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 than 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 than 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 at 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)