Causality and Research Design

POLI 205 Doing Research in Politics

Fall 2015

Causal Theories

- The goal of political science (and all science) is to create and then evaluate causal theories
- Cause (X) and effect (Y)
- Basis of causality
  - *Time Ordering*: The cause precedes the effect
  - *Co-Variation*: Changes in X are associated with changes in Y
  - *Non-Spuriousness*: There is not a variable Z that causes both X and Y

Determinism and Probabilities

- **Deterministic**: If X then Y with certainty

$$Y_i = \alpha + \beta X_i$$

- **Probabilistic**: If X then Y with uncertainty

$$Y_i = \alpha + \beta X_i + \epsilon_i$$

Multiple Causes

- Theories are *bivariate*, X causes Y, but reality is *multivariate*
- X causes Y but some other variables, Z, might also (or instead) cause Y
- If we don't control for Z, the other possible causes of Y, then our conclusions about whether X causes Y might very well be mistaken
- How do we control for Z?
    - Research design

Four Causal Hurdles

- Is there a credible *causal mechanism* that connects X to Y?
- Can we rule out *reverse causation* the possibility that Y could cause X?
- Is there *covariation* between X and Y ?
- Have we controlled for all *confounding variables* Z that might make the association between X and Y spurious?

Causal Mechanism

- Answer the "how" and "why" questions
- What is the process or mechanism that, logically speaking, suggests that X might be a cause of Y?
- What is it specifically about having more(less) X that causes more(less) Y?

Reverse Causation

- Endogeneity
- *A country's level of economic development causes it to be more or less democratic*
- *Variations in consumer confidence cause a president's approval rating to change*
- *Ethnic conflict causes civil wars.*

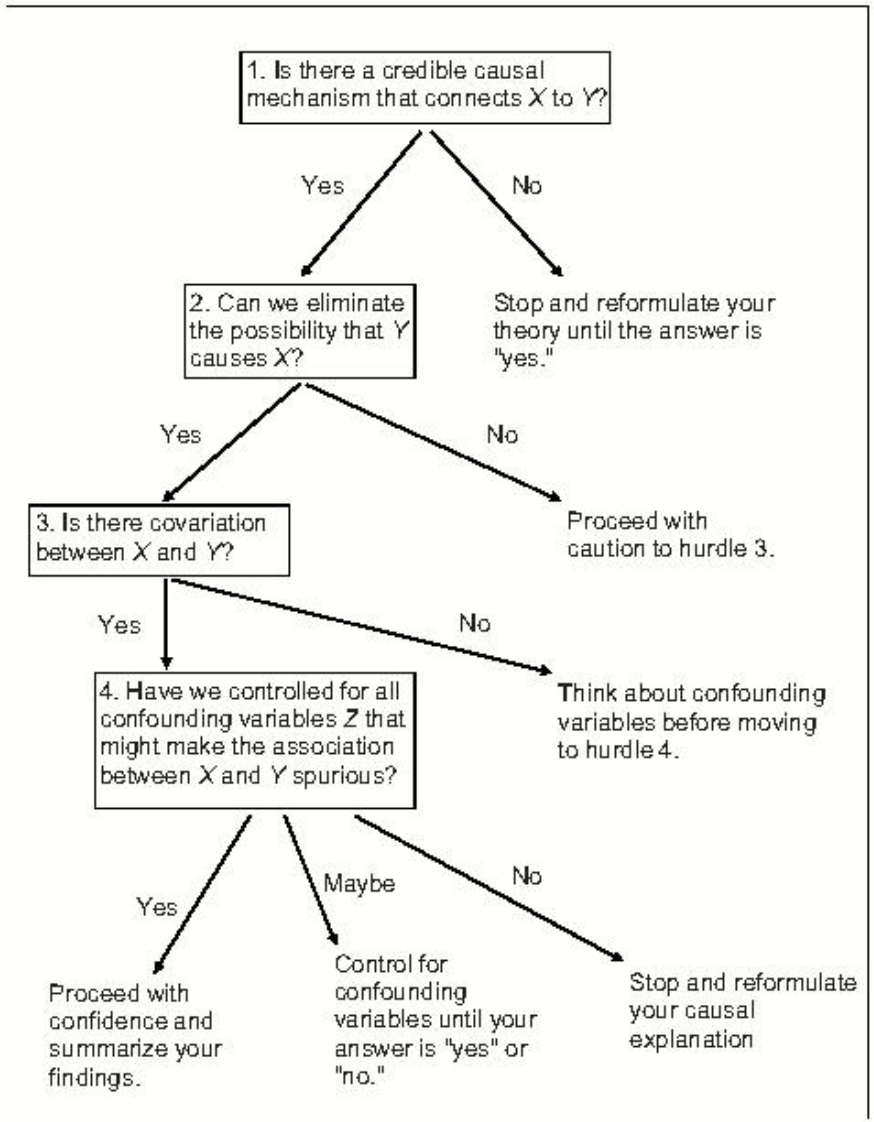
Covariation

- Measured empirically
- *Correlation is not causation*, but it's normally a key component of causation

