

# Lecture 9: Strategies

Dewayne E Perry

ENS 623

[perry@ece.utexas.edu](mailto:perry@ece.utexas.edu)

# Independent Variables

## → Manipulated variables

- ↳ If an experiment, one expects manipulation
- ↳ Intentional and systematic variation

## → Naturally occurring variables

- ↳ Manipulated by real life experience
- ↳ Eg, desk versus meeting inspections
- ↳ Context: normal or exceptional conditions

## → Static group variables

- ↳ Pre-existing groups with identified characteristics:
  - Organismic variables: sex, age, weight, etc
  - Status variables: education, occupation, marital status
  - Attribute variables: diagnoses, personality traits, behaviors
- ↳ Cannot be manipulated - but are selected to gain proper contrast groups

# Independent Variables

- ↳ Analogous to experimental treatment
- ↳ When used as a dependent variable, may make inferences as to how the group acquired its characteristics
  - Eg, overweight lowers self-esteem
  - Lower self esteem causes overweightness
- ↳ Risk of causal inferences -
  - Tempting but risky
  - Dependent variable not an accurate descriptor
  - At best an association, connection, relationship, correlation
  - Example of weight/esteem experiments
    - ✓ Case 1: high calorie diet -> check esteem
      - Ethical problems
    - ✓ Case 2: overweight + low calorie -> raise esteem
      - Doesn't prove overweight, low esteem
    - ✓ Case 3: overweight + success -> lower weight
      - High esteem, low weight doesn't prove le/ow
    - ✓ Must be careful about the logic

# Independent Variables

## ↪ Unidirectional paths

- Eg, height and self-esteem - cannot switch
- Fixed by logic of antecedents and consequences
- Multiple variables: income, age -> truancy, discipline
  - ✓ Need 2x2 analyses
  - ✓ Question: does income discriminate truancy and discipline problems

## ↪ One-way, non-causal enabling relationships

- Eg, income - IQ -> income
- But not vice versa

## ↪ Two-way, sequential causation

- Eg, success-failure and self-confidence
- Eg, baseball players slumps, hitting streaks

## ↪ → *Causation established by experimentation*

- Manipulation
- Using static variables is descriptive/relational
- But not experimental

# Independent Variables

## → Establishing levels of independent variables

### ↪ First decision: categorical or continuous

- Eg, age is continuous, sex is categorical
- If continuous data, whole range, dichotomous, or graduated
- Risky as information is lost
- May be theoretical reasons for categories

### ↪ If hypothesis is state in categorical terms, then should be consistent

### ↪ If a relationship, not appropriate to break into dichotomies or nominal categories if variable is continuous

- For theoretical or rational, not statistical reasons

### ↪ Examine how the levels of categories established

- Should be consistent with hypothesis
- Possible groupings: extremes, ranges of categories, median split (as in IQ)

# Independent Variables

- ↪ **Continuous full-range distribution**
  - Sometimes linear correlations, sometimes not
  - Eg, learning (perhaps), visual acuity (not)
- ↪ **Theory driven levels**
  - Hypothesis stated consistently with current theory
- ↪ **Strength of independent variable (magnitude of effect)**
  - Extreme groupings tend to magnify effect
  - Increasing magnitude may reduce generality
  - Can more easily argue weaker to stronger (eg, stress) and have great generality
  - Levels of independent variable should match hypothesis

# Time Sequencing

## → Prospective

- ↳ Predict consequences or effects from known antecedents/causes
- ↳ Where not in control of independent variable, must be careful about causality

## → Retrospective

- ↳ Postdicts antecedent or cause from known causes
- ↳ Obviously independent variable cannot be manipulated
- ↳ Lack control over other factors
- ↳ Have to weigh credibility, validity of causal statements
- ↳ However, a rich source of descriptive, correlative studies
  - Expands knowledge, generates hypotheses, basis for further experiments

# Time Sequencing

## → Longitudinal versus cross-sectional

- ↳ Time is a primary factor
- ↳ Cross sectional is quicker, more feasible to carry out
- ↳ But more chance for error
  - Not the same subjects at different times
  - May not be equivalent in important aspects
- ↳ Eg, Lucent time studies

# Lab versus Field

## → Genuine situations

- ↪ Can be powerful
- ↪ But there are ethical considerations
- ↪ Can be very costly (eg, real life programmer studies)

## → Analog-simulated situations

- ↪ As if, parts of the experimented simulated
- ↪ Eg, pilots and flight simulation
- ↪ Must scrutinize the kinds of claims and generalizations made

## → Field studies

- ↪ Natural habitat (mislabeled *in vivo*, should be *in situ*)
- ↪ Difficult to control all variables
- ↪ But with SWE, preferred for various validity claims

## → Lab studies

- ↪ Tightly focused
- ↪ Analog studies - part of it is simulated
- ↪ Limit uncontrolled variables

# Lab Experiments

## → Virtues

- ↪ May test causal hypothesis directly
- ↪ Complete control is possible
- ↪ Independent variables can be manipulated
- ↪ Random assignment can be done
- ↪ Precision of measurement is possible
- ↪ Internal validity is high

## → Weaknesses

- ↪ Lack of strength of independent variables
- ↪ Artificiality
- ↪ Weak external validity

# Field Experiments

## → Virtues

- ↳ Suitable to social and educational problems
  - And to SWE problems
- ↳ Subject to independent variable manipulation
- ↳ Subject to random assignment

## → Weakness

- ↳ Controls not as tight as would like
- ↳ Often very expensive

# External Validity (EV)

- SWE: lab studies tend to be with students and that restricts EV and generalization
- Ecological validity: representativeness of the real world
- Efficacy vs effectiveness studies
  - ↳ Former very rigorous, latter more open
  - ↳ Former needs to be more concerned with EV
  - ↳ Latter with internal validity

# External Validity

- For many, EV and  $G$  are synonymous
- For some, external validity is bound by intent and claims (they must agree)
  - ↳ One might not claim to generalize
  - ↳ But claim that intent and claims agree
  - ↳ Ie, external validity is good
- EV: *the demonstrated validity of the generalizations that the researcher intended the research to make at the outset and the validity of the generalized inferences that the researcher offers at the end*

# Generalizability (G)

## → Generalizable considerations

- ↪ People
- ↪ Researchers
- ↪ Places, environments, settings
- ↪ Time
- ↪ Treatments, levels of treatments
- ↪ Procedures, conditions and measurements
- ↪ Technology

# Reproducibility

- Key to generalizability is whether the study can be reproduced
- Replication is an exact as possible repeat
  - ↳ Same procedure, different sample
  - ↳ Look for congruent results
- Replications on a broader set of subjects under additional conditions further strengthens generalizability