Prospective and Retrospective Studies

Phil 12: Logic and Decision Making
Winter 2010
UC San Diego
3/5/2010
Paper 2

• Reminder that papers are due Monday by 12pm
• late penalty if turned in after lecture starts
• If you want to turn them in early, there is an envelope on my office door (HSS 8037)
Which of the following involves questioning the **internal validity** of an experiment?

A. Questioning whether this causal relation would hold when using a different task

B. Raising doubts about whether the results are applicable to a different context

C. Questioning whether your operational definitions really measure the theoretical constructs of interest

D. Questioning whether there might be an alternative explanation for the effect produced
Which of the following concerns are about external validity?

A. Your study did not achieve statistical significance

B. A non-representative group of participants was studied and one can’t anticipate what sorts of effects the independent variable will have on other participants

C. Participants might have responded to the novelty of the experiment more than the specific effect of the independent variable that was manipulated

D. The participants figured out which treatment they were on
Review

• **Internal validity**: are the effects on the dependent variable due solely to the manipulation of the independent variable?
  - Was there a confounding subject variable?
  - Was there a confounding procedural variable?
  • Demand characteristics—did subjects behave as they did because of knowing they were in an experiment?

• **External validity**: do the results of the study generalize to the population, setting, and manipulation of interest?
Settle for *controlled* correlations

- When manipulating the independent variable is *impossible* or *immoral*, must settle for controlled correlations
- Select subjects based on their value on the independent variable rather than manipulating the variable
  - Control as much as possible for confounds
  - Draw tentative causal conclusions based on correlation
- Two strategies:
  - **Prospective studies**: identify groups in terms of possible *cause* variables and measure possible *effect* variables
  - **Retrospective studies**: identify groups in terms of possible *effect* variables and measure possible *cause* variables
Prospective studies
Prospective studies

Task

Key Behavior

IV

Task

Key Behavior

DV

Statistically Significant Difference?
Benzpyrene and lung cancer

Benzpyrene, an ingredient in coal tar pitch and asphalt, is known to cause skin cancer.

It is also present in cigarettes.

Could it be a factor in lung cancer?

Roofers are constantly in contact with coal tar pitch and asphalt—exposed to the amount of benzpyrene equal to smoking 35 packs a day!

Prospective study published in 1976 traced 5,788 roofers for 12 years
Benzpyrene and lung cancer

Rather than following an explicit control population, researchers used US mortality rates for the general population as the comparison

- Roofers with less than 20 years experience showed no increase in rates of lung cancer
- Roofers with 20-30 years experience showed 1.5 times the usual rate of lung cancer
- Roofers with 30-40 years experience showed 2.47 times the usual rate of lung cancer
With selection comes confounds

• Many other variables may correlate with both the independent and dependent variables and one of these may be responsible for the observed group differences
  - What might correlate with Benzpyrene exposure in roofers?

• The nature and number of potential confounding variables may not even be known

• Without randomization, have no way of countering possible effects of unknown confounding variables

• There are strategies for dealing with known possible confounding variables
Matching to control confounds

• As long as we know what might be the possible confounds, we can control for them by matching the different groups.

• Two strategies for matching
  
  - Match each subject in the different treatment groups on each confounding variable
  
  - Match means for confounding variables across treatment groups

• Limits: there may be many other variables (or too many to match on) that differ between groups that might have causal effects on the dependent variable
Measuring to control confounds

- Sometimes it is not practical to match the groups on all suspected confounds.
- But if you can measure values on these variables, you can investigate whether they correlate with the dependent variable.
- If they do, they become possible causes.
  - **Multi-factor studies** examine the contributions of multiple independent variables on the dependent variable.
Example of measuring confounds

- Condition known as *failure to thrive*: infant’s weight gain (relative to height) is in the bottom 3% of the distribution.

- What is the effect of failure to thrive (IV) on mental development (DV)?
  - Compare failure-to-thrive group with normal-growth group over several years on Bailey Mental Scale of Infant Development (operational definition of DV).

- Measure several other possible confounds and evaluate whether they correlated with dependent variable.
  - Two found:
    - Education level of parents
    - Time placed with alternative care-giver
From Prospective to Retrospective Studies

• To do a **prospective study** you must identify groups based on the relevant independent variable, then wait until you can measure the dependent variable
  
  - In some cases of interest, that may mean waiting years

• Alternative strategy is to start with the effect and look backwards to isolate the possible cause
  
  - This is what a **retrospective study** attempts to do
Retrospective studies

• Both experiments and prospective studies begin with the groups identified in terms of the *independent variable* (suspected cause)
  - Either assign or select subjects
  - Measure the *dependent variable* (suspected effect)

• Retrospective studies work the other way around
  - Begin with subjects who show the value on the *dependent variable* (suspected effect)
  - Match them with others who lack the value on the dependent variable
  - Measure the presence or absence of the *independent variable* (suspected cause)
Why retrospective studies?