Confounding Variables

- When one scholar is evaluating another's work, perhaps the most frequent objection is that the researcher "failed to control for" some potentially important cause of the dependent variable
- So long as a credible case can be made that some uncontrolled-for Z might be related to both X and Y, we cannot conclude with full confidence that X indeed causes Y
- The importance of *research design*

Causal Checklist



Use of the Scientific Method

- Scientific method
- Scientific research:
  - The goal is *inference*
  - Procedures are public
  - Conclusions are uncertain
  - *Observe* and *explain*
  - Can be replicated

Inference and Validity

- **Inference**: the process of using *what we know* to learn about *what we do not know*
  - What we do not know: is our theory correct?
  - What we do know: data
- Types of inference:
  - *Descriptive* inference: using observations (data) to learn about unobserved facts
  - *Causal* inference: using observations (data) to learn about causal effects

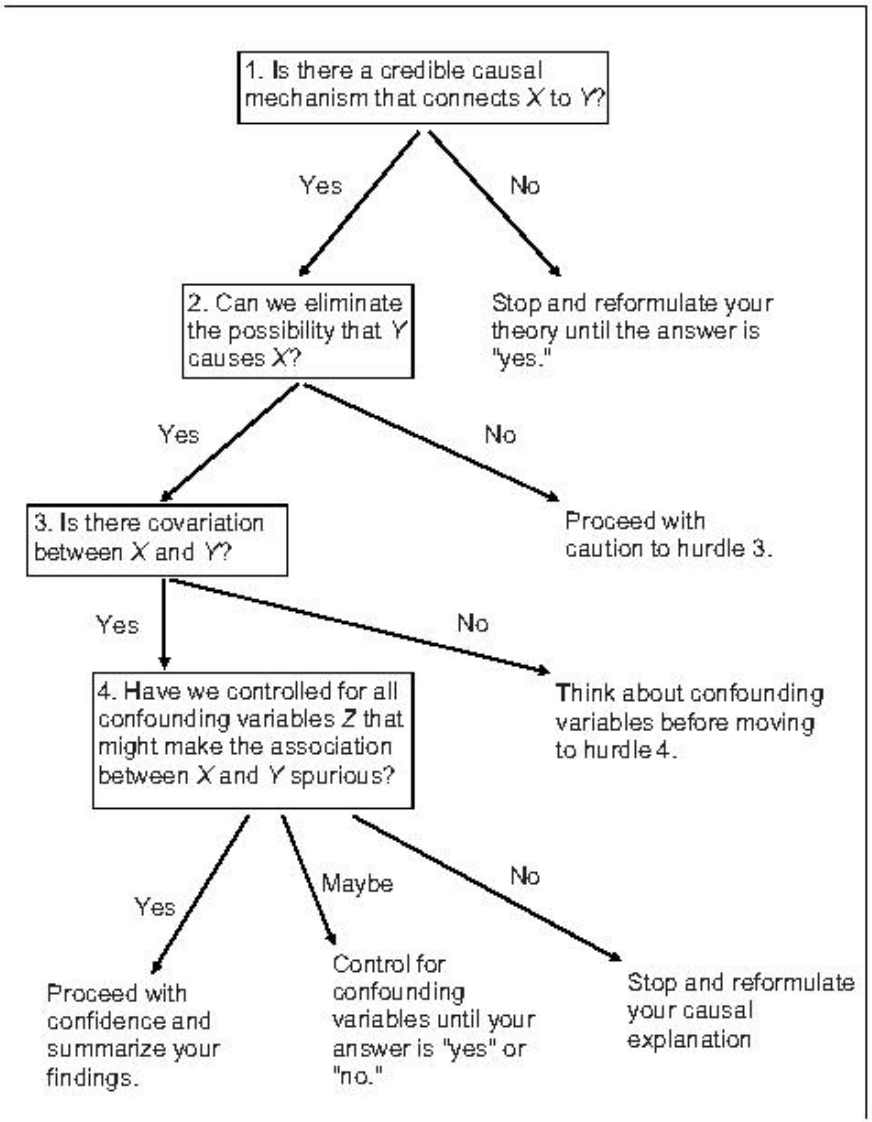
Inference and Validity

- **Validity**: Are we making *valid* inferences about the relationship between X and Y?
- Types of validity:
  - External
  - Internal

