

# Notes on Philosophy of Science: Criteria for Explanation

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Summer, 2019

# Definition: Psychology

- **Psychology** is the study of alternative explanations of behavior of living beings.
- **Judgment and Decision Making**- a subset of psychology, dealing with certain types of behaviors and certain types of explanations. Responses often (not always) modeled as result of a (perhaps implicit) decision based on evaluations of the likelihood that certain actions lead to certain consequences and comparisons with other possible actions.

# Criteria for Explanation

- An **explanation** (for a phenomenon) is a set of statements satisfying the following criteria:
- 1. **deductive**: One can *deduce* the phenomena from the explanation
- 2. **meaningful**: not meaningless; testable.
- 3. **predictive**: In principle, if we knew the explanation in advance, one could have predicted the phenomena.
- 4. **causal**: in principle, can control phenomena.
- 5. **general**: premises are “laws”, not assumed or denied for each case.

# Basic Terms

- **Definition:** A statement of equivalence in language. Bachelor = {Hum  $\cap$  Male  $\cap$  NeverM}
- **Operational definition:** definition that specifies operations of measurement.
- **Logical Statement:** truth known a priori.  
All Bachelors are unmarried.
- **Empirical Statement:** truth tested a posteriori  
All Bachelors are happy.

# Meaning of Empirical Statement

- Empirical statements, unlike definitions and logical statements, have implications that can be tested.
- The empirical MEANING of a statement is equivalent to the set of operationally specifiable tests and outcomes.
- A TEST is a procedure to obtain observations that *in principle* could DISPROVE the statement, if it is false.

# Theory of LUB: Unverifiable Brownies

- Everything that happens is the result of the actions of logically untestable brownies.
- Properties:
- Existence, completeness, uniqueness
- Inertia, Action/Reaction
- Fringes\*

# Deduction

- **Deduction** is logical procedure for reaching conclusions by means of rules that guarantee that if the premises are true, then the conclusion is true. Classic logic and set theory.
- Two principles of logic:
  - 1. Transitivity of implication: If (All As are B and All Bs are C) then All As are C.
  - 2. All As are B if and only if All not B are not A.

# Deduction

- P1: Socrates is an Athenian
  - P2: All Athenians are Greeks
  - C: Socrates is a Greek
- 
- If the premises are both true then logically deduced conclusion is true.
  - If the conclusion is false, then both premises cannot be true.



# Quiz: The Wason Task

- To test your understanding of the last two slides, take the Wason task:
- [http://ati-birnbaum.netfirms.com/  
logic\\_test.htm](http://ati-birnbaum.netfirms.com/logic_test.htm)
- Feedback:
- [http://psych.fullerton.edu/mbirnbaum/  
Psych466/Chap\\_07/Ch7\\_ex3.htm](http://psych.fullerton.edu/mbirnbaum/Psych466/Chap_07/Ch7_ex3.htm)

# Can we Deduce a True Conclusion from False Premises?

- P1: Bread is made of Cyanide
- P2: All things made of Cyanide are good to eat
- C: Bread is good to eat\*
  - \* operational definition of good to eat. Pseudo-Bayesian
- Can we “prove” the theory by eating bread?
- True conclusion does not “validate” the premises.
- Debate with N. H. Anderson (“validating FM”)

# Whole equal to sum of parts?

- P1:  $s(i) = f[\phi(i)]; t(j) = g[\theta(j)]$  (indep.)
- P2:  $\psi(ij) = s(i) + t(j)$
- P3:  $R(ijk) = a\psi(ij) + b + e(ijk)$
- C: curves will be parallel. (no interaction).
- C1: estimate  $s(i)$  from row marginal means
- C2: estimate  $t(j)$  from column marginal means
- C3: curves can't cross; etc.
- But if C true, can we “validate”?

# Induction vs. Deduction

- Deduction uses rules of logic
- Induction based on observations
- Principle of Induction: Past is relevant to predicting the future. Or: the laws of nature don't change.
- Examples: drop item, it falls. Old man who would live forever. Stock market rising?

# Correlation vs. Causation

- Two types of empirical induction are correlation and causation.
- Correlations based on surveys, ask if X predicts Y.
- Causation based on experiments.
- Classic, Triple-Blind, randomized experiment with placebo control. Independent & Dependent variables, role of statistics. Hypothesis testing.

# Insurance Company

- Classic experiment: Treatment group: penicillin, Control: placebo. Triple blind: doctors, patients, coroners don't know what group. Reject  $H_0$ , treatment group more likely to survive.
- Hospital survey: got penicillin or not? Survived this year or not? Those who received penicillin more likely to die.
- Selling life insurance? Prediction. Already insured? Advice (control).

# Correlation is the Instrument of the Devil!

- Causation and correlation are unrelated and are often opposites, as in education and medicine.
- Coincidence is even less than correlation. E.g., Mark Twain visits England; Crown Jewels missing.
- Survey versus Experiment
- Prediction versus Control

# Context Effects and Between-Ss designs with Judgments

- Randomly assign people to two groups
- One group judges the “size” of the number 9.
- Other group judges 221.
- Finding: 9 is significantly “bigger” than 221.
- Within-subjects, everyone says  $221 > 9$ .
- Conclusion: Beware Between-Ss designs.
- Many examples of within and between-Ss designs yielding opposite conclusions. Problem: confounded contexts. Number and context.



# Summary

- Explanation: Set of statements satisfying 5 criteria: deductive, meaningful, predictive, causal, & general.
- Exercise: Can you write out a set of premises to account for a behavioral phenomenon that satisfies all 5 criteria? Quick check: How would you reject your theory, besides denying the phenomena you set out to explain? This is classic PhD preliminary orals question.

# Homework No. 2

- Visit: <http://ati-birnbaum.netfirms.com>
- Take logic test
- View Source (CTRL & U on most browsers).
- If you don't know basic HTML (tomorrow), to get started, visit <http://neocities.org>
- Free hosted Website and friendly tutorials.