• An effect occurs but we are lacking in good hypotheses as to what might cause it
  - making it hard to do either an experiment or a prospective study

• The effect (dependent variable) of interest occurs very infrequently
  - which would require enormously large samples to get enough cases with the effect
  - but we still want to know why it occurs

• There is not time for a prospective or an experimental study
  - but we need answers NOW
Birth control pills and blood clots

• In the 1960s a surprising number of fatal blood clots started appearing among relatively young women
  – Most of these women had started taking birth control pills within the last year

• Was the pill the culprit?
  – It would take years to design and run a proper study
    • meanwhile, women were dying

• Search for women who had been treated for nonfatal clots (legs or lungs) within previous two years—58 such women found
Birth control pills and blood clots

• Need a comparison group: 116 married women who had been admitted to the same hospitals for serious surgery or other medical condition than blood clotting
  - Matched on age, number of children, etc. (the likely confound variables)

• Of the 58 admitted for blood clots, 26 (45%) had taken oral contraceptives in the preceding month

• Of the 116 matched individuals, 10 (9%) had taken oral contraceptives in the preceding month

• This difference is statistically significant
  - But NOTE: you cannot judge how much the risk is!
Retrospective Design

Blood clots

Percent using birth control pill

Statistically Significant Difference?
Confounds in retrospective studies

- Must match on the Dependent Variable
- Must be able to detect differences in the Independent Variable
  - Only look for those differences you suspect are relevant
  - Often this requires relying on memory of the participants
- Memory of those with the value of interest on the dependent variable, especially if it is negative, may differ from those without it
What predicts or causes Alzheimer’s?

- Start with population, some of whom have developed Alzheimer’s and some who haven’t
- Study of the School Sisters of Notre Dame, an order of nuns
  - Examined 678 nuns from Minnesota, Texas, Wisconsin, Connecticut, Maryland, Missouri, and Illinois
- Look back into the records of those who developed Alzheimer’s and those who didn’t
  - Look for differences earlier in their lives
Nun study

- Taking folic acid negatively correlated with Alzheimer’s
- Occurrence of small strokes a predictor of Alzheimer’s
- The more ideas nuns packed into the sentences of their early autobiographies, the less likely they were to get Alzheimer's disease six decades later
- Maybe also the prevalence of positive emotions in early writing predicts less Alzheimer’s
Contrast:

“My father, Mr. L.M. Hallacher, was born in the city of Ross, County Cork, Ireland, and is now a sheet metal worker in Eau Claire”

with:

“My father is an all-around man of trades, but his principal occupation is carpentry, which trade he had already begun before his marriage with my mother”
From Retrospective Study to Prospective Study to Experiment

- Growing phenomenon of childhood obesity (dependent variable)
  - Hypothesis: Hours reading is a cause (independent variable)

- Retrospective Study of Childhood Obesity
  - Begin with group of obese children
    - Need operational definition of obesity!

- Find non-obese matches on possible confound variables
  - Obese parents
  - Foods in diet
  - Grades in school
From Retrospective Study to Prospective Study to Experiment

• If, after matching on these other variables, there is a statistically significant difference in hours spent reading
  - Then hours spent reading is a candidate cause of childhood obesity
  - But, despite care in matching, many variables will not be matched

• Follow up retrospective study with a prospective study
  - Identify groups of children who are readers and non-readers
  - Match the two groups on all known potential confounds
From Retrospective Study to Prospective Study to Experiment

• Prospective Study of Reading and Obesity using Pretest-Posttest Design
  - Measure participants degree of obesity at outset
  - After test period, measure participants degree of obesity
  - Determine the change in obesity

• If there is a statistically significant difference in the increase in obesity in the readers versus non-readers, it is highly plausible that reading is a cause of obesity
  - But there may well be unsuspected confounds
  - Unknown confounds can only be controlled in an experiment
From Retrospective Study to Prospective Study to Experiment

- Set up a controlled experiment
  - Choose a sample of children
    - Randomly assign some of them to a reading enticement program
    - Still need to control for confounding procedural variables such as time spent reading
  - What do those not in reading enticement program do with their time?
  - Perhaps create a crafts enticement program
- If correlation between participation in reading enticement program and increase in obesity holds up:
  - then you have the best possible evidence for a causal link between reading and obesity