Types of Validity

- **External validity**: Degree to which we can be confident that our results apply to *other contexts*
  - Are the results generalizable?
- **Internal validity**: Degree to which we can be confident that X causes Y
- Threats to validity
  - What could reduce our confidence about our results?
  - Causal hurdles

Causal Hurdles



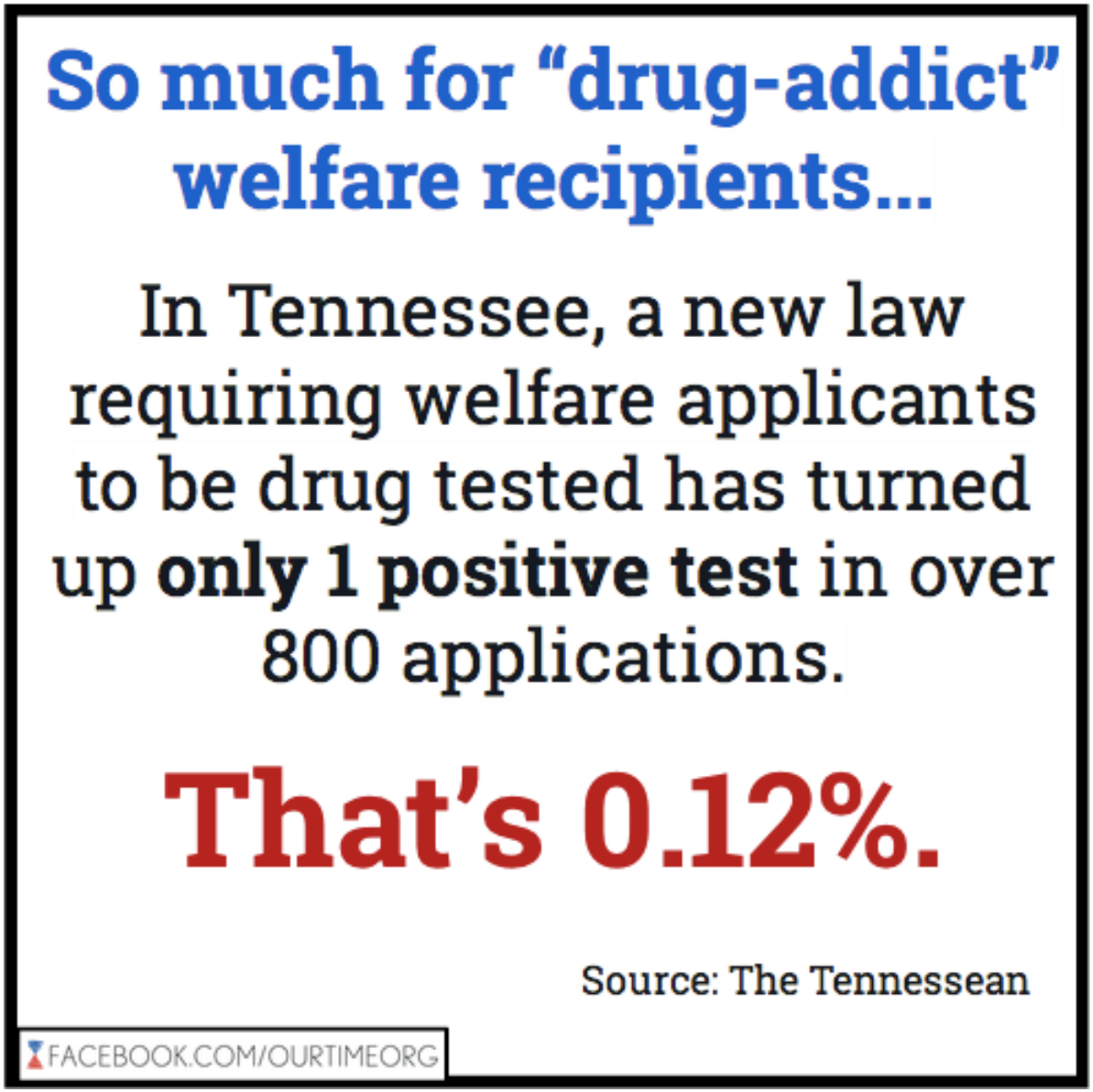
Other Threats to Validity

- Poor measures of variables
  - are the measures valid and reliable?
- Selection bias
  - is the sample representative?
- Setting
  - *Hawthorne* effect

