Experimental Research Manipulation & Control

- Tests to establish cause and effect relationships
- Has strongest chain of reasoning between and among links

The Researcher (the Manipulator)

- Manipulates at least one independent variable
- Controls other relevant variables
- Observes the effect on one or more dependent variables

The Researcher

- Establishes who gets what
- Causal – comparative researcher can not control “who” got “what”

The Independent Variable

- Called the “treatment” causal or experimental variable
- Is believed to make a difference

Independent Variables in School

- Models of teaching
- Methods of instruction
- Type of reinforcement
- Structure of learning environment
- Type of learning materials
- Length of treatment

The Criterion Variable (Effect) Dependent Variable

- Shows result (outcome)
- Change or difference

Experimental Research

- In a word STRUCTURE

The Process

- Select and define a problem
- Select participants
- Select measure
- Select / draft research plan
  - Design
  - Execution
  - Analysis of data
  - Formulation of questions

The Guide

Experimental studies are guided by at least one hypothesis that states an expected causal relationship between two variables

Researcher Duties (Process)

- Selection of groups
- Decision of treatments
- Decision of treatment for groups
- Control of extraneous variables
- Measurement of effect of treatment

Experimental Research is Unique

- Randomly selected from a well defined population
- Researcher randomly assigns groups to treatment
- Researcher”s manipulation of the treatment is a unique characteristic

Comparison

- Three Types
  1. Comparison of two approaches
  2. Comparison of new to traditional approach
  3. Comparison of amounts

Groups

- Experimental - receives treatment
- Control group - used as a comparison
  - Can receive treatment
  - Refers to type of comparisons

Keeping Groups Equal

- Equate all variables that may influence treatments
- Use random or stratified sampling procedures

Treatments

- Administer treatments
- Keep groups as equal as possible on all but independent variable

Data Collection and Analysis

- Occurs after treatment
- Data collected on dependent variable
- Determine if a significant difference between group's performance
- Use statistical analysis

Two Problems

- Lack of sufficient exposure to treatments
- Failure to make treatments substantially different

Manipulation

- Direct responsibility of researcher
  - Selection of number and type of treatments
  - Randomly assigns participants to treatments

Control

- Researcher's effort to remove influence of variables (other than independent variable) that may affect dependent variable
- Control participant variables
- Control environment variables

Threats

- Uncontrolled extraneous variables
- Too much control (laboratory)
- Less realistic
- Less generalizable

Internal and External (Ecological) Validity

- Results due to manipulated variable
- Results are generalizable beyond experimental setting

Threats to Internal Validity

- History
- Maturation
- Testing
- instrumentation
- Statistical regression
- Differential selection of participants
- Mortality
- Selection – maturation interaction

History

Events not part of treatment but occur during study and affect result

Maturation

- Natural change in participants
  - Physical
  - Intellectual
  - Emotional

Testing

- Pretest effects on posttest

Instrumentation

- Unreliability of inconsistency in measuring instrument
- Pretest and post test be of equal difficulty
- Observable data
  - Tend to record what is expected (unconsciously)
- Mechanical data collection
  - Device must be carefully calibrated
- Use extreme care in selecting test, observers, and devices

Statistical Regression

- Participants who score high on first test score lower on second (vise versa)
- Scores tend to move toward mean (average)

Differential Selection of Participants

- Using already formed groups
- Groups may be different

Mortality

- Attrition – participants drop out of study
- Drop out for
  - Different reasons
  - Different frequency
- Changes characteristics of groups
- Obtain demographic information of groups and compare data at end of study
- Provide incentive for participants to remain

Selection – Maturation Interaction

- Use of already formed groups
  - May mean one group may profit more (or less) from treatment
  - May have initial advantage
  - Study Table 11.1 page 376

Threats to External Validity

- Pretest treatment interaction
- Selection treatment interaction
- Multiple treatment interference
- Specificity of variables
- Treatment of diffusion
- Experimenter effects
- Reactive effects

Pretest – Treatment Interaction

- Participants respond or act differently to treatments BECAUSE of pretest
- Seriousness of threat dependent
  - Participants
  - Nature of dependent and independent variables
  - Duration of study
- Studies that require self-report (attitude and interest)

Multiple Treatment Interference

- Participants receive more that one treatment (carry over effects)
- Minimized by
- Using only one treatment
- Allowing sufficient time between treatments
- Participants participate in more than one study, gather and evaluate information on previous studies

Selection – Treatment Interaction

- Similar to differential selection of participants
- Occurs when participants are not randomly selected
- An un-controlled variable
- Accessible population often differs from target

Specificity of Variables

- Refers to studies with
  - Specific kind of participant
  - Based on particular operational definition of independent variable
  - (use) specific dependent variables
  - Specific times
  - (under) specific set of circumstances

Specificity of Variables (cont.)

- Refers to studies with
  - Detail research procedures
  - Use clear definitions of variables
  - Describe short-long term extraneous events
  - To lessen time effects measure dependent variable several times
  - Carefully state conclusions and generalizations

Treatment Diffusion

- Groups communicate and learn from one another
- Treatments change from two distinct treatment to two overlapping ones
- Request that participants not communicate with another during study

Experimenter Effects

- Experimenter unintentional effects
  - Study procedures
  - Behavior of participants
  - Assessment of performance

Passive Effects

- Experimental personal – attributes effects
  - Age
  - Gender
  - Race
  - Hostility level
  - Anxiety level

Active Effects

- Experimenter bias effects
- Researcher's expectations influences study results
  - Previous knowledge of participants
  - Knowledge of which participants are in which groups
- Score dependent variables "blind"

