Compare to other conditions
- Limiting to certain values of a control variable may reduce generalizability to other values
- Control group is a group in which levels of the IV are held at base or comparison levels

Randomization

- Assignment of subject to
 - Conditions
 - Levels of an IV
- By the investigator or a natural process in the field

Confounding

- Variables, related to variables of interest, which distort or confound the results

Generalizability

- Do the results found in the present study hold as well for other samples of subjects at other locations?
- Sources of internal invalidity
 - ▣ Instrument reactivity, history, unreliability of measures, differential subject loss across groups, bias in treatment assignment, instrument changes over time
- Source of external invalidity
 - ▣ Instrument reactivity, Hawthorne effects, invalidity of instruments, confounding characteristics of particular samples (i.e., nonrepresentative samples)

Steps in designing a study

1. Formulate a researchable question

- Eventually stated such that a testable hypothesis or model is generated

2. Plan the design of the investigation

3. Variable definition

- Selection of instruments for DVs
- Operationalization of IVs

4. Conduct the study

Campbell & Stanley Notation

- O = observations or measurement of variables
- X = applications of IVs or treatments
- Times sequence of O's and X's run from left to right

One-group designs: Pretest-Posttest

- Nonexperimental, as there is no assignment of subjects to conditions
- Pretest-posttest design: $O_1 \quad X \quad O_2$
 - ▣ Subjects serve as their own control
 - ▣ Comparisons are made before and after treatment
 - ▣ Shortcoming: cannot be sure the some factor or event other than the treatment was responsible for change
 - ▣ Simple statistical procedures are appropriate
 - ▣ Often use for program evaluation

One-group designs: Interrupted time series

- Direct extension of pretest-posttest design with more than two measurements
- Used when periodic data exist over a considerable length of time, and the purpose of the study is to determine whether the variables of interest change at a specified point in the time series
- Example: $O_1 \quad X \quad O_2 \quad O_3 \quad O_4 \quad O_5$
- While more powerful than single pretest-posttest, suffer from most of the same shortcomings
- The advantage is that one can see the direction in which trends were heading at the time of the treatment

One-group designs: Correlational designs

- Purely observational
- Cross-sectional design: ○
- Attractive in field studies when control over subject is quite difficult to acquire
- Useful in determining if two or more variables are related (often the extent of the research question)
- Multiple regression can be used for theory testing, and provide weak support for causal models
- Improvement in causal testing is measurement at some later point: ○ ○'
 - ▣ Variables predicted to be causes are measured first, followed later in time by variables expected to be effects
- Shortcoming: only establishes relationships
 - ▣ Common method variance—a serious problem

One-group designs: Correlational and longitudinal correlational designs

- Improvement in causal testing is measurement at some later point: $O \quad O'$
 - ▣ Variables predicted to be causes are measured first, followed later in time by variables expected to be effects
 - ▣ Shortcoming: only establishes relationships
 - ▣ Common method variance—a serious problem
- Longitudinal or panel design: 2 or more measurements of the same variables:
 $O_1 \quad O_2 \quad O_3 \dots O_n$
 - ▣ history, instrument reactivity, and Hawthorne effects pose problems