

Concepts, Variables, and Hypotheses

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PS #585
Research Methods

Today's Blueprint

Last Class:

- What is Science?
- Hard vs. Soft Science
- The Scientific Method

Today's Class:

- Concepts
- Variables
- Theories
- Hypotheses
- Models

Concepts

“Over time a discipline cannot proceed very far unless there is some minimal agreement about the meanings of the concepts with which scientific research is concerned. Researchers must take care to think about the phenomena named in a research project and make explicit the meanings of problematic concepts.”—Johnson, et. al. 2001

Concepts

- What are they?
 - Abstract ideas that scientists use to describe the real world

Concepts

- What purpose do they serve?
 - Provide common language for scientists to communicate with each other
 - Give scientists a way of looking at things
 - Allow scientists to classify things and generalize from them
 - Define the content of theories

Concepts

- Remember:
 - Concepts cannot be measured!!!

Variables

“A variable differs from a concept by including some form of measurement. Age, for example, is a concept; but people's answer to the question, “How old are you?” result in a variable”—Blackwell Dictionary of Sociology

Variables

- What are they?
 - Empirical representations of concepts that can take on more than one value

Variables

- What function do they serve?
 - Dependent variables
 - Independent variables
 - Control variables

Variables

- Dependent Variable (Y):
 - AKA: “outcome variable”
 - Reflects the outcome(s) of a research study

Variables

- Independent Variable (X):
 - AKA: “predictor variable,” “treatment,” or “factor”
 - Has a differing impact on the dependent variable at different values

Variables

- Control Variable (Z):
 - A variable related to the Y that must be *controlled for* in order to examine the influence of X on Y
 - In order to say that X influences Y, you must rule out the effect of Z

Variables

- A relationship exists between X and Y

Variables

- X influences Y

Variables

- X and Y influence one another (feedback loops)

Variables

- Z mediates the effect of X on Y

Variables

- Z moderates the effect of X on Y

Variables

- Both X and Z influence Y

Variables

- The relationship between X and Y is spurious

Variables

- Conditions for Causality:
 - Correlation:
 - X and Y *covary*
 - Temporal Order:
 - A change in X *precedes* a change in Y
 - No rival explanations:
 - The covariation between X and Y is neither *spurious* nor a *coincidence*

Theories

“[A theory is] a hypothesis or group of hypotheses which have been validated but not to the point of near certainty.”—JP Seipmann (1999)

Theories

- What are they?
 - Sets of ideas that explain events that have occurred and/or predict events that may happen

Theories

- What purpose do they serve?
 - Summarize observations
 - Describe the relationships between observations
 - Turn observations into propositions that can be accepted or rejected
 - Place observations into frameworks from which other propositions can be emerge

Theories

How do we build theories?

- Induction:
 - From experience to theory
 - Bottom-up process
- Deduction:
 - From theory to experience
 - Top-down process

Theories

- *It is the theory that decides what we can observe.*

Theories

What Makes for A Good Theory?

- *Truth*: It is correct
- *Beauty*: Simplicity, Novelty, Fertility
- *Justice*: It benefits humanity and the search for knowledge

Hypotheses

“To test a hypothesis for significance is easy, to find a significant hypothesis to test is not.”—Author unknown

Hypotheses

- What are they?
 - Statements proposing [testable] relationships between variables
 - An educated guess

Hypotheses

- What purpose do they serve?
 - Hypotheses inform theories (theory elaboration)

Hypotheses

Types of Hypotheses:

- Null Hypothesis (H_0):
 - Statement of no relationship between variables
- Rival/Alternative/Research Hypothesis (H_1):
 - Statement of the relationship between variables

Hypotheses

- Directional Hypothesis:
 - A hypothesis that specifies the specific relationship between variables
 - Positive: As X increases, Y increases
 - Negative/Inverse: As X increases, Y decreases

Hypotheses

- Unit of Analysis

- Tells us the focus of our hypotheses
- What type(s) of actor(s) are we interested in studying?
 - Individuals
 - Groups
 - Institutions
 - Nations

Hypotheses

What Makes For a Good Hypothesis?

- Clearly specified units of analysis
- Declarative in form (not a question)
- Suggests a relationship between variables
- Reflects theory or previous research
- It is brief
- It is testable

Models

“All models are flawed, but some are useful.”—George Box

Models

- What are they?
 - Abstractions from reality that order and simplify our view of reality

Models

- What purpose do they serve?
 - Discusses significant relationships among aspects of the real world
 - Enables researchers to form testable propositions regarding these relationships
 - Summarizes data

Models

The Modeling Process (Lave and March 1975)

- Observe some facts about the world
- Speculate about the process that produced the facts
- Deduce other results from the model.
- Produce new, more general, models as necessary

Models

- Remember:
 - You *cannot* test theories
 - You *can* test models based on theories

References

- FYI:
 - Seipmann, J.P. 1999. “The Laws of Space and Observation.” Journal of Theoretics, April/May 1(1).
 - Charles A. Lave and James G. March. 1975. An Introduction to Models in the Social Sciences. New York: Harpers and Row.