Reactive Arrangements

- Participant Effects
  - Ways in which study is conducted
  - Artificial experimental environment
    - Participants knowledge of “specific” treatment
  - Hawthorne Works of Western Electric Company 1927

John Henry Effect

- Compensatory rivalry
  - Participants in control group challenge experimental group's treatment

Placebo Effect

- Used to control group's reaction to study
- All participants believe they are receiving treatment

Novelty Effects

- Participant's increased interest motivation or engagement in study
- Participants perform better because they are doing something new
- To counteract increase time of study

Table 11.2 page 383

- Summary of External Threats to Validity

Types of Extraneous Variables

- Participant
  - Characteristics of participants
  - Cannot be altered, must be controlled
- Environmental
  - Variables that intervene between dependent and independent variables
  - Cannot be observed but must be controlled

Randomization

- Controls threats of validity
  - Selection of sample
  - Selection of groups
  - Selection of which group receives treatment

Pair-Wise Matching

- Used to equate groups on one or more variables
  - Base match on participant characteristics
  - One member of each pair is randomly assigned to groups (one of each)
  - Participants without a match are excluded
- Major problem
  - Difficulty of finding matches
  - Exclusion of participants

Ranking

- Related to matching
  - Rank all participants highest to lowest on scores of first variable
  - Highest two become first pair and so forth
  - Pairs randomly assigned
- Prevents participant loss
- Less specific that pair-wise matching

Participants as Controls

- Use single group
- Group receives different treatments over time – one treatment at a time
- Problem
  - Carryover effect
- Solution
  - Divide group (randomly)
  - Each subgroups receives both treatments but at different times

Analysis of Covariance

- Statistically equates groups on one or more variables
- Most appropriately used when randomization is used to form groups
- Not universally useful
- Cannot be used if relationship between variables is curvilinear

Types of Group Design

- Determine which designs are appropriate for study
  - Random
  - Stratified
- Which designs are feasible given constrains
- Which will control most sources of internal and external validity threats

Classes of Experimental Designs

- Single variable
  - Pre-experimental
    - Do not control threats to validity
    - Results are questionable
    - Can be used as preliminary investigation
  - True experimental
    - High degree of control
    - Always preferred
  - Quasi-experimental
    - Some control

Classes of Experimental Designs

- Factorial
  - Investigate two or more variables

Turn to Figure 11.1 page 388

Define

Pre-Experimental

- One shot Case Study (387)
- One Group Pretest – Posttest (389)
- Static – Group Comparison (389)

Define

Free Experimental

- Pretest – Posttest Control Group (392)
- Posttest – Only Control Group (393)
- Solomon Four Group Design (394)

Define

Quasi – Experimental

- Nonequivalent Control Group (395)
- Time – Series (395)
- Counterbalanced (396)

Factorial Design

- Factorial
- Involve more than one independent variable
- Purpose is to determine if effects are generalizable across all levels
- Study Figures 11.4 and 11.5 pages 398 and 399
- Each additional variable increases number of participants needed
- Interpretations become difficult

Single – Subject Experiments

- One participant or one group (unit)
- Used to study behavior change
- Participants serve as own control
- Participant is given a non-treatment and treatment phase; behavior is measured in both phases

Validity in Single-Subject Design

- External Validity
  - Results are not generalizable to group
  - Key to external validity concerns is replication
- Internal Validity
  - Use proper controls

Repeated and Reliable Measurement

- Time-series pretest a number of times before treatment
- Single-subject multiple pretests are called baseline measures
- Invalidity sources are controlled in ways similar to time-series
- Difference: performance is measured a various points while treatment is applied

Internal Validity Threat

- Instrumentation – unreliable on inconsistent measuring instruments
- Obtain observer reliability
- Standardize observer conditions

Specificity

- Treatment must have same procedure each time
- Standardize for replication

Baseline

- Purpose to provide detailed description before treatment is introduced
- Serves as comparison
- Trends can affect number of baseline data points needed
- Length of treatment phase and number of measures taken should parallel the baseline phase

Single Variable Rule

- In single subject studies the principle is only one variable at a time should be manipulated

Types of Single –Subject Design

- A-B-A withdraw
- Multiple-baseline
- Alternating treatments

A-B-A Withdraw Designs

- A-B (page 404)
  - Least complex
  - Internal validity in question
- A-B-A (page 404)
  - Internal validity improved
  - Treatment is withdrawn following baseline assessment
  - Ethical questions about withdrawing beneficial treatments exist
  - Variation is B-A-B design treatment – withdraw - treatment

A-B-A-B

- Overcomes ethical consideration of A-B design
- Strengthens research conclusions

Multiple Baseline Design

- Used when not possible to withdraw treatment
- Used when there are “carry over” effects if treatment is withdrawn
- Types of multiple baseline
  - Across behaviors
  - Across participants
  - Across settings

Data Collection – Multiple Baseline Collection

- Several behaviors for one participant
- One behavior for several participants
- One behavior on one participant in several settings

Alternating Treatment

- Aliases
  - Used to assess relative effectiveness of two (or more) treatments
  - Multiple schedule design
  - Multiple manipulation design
  - Simultaneous treatment design
  - Involves relatively rapid alteration of treatments for single subject
  - Treatments altered in random pattern

Advantages and Disadvantages

- No withdraw necessary
- No baseline necessary
- Members of treatments can be studied more quickly
- Carry over effects can occur

Data Analysis and Interpretation

- Based on visual inspection and analysis of graphic representation of results
- Evaluate design
  - Assess effectiveness of treatment
  - Clinical not statistical significance

Replication

- More times results are replicated the greater confidence in procedures
- Establishes generalizability of findings
- Types in single – subject designs
  - Direct (same researcher)
  - Systematic (different researcher, behavior, or settings)
  - Clinical (treatment packages)