Notes on Philosophy of Science & Criteria for Explanation

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Definition: Psychology

- **Psychology** is the study of alternative explanations of behavior of living beings.

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.

Types of Statements in an Explanation

- **Definition:** A statement of equivalence in language. Bachelor = {Hum ∩ Male ∩ 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.

Examples

- What kinds of statements are these (definitions, logical, or empirical. Are they a priori true or false? A posteriori true or false?)
- All bachelors are unmarried.
- Some bachelors are married.
- Some bachelors are happy.
- All bachelors are happy.
- All persons in this room taller than 1.9 meters are male.
- All males in this room are taller than 1.9 meters.

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, action-reaction (competitiveness), inertia,

- Fringes* (debated among brownie theoreticians, who hate each other as to whether brownies have fringes.)

What is wrong with the theory of LUB?

- Why don't you accept the theory? (Answer: the brownies).

- There are many variations of this theory, such as Freudian psychoanalysis.

- Important to identify new variations of the theory, as they are developed and published.

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.
- Set Theory ←→ Logic
- All As are B == if A then B == A implies B
- Venn Diagrams. Universal Set.
- Not A is complement of A.

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.

  That is, A implies B is the same as

  not B implies not A.

Quiz: The Wason Task

- To test your understanding of the last two slides, take the Wason task:

- https://konstanzworkshop.neocities.org/logic.htm

- http://ati-birnbaum.netfirms.com/logic_test.htm

- Feedback:

- http://psych.fullerton.edu/mbirnbaum/Psych466/Chap_07/Ch7_ex3.htm

Deduction

- P1: Socrates is an Athenian
- P2: All Athenians are Greeks
- C: Socrates is a Greek

- If the premises are both true then a logically deduced conclusion is true. P1 and P2$\rightarrow$ C.
- If the conclusion is false, then both premises cannot be true. One or more are false.

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.
- Classic question for dissertation defense.

Whole equal to sum of parts?

- P1: $s(i) = f$(adjective row)
  $t(j) = g$(adjective column)
- 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, does it "validate" model?

Impression Formation

- Norman Anderson argued that impression formation task was additive, so this proved that adjectives did not change value, integration function was additive, and response scale linear. Bread is good to eat, so bread made of cyanide.

- But evidence showed nonadditivity. Liking task refutes model. Then two rival theories appeared. Additive model with nonlinear judgment function vs. interactive model with linear response function.

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 H0, 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

- Philosophy & Web/Lab: Read Chapter 1 of my Prentice-Hall book, preprint available:

  http://ati-birnbaum.netfirms.com/book/

- EXPLAIN a psychological phenomenon. Does your explanation satisfy the five criteria for explanation? (This is a very difficult assignment for advanced undergraduates and graduate students in psychology).

Examples: What kind of statements are these?

- 80% of those who are have COVID test positive on the Quick Test, and 80% of those who do not have COVID test negative.

- Horse de-wormer is effective treatment of COVID, as it reduces the probability of death due to covid.

- Human behavior is causally affected by conflicts in the subconscious mind.

Another example: What type of statement is this?

- There is a class in which half the students fail. "If you study hard enough in that class, you will do well."

"Define your Terms"

- Suppose: *study hard enough* DEF= study enough to pass.
- Suppose: *study hard enough* DEF= study more than 3 hour/day
- *Suppose do well* DEF= pass the class.
- Suppose: *do well* DEF=study more than 3 hours/day. Define "you"
- So, meaning depends on DEFINITIONS. In this case, statement might have been circular, it might be a definition, or might have been an empirical statement.