Scientific Explanation

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First: a correction from the lecture on “Argumentation”

Genetic fallacy/bias
- mistaking some feature of the origin of an idea as evidence for its truth or value

Naturalistic fallacy/bias
- assuming that because something *is* or *has been* the case, that it *ought* to be

An example of abductive inference

If a driver crashes their car, it will get damaged

A car is damaged

Therefore, a driver crashed the car

Inference to the best explanation

Evidence: A car is damaged

Possible causes/hypotheses:

- A driver crashed the car
- Someone crashed into the car while it was parked
- Someone whacked the car with a sledgehammer

Ockham's razor

Popular rendering: "Entities must not be multiplied beyond necessity" (i.e., simpler explanations are better than complicated ones, *ceteris paribus*)

Einstein's modification (popular rendering): Make the theory as simple as possible, but not simpler.

The role of new/additional evidence

Confirming/corroborating evidence

Testable predictions

- Hypothetico-deductive (H-D) method: Derive a prediction from the hypothesis, and test it. If prediction is true/false, hypothesis is confirmed/ disconfirmed.
- How can we apply this to the damaged car example?

Forms of confirmation

Absolute confirmation

Absolute disconfirmation

Incremental evidence – Bayesian updating

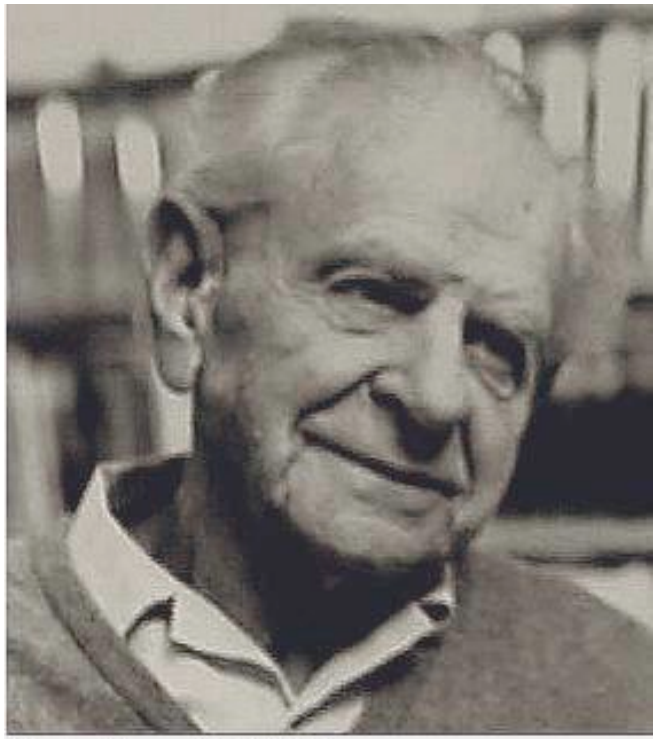
$$P(H_1|E) = \frac{P(E|H_1)\,P(H_1)}{P(E|H_1)\,P(H_1) \;+\; P(E|H_2)\,P(H_2)}$$

$$= \frac{0.75 \times 0.5}{0.75 \times 0.5 + 0.5 \times 0.5}$$

$$= 0.6$$

Popper's theory of falsification

1. Theory should make a risky prediction – one that other theories predict would be false
2. Theory is better if it makes strong predictions
3. Irrefutable theories are unscientific
4. Testability is falsifiability



Sir Karl Popper (1902-1994)

Another example involving everyday behavior

A friend calls to cancel a planned meeting, texting only “Something has come up.”

How might we apply scientific method to try to explain this?

Causality

How can causality be defined?

Hume's problem of causation

We regularly see A happening before B

We infer A causes B

But there can be no *necessary connection* between A and B

Causation and correlation/ covariation

A causes B

A antecedently covaries with B

- Third variable effects
- Confounding variables
- Spurious effects

Mill's methods for establishing causal claims (from M. Salmon, 2006)

- Assume effect e
- Method of agreement – find a common antecedent of e in many cases
- Method of difference – find one case of e and one of not e which are otherwise very similar
- Joint method of agreement and disagreement
- Concomitant variation – strength of e varies with strength of proposed causal factor
- Residues – process of elimination

Types of causes

Necessary causal condition

Sufficient/deterministic causal condition

Contributory/probabilistic causal condition

Proximate cause

Indirect cause