

The Philosophy of Science



Claude Oscar Monet: London: Houses of Parliament at Sunset, 1903

Epistemologies

1. Religion

- Faith-based knowledge.
- Cannot be falsified.

2. Mystical

- Trust-based knowledge.
- Can be undermined.

3. Authoritarian

- Experience-based knowledge
- Often changing.

Epistemologies

4. Logico-Deductive

- Observational knowledge.
- Wide variety of interpretations.

5. Science

- Observational knowledge interpreted within the context of theory.
 - A theory can be falsified.
 - A theory can be replaced with a better theory.
 - A theory does not claim to be “the truth.”

Theory

1. Definition

- A set of empirically falsifiable, abstract statements about reality.

2. Advantage

- Can be falsified by anyone with training in science.

3. Disadvantage

- More than one theory can fit a set of observations.

4. Uses of Theory

- Describes *why* events occur.

Elements of Theory

1. Concepts

- Abstract elements of a theory.

2. Variables

- Concepts that have more than one attribute.

3. Propositions

- Abstract statements about reality.

4. Hypotheses

- 4. A specific, testable form of a proposition.

5. Facts

- Observations about reality.

The Logic of Science

1. Deduction

- Theory.
- Propositions.
- Hypotheses.
 - Operationalism.
- Observations.
- Testing of Hypotheses.
 - Statistical significance.
 - Substantive significance.

The Logic of Science

2. Induction

- Observations.
- Empirical Generalizations.
- Theory.

3. Hypothesis Testing

- The research hypothesis.
- The null hypothesis.
- Type I Error (False assumption of causality).
- Type II Error (False assumption of no causality).

What is Good Science?

Logical Positivism: Perfect Observations?

1. Operationalism: Record only what is directly observed with the senses.
2. Nominalism: Concepts constructed from observations do not exist in reality. (*Realism*: Abstract concepts are real in their consequences.)
3. Value-free Knowledge: The researcher must remain free of bias.
4. Unity of Science: All sciences must follow the rules of operationalism, nominalism, and value-free knowledge.

What is Good Science?

Logical Positivism: Critique

1. Operationalism: All observations involve an element of subjectivity.
2. Nominalism: All concepts involve an element of constructivism.
3. Value-free Knowledge: No person can be completely free of bias.
4. Unity of Science: All sciences are affected by the critiques of logical positivism.

What is Good Science?

H-D Procedure: Perfect Interpretations?

The Hypothetico-Deductive procedure (see: modus ponens) uses a system of logic in interpreting observations to arrive at an unbiased conclusion.

Example

1. Law: All men are mortal.
2. Observation: Socrates is a man.
3. Conclusion: Socrates is mortal.

What is Good Science?

H-D Procedure: Critique

1. Problem of Deduction

- One might begin with the wrong law.
- If the theory is flawed, then derivations from the theory will be flawed.

2. Problem of Induction

- One might develop the wrong law from observations because observations can be explained by multiple theories.
- See: [Affirming the consequent](#).

What is Good Science?

Community of Scholars: Safety in Numbers?

The community of scholars approach is to expose research findings to review by persons qualified within a scientific discipline.

1. Typically, all persons with a PhD degree within an area of scientific inquiry are considered to comprise the “community of scholars” within that area.
2. Others, such as PhD students or scholars in closely related fields, also are included.

What is Good Science?

Community of Scholars: Procedure

1. Researchers complete their study, write a paper, and submit the paper to a refereed journal in their field of inquiry.
2. The Editor sends the paper to 2-5 qualified reviewers.
3. The author(s) of the paper are unknown to the reviewers.
4. The reviewers rate the paper as acceptable or unacceptable for publication in the journal.

What is Good Science?

Community of Scholars: Critique

1. Although the author(s) name(s) are omitted from the paper sent to reviewers, given the high level of awareness of work being conducted by other scientists, reviewers often know who wrote the paper.
 - Reviewers might be biased against the author(s).
 - Reviewers might be biased against the institution where the author(s) are employed.

What is Good Science?

Community of Scholars: Critique

2. Reviewers might disagree with the findings.
3. Reviewers might be ideologically opposed to the paradigm, theory, or implications of the findings.
4. Some reviewers have more prestige than others. Thus, when reviewers disagree about whether the paper should be published, the journal Editor might be persuaded by the opinions of the higher prestige reviewer.

What is Good Science?

Community of Scholars: Critique

5. The findings might raise questions about the efficacy of an economically important technology.
6. The findings might imply religion-based conclusions not favored by the reviewers.
7. The findings might imply politically-based conclusions not favored by the reviewers.
8. The findings might contradict well-established theories or the opinions of highly prestigious scientists.

What is Good Science?

Summary

1. The actual practice of science is influenced by politics, economics, authoritarianism, and religion because the community of scholars is affected by the same types of cultural norms as other groups in society.

What is Good Science?

Summary

2. The subjectivity of science does not mean that scientific “facts” are invalid.
3. Subjectivity means that science is guided by culture:
 - Which “facts” are “discovered” depends upon which topics are more interesting to the public.
 - The “facts” that are “discovered” tend to be consistent with those that are deemed acceptable by the community of scholars.

Questions?