Inference


Stephen Colbert
@StephenAtHome
Following
Global warming isn't real because I was cold today! Also great news: World hunger is over because I just ate.

Inference


So much for "drug-addict" welfare recipients...
In Tennessee, a new law requiring welfare applicants to be drug tested has turned up only 1 positive test in over 800 applications.
That's 0.12%.
Source: The Tennessean
FACEBOOK.COM/OURTIMEORG

Research Design

- **Research Design**: the plan to collect information to address your research question
  - Two types: *Experimental* and *Observational*
  - Four Components:
    - Research question
    - Theory
    - Data
    - Data analysis
- **Data**: pieces of information
  - Can be *qualitative* or *quantitative*

Causality

- Does X (treatment) cause Y (outcome)?
- Causal (treatment) effect: $\tau_X = Y_1 - Y_0$
- τ_X : Treatment (X)
- Y_1 : Group that received treatment
- Y_0 : Group that *did not* receive treatment

Experimental Design

- **Experiment**: is a research design in which the researcher both *controls* and *randomly assigns* values of the independent variable (treatment) to the subjects
- Causal (treatment) effect: $\tau_X = Y_1 - Y_0$

Experimental Design

- **Control**: the values of the independent variable that the subjects receive are not determined either by the subjects themselves, or by nature
- **Random Assignment**: All participants are equally likely to be in the *control* group as the *treatment* group
  - *Treatment* group: Group that receives treatment
  - *Control* group: Group that did not receive treatment
- Why is random assignment important for experimental designs?

Observational

- **Observational**: is a research design in which the researcher does not have control over values of the independent variable, which occur naturally
  - Variation of X and Y important
- Causal (treatment) effect: $\tau_X = Y_1 - Y_0$
  - more (less) X = more (less) Y
  - statistical controls for Z variables
- *Large n* either *Cross-sectional* or *time-series*, and *case study*

Large n Cross-Sectional

- A *cross-sectional observational study* examines variation across a cross-section of individual spatial units
  - Same variable(s) across units
- Example: the connection between the preferences of the voters from a district (X) and a representative's voting behavior (Y)

Large *n* Times-Series

- A *time-series observational study* examines variation within one spatial unit over time
  - Same variable(s) and same unit(s) over time
- Example: the connection between GDP growth and presidential approval from 1995-2005

Longitudinal

- A *longitudinal observational study* examines variation across *spatial units over time*
  - *Panel data*: Same variable(s) across the same units and over time
  - *Times-series cross-sectional* (TSCS): Same variable(s) across different units and over time
- Examples:
  - *Panel*: the connection between GDP growth of countries in the European Union and incumbent party support from 1995-2005
  - *TSCS*: the connection between ideology and concern about climate change from 1995-2005 using pooled surveys

Case Study

- *Case Study*: Precise description of a single case (n=1 or maybe a few)
  - *Exploratory*: little is known about a phenomenon
  - *Descriptive*: discover or describe what happened in a single or select few situations
  - *Explanatory*: answer how or why questions

Case Study Approaches

- Controlled Comparison:
  - *Method of difference*:
    - One (or a few cases) Y=1
    - One (or a few cases) Y=0
    - Z is the same across cases; what is different? (X)
  - *Method of agreement*
    - Two (or a few) cases Y=1
    - What is similar across cases? (X)

Case Study Approaches

- Congruence Procedures: congruence between values of X and Y
  - *Type 1*: Compare to typical values
    - Are values of X higher or lower than average matched by higher or lower values of Y?
    - Look for extreme values of X and Y
  - *Type 2*: Multiple within-case comparisons
    - Does X and Y covary across a range of circumstances within the case?
    - Need multiple occurrences of X and Y
    - Approaches a large-n study as number of observations increase

Case Study Approaches

- Process Tracing: Explores the chain of events through which X causes Y

$$X \rightarrow p \rightarrow q \rightarrow r \rightarrow Y$$