RESEARCH DESIGN

A Plan for Research

A RESEARCH DESIGN

- A Plan of Action = Design LOGiC &
  A detailed plan for data collection and analysis: “Everything but cell entries in the tables!”
Choosing a Research Design:
LOGICAL considerations

- What type of question am I asking?
  - Purpose?
  - Exploratory (a case study)
  - Descriptive
  - Explanatory
  - Predictive
  - Policy Evaluation (Pilot study)

What Research Design Logic would be most desirable?

- What do I want to explain?
  - What are my Xs? Ys? Cnts variables?
- When (cross-sectional or longitudinal?)
- About WHOM?
  - Units of Analysis
  - Level of Analysis
- How Can I avoid LOGICAL FALLACIES?
**SCOPE of Research**

- “Spacial-temporal domain” (where & when)
- What are your “units of analysis”? individuals or aggregates
- “MICRO” vs “MACRO” level
- What domain? population or sample
- Time Frame?

**What measurement procedures should I use to collect data?**

- Experiment - lab, field, quasi-experimental
- Participant Observations (unobtrusive)
- Interviews
- Surveys
- Secondary Data analysis (existing sources)
  - Content Analysis (any trace record)
  - Comparative case studies (library sources)
Experiments are the STRONGEST Design Logic

- The “best” research design to determine CAUSAL RELATIONS
- Why not used more often in Education?

Why Best? -- CONDITIONS necessary to demonstrate CAUSALITY

- EMPIRICAL (*)
- *1) Time Order
- *2) Correlation
- *3) No other Xs
- 4) Plausibility
- 5) Consistency
CHARACTERISTICS of an EXPERIMENT

- RANDOM assignment: \( 0_1 \times 0_2 \) (EXP Group)
  \( 0_3 \times 0_4 \) (CNT Group)

- Temporal order: \( 0_1 \times 0_2 \)
- Physically manipulate: \( X \) (Treatment)
- Physical ISOLATION controlled conditions
- Minimizes “confounding” influences

CHARACTERISTICS of an EXPERIMENT (5)

- MAXIMIZES
  - Lab Experiment:
    - \( 0_1 \times 0_2 \)
    - Control Group
    - \( 0_3 \times 0_4 \)
  - Researcher’s CONTROL
- MINIMIZES
  - CONFOUNDING
  - influences
Use Experimental designs whenever possible

- Types of EXPERIMENTAL DESIGNS:
  - Laboratory
  - Field Experiment
  - Quasi-Experimental

Advantages of a LAB EXPERIMENT???

- INTERNAL VALIDITY: HIGH

  “Confounding influences associated with exp conditions”
DISADVANTAGES of a LAB EXPERIMENT

- EXTERNAL VALIDITY: VARIABLE
- “Generalizability to other contexts” may be limited

Use another EXPERIMENTAL DESIGN: Field Experiments

- Useful to evaluate EFFECTIVENESS of a public policy program.
- Example: “Does HEAD START improve performance of low SES kids?”
- Exp Group: Exposed to Head Start
  - $X_{01}$
  - $X_{02}$
- Control Group: NOT
  - $0_3$
  - $0_4$
- Controversial-->
- Random assignment to groups!!!
Results of Head Start Policy Experiments?

- “Does HEADSTART improve performance of low SES kids?”
  - YES – 1st grade
  - Some – 2nd grade
  - NO DIFFERENCE – 3rd grade
- EVALUATION?

Interpreting Policy Evaluations

- Short vs Long effect
- Intended vs Unintended impacts
- What was purpose or INTENT of PROGRAM???
- Note: Politics NOT science can confuse interpretations!!!
Use QUASI-EXPERIMENTAL DESIGNS

- FIELD EXPERIMENTS for policy evaluations
- Example: Connecticut Crackdown on speeders

- CONNECTICUT
  - 0₁ X 0₂
  - 2nd state = CONTROL
  - 0₃ 0₄

- Similar on “ALL OTHER Relevant Variables” (Zs-)

Connecticut Crackdown Study

- Does increased speed CRACK DOWN (X) reduce AUTO FATALITIES??
Results of CONNECTICUT CRACKDOWN STUDY?

- Does X (Crackdown) lead to Y (reduced auto fatalities?)
  - Answer: YES

- Confounding influences??

Use the “logic” of an experiment whenever possible

- Even with non-EXPERIMENTAL Designs,
- Comparative Case Studies
- Surveys, interviews
- Aggregate (interrupted) time series analysis
“Think” like an experimentalist when DESIGNING research

- TYPES of RESEARCH DESIGNS:
  - EXPERIMENTAL
  - NONEXPERIMENTAL

Try to use EXPERIMENTAL Design CHARACTERISTICS

- 5 CHARACTERISTICS of an Experiment
- Random assignment of subjects (ESs)
- CNT and EXP Groups
- PRE & POST Measures $O_1$, $O_2$
- Physical manipulation of $X$
- Reduce impact of “confounding” influences (other variables or “Zx”)
WEAKEST RESEARCH DESIGN

■ “ONE SHOT”

■ CASE STUDY

■ WHY???

“One-shot” Case Study: Pre-experimental design

X  0₁

■ Problems:
■ Post-test only
■ Must infer “X” to be causal agent
■ Lots of “confounding” (i.e., unmeasured) variables
“One-shot” Case Study: Why Use?

- EXPLORATORY research
- In-depth understanding of processes
  - hypothesis generation.
  - First stage of research....goal....>
- GENERALIZE

How to “Strengthen” this design?

