Psych 218 Introduction to Behavioral Research Methods

Week 3: Lecture 6

Outline of Today's Lecture

- Last lecture we discussed
  - Research Designs and Causation
  - Measurement vs. Manipulation
  - Independent vs. Dependent Variables
- Today we will discuss
  - Testing Theories: Disconfirmation and strong inference
  - Validity

To Prove or Disprove, That is the Question…

- Conditional Reasoning and the logic of falsification (Popper)
  - Theories Predict Data
    - Confirmational Strategy: trying to prove a theory

      "If theory A is correct,

      then I will observe pattern of data A"
    - Disconfirmational Strategy

      "If theory A is correct,

      then I will not observe pattern of data B"
  - These are statements of conditional reasoning

To Prove or Disprove, That is the Question…

- Conditional Reasoning: The Propositional Calculus
- Two premises and a conclusion

  Premise 1) *If <antecedent> then <consequent>*

  Premise 2) *Affirm/deny <antecedent/consequent>*

  Conclusion) *Therefore <consequent/antecedent>*
- Four Possibilities for Premise 2

Affirm Antecedent	Deny Antecedent
Affirm Consequent	Deny Consequent

To Prove or Disprove, That is the Question…

- Confirmational Reasoning
  - **Premise 1**

  If <theory A is correct> then <pattern of data A will be observed>
  - **Premise 2; Conclusion**

    AA) *theory A is correct; therefore data A will be observed (Valid, but pointless)*

    DA) *theory A is incorrect; therefore data A will not be observed (Invalid and pointless)*

    AC) *data A observed; therefore theory A is correct (Invalid, but often used)*

    DC) *data A not observed; therefore theory A is incorrect (valid, but only if observations are exhaustive—accepting the null)*

To Prove or Disprove, That is the Question…

- Disconfirmational Reasoning
  - **Premise 1**

  If <theory A is correct> then <pattern of data B will not be observed>
  - **Premise 2; Conclusion**

    AA) *theory A is correct; therefore data B will not be observed (Valid, but pointless)*

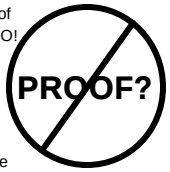
    DA) *theory A is incorrect; therefore data B will be observed (Invalid and pointless)*

    AC) *data B not observed; therefore theory A is correct (Invalid)*

    DC) *data B observed; therefore theory A is incorrect (valid, most scientifically useful!)*

Confirmation and Disconfirmation of Theories: Summary

- Confirmation (Poor)
  - if theory correct then observation will occur
  - Observation occurs → Support, but **not** proof
  - Observation does not occur → disproof? NO! We may not have looked in the right place
- Disconfirmation (OK)
  - if theory correct then observation will not occur
  - Observation does not occur → Support, but **not** proof (again, maybe we didn't look in the right place)
  - Observation does occur → **disproof**
- Strong Inference (BEST!)



Strong Inference (Platt, 1964)

- Science is fundamentally based on disconfirmation (Popper)
- Theories are not evaluated in isolation, rather they compete with one another (relativism)
- Critical Experiments – results will disconfirm one (or more) theory (theories) while confirming one or more alternative theories
- Disconfirmed theories are discarded (or revised) like logical branches pruned from the tree of understanding, in which only one branch represents truth

Strong Inference (Platt, 1964)

- The Question to ask in your own
  - on hearing any scientific explanation or theory put forward:

"What experiment could *dis*prove your hypothesis?"

or

  - on hearing a scientific experiment described:

"What hypothesis does your experiment *dis*prove?"

- Practicing explicit and formal analytical thinking
  - the "notebook" containing the logical trees, alternative hypotheses, and crucial experiments

Confirmation and Disconfirmation of Theories: Summary

- Confirmation (OK)
  - if theory correct then observation will occur
  - Observation occurs → Support, but **not** proof
  - Observation does not occur → disproof? NO!
- Disconfirmation (better than OK)
  - if theory correct then observation will not occur
  - Observation does not occur → Support, but **not** proof
  - Observation does occur → **disproof**
- Strong Inference (BEST!, Platt, 1964, *Science*)
  - Test competing predictions of multiple theories
  - Simultaneously use both confirmation and disconfirmation

Internal Validity

- The ability of your research design to adequately test your hypotheses, in particular hypotheses related to causality
- Threats to internal validity
  - Effects of extraneous variables that could mask or explain the variation in your dependent variable
  - Confound: any extraneous variable that covaries or is correlated with your independent variable such that it's effects cannot be separated from the effects of the extraneous variable– rival hypotheses

Common Confounding Variables

- History
- Maturation
- Instrumentation
- Statistical Regression (regression to the mean)
- Biased selection of participants
- Experimental Mortality

Enhancing Internal Validity

- Use careful experimental design
  - Carefully plan which variables will be manipulated or measured
  - Identify plausible rival hypotheses and extraneous variables
  - Control extraneous variables
- In effect, these measures control *variance*
  - Increase variance in data due to manipulation
  - Decrease variance in data due to noise or extraneous variables

External Validity

- How well can the results of a study be extended beyond the particular research setting under which the study was conducted?
- Common Threats to External Validity
  - Unrepresentative sampling from a population of interest
  - Reactive effects of experimental testing

Internal vs. External Validity

- Internal and external validity typically trade-off
- Basic research tends to emphasize internal validity
- Applied research tends to emphasize external validity

Research Settings and Validity

- Laboratory Setting
  - Experiments using simulation, but also non-experimental methods
  - Advantage: Easier to control extraneous variables—better internal validity
  - Disadvantage: results may lose generality beyond the laboratory—decreased external validity
- Field Setting
  - Used most with non-experimental methods (naturalistic observation or surveys)
  - Some field experiments
  - Advantage: results are more generalizable—greater external validity
  - Disadvantage: less control over extraneous variables—decreased internal validity