- Add pre- and post test
- Add CASES
- Add data points
- QUASI-Experimental
  - logic 0₁ X 0₂
  - Case #2 0₃ 0₄
- COMPARATIVE CASE STUDIES
- TIME SERIES
CORRELATION DESIGNS:
30+ cases

- CROSS-SECTIONAL correctional designs
- Case #1 X1  X2  Y1
- Case #2  "  "
- Case #n  (30+)

- TIME SERIES
- CORRELATION DESIGNS
- 0_1  0_2  0_3  0_4  0_n  (30+ data)

- ONE CASE OVER TIME

"STRONGEST" Experimental Design

- SOLOMON 4 GROUP DESIGN:
- Group #1  0_1  X  0_2
- Group #2  0_3  0_4
- Group #3  X  0_5
- Group #4  0_6

- Purpose of 4 groups?
To reduce “TEST EFFECTS”

- “Test Effect”
- changes associated with pre-test

SOLUTION

Solutions to avoid TEST EFFECTS

- No pre-test
- Solomon 4 Group Experimental Design
- Use Unobtrusive measurement
THREATS to INTERNAL VALIDITY

- “TEST effects” only
- 1 of 10 THREATS
- INTERNAL VALIDITY = confounding influences associated with experimental (research) conditions

VERY important RULE

- Evaluating ACCURACY of results
- You must be sure there were NO THREATS to INTERNAL VALIDITY before you can generalize to other contexts
- (EXTERNAL VALIDITY)
THREATS to INTERNAL VALIDITY (10)

- No.1: Differences in Characteristics SUBJECTS
- SOLUTION???

Threat to Internal Validity No. 1: Differences in Ss Characteristics

- SOLUTION???
- RANDOMIZE
Threat to Internal Validity No. 2

- HISTORY EFFECTS:
  - events or confounding influences occurring between pre- and post- test
  - (changes in environment)

SOLUTION???

- To Avoid HISTORY EFFECTS???
Threat to INTERNAL VALIDITY No. 3

- MATURATION:
  changes in subjects between pre- and post-tests

- SOLUTION???

Threat to INTERNAL VALIDITY No. 4

- TEST EFFECTS:
  changes associated with pre-test

- SOLUTION???
THREAT to INTERNAL VALIDITY No. 5

- **INSTRUMENTATION:** Changes associated with change or decay in test instruments
- **SOLUTIONS??**

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THREAT to INTERNAL VALIDITY NO. 6

- **SUBJECT MORTALITY:** Loss of subjects
- **SOLUTIONS??**
Threat to INTERNAL VALIDITY NO. 7

- REGRESSION towards the mean
- unreliable measures (values) due to choice of extreme values for subjects
- SOLUTION

Scores on test
- $f$
- 100% x Es#1
- xxxx
- 50% xxxxx
- xxxxxxxx
- 0% xxxxxxxxxxx

SOLUTION: Randomize

- Best way to minimize “atypical values”
- Can calculate “odds” or “p value” of getting an extreme score
Another Solution

- REPLICATION:
  Repeat same study with AT LEAST ONE new wrinkle

- If sample representative should get same results

THREAT to INTERNAL VALIDITY NO. 8

- REACTIVITY (HAWTHORNE Effect):
- artificial change produced by measurement process
- SOLUTION???
THREAT to INTERNAL VALIDITY NO. 9

- EXPERIMENTER BIAS
- SOLUTION???

INTERNAL THREAT to VALIDITY No. 10

- INTERACTION EFFECTS:
- Effect caused by any combination of the above threats
- SOLUTION???????
INTERACTION effects

- Is the “WORST” threat to validity:
  - can’t control
  - can’t always predict
  - must try to avoid

Threats to EXTERNAL VALIDITY

- “Generalizability”...

- To what extent will your findings apply to other contexts????
How Representative was experiment?

- CRITERIA: Judgmental
- Are SUBJECTS representative?
- Is experimental SETTING representative?
- Are MANIPULATIONS & MEASURES of X & Y representative of all Xs & Ys?
- Are there UNIQUE circumstances associated with the EXPERIMENTAL CONDITION NOT present in other contexts?

GENERALIZABILITY of results

- Internal/External Validity are often …
- a subjective judgment… Are you measure what you claim to be measuring???
EXTERNAL VALIDITY

To what extent can your findings be applied to other contexts?

Choose Data Collection Method and Analytical Routines

- Data Collection Methods:
  - 1+ Case studies
  - Experiment
  - Surveys (1 time pt)
  - Content analysis
  - Aggregate data analysis
    - (cross-sectional)
    - (time series)

- Analytic method (stat)
  - Qualitative (none)
  - ANOVA; $x^2$
  - Factor Analysis
  - Descrip.stats;p<.05
  - Regression
  - Correlation
  - Time Series
Design Logic... determines Measure & Analysis

- Example
- Descriptive study of US public opinion.
- Cross-sectional (1 pt)
- Units = individuals
- Measurement = survey
- stats: regression, factor analysis

Research QUESTION determines Research Design Selection

- i.e., Study political influence of drug merchants in Columbia
- ....>participant observation better than interviews
“Real World” considerations as Constraints

- Practical considerations determine Research Design & Revised Research questions

Consider FEASIBILITY & PRACTICALITY of Design

- What’s my motivation?
- Basic or Applied research
- Other Considerations
- RESOURCES? Time & Money
- Can I get the data in allotted time?
- A Realistic Work Schedule
- Do I have a PUNT Position??????
Remember:

- Double all time estimates
- Anticipate “No Significant “ results
- Remember (punt positions):
  - Pilot Studies,
  - Replication &
  - Exploratory research

How detailed should I get in writing a Research Design?

- Provide enough details so SOME ONE ELSE could “execute it”...collect the data and analyze it according to your plan”
- “All but the cells in the table”
Congratulations!

- The hard creative work is over
- on to ........
- Implementation of your RESEARCH ACTION PLAN!!!