Science and Interpretation
PHIL 375, UBC

Philosophy and Literature

October 26, 2017

Choose from the following options. This item will be graded.

iClicker Question

Which of these principles is Carnap's?

- A ▶ the principle of contiguity
- B ▶ the principle of reciprocity
- C ▶ the principle of equivalence
- D ▶ the principle of tolerance

Choose from the following options. This item will be graded.

iClicker Question

Einstein and Perrin's work on Brownian motion scientifically established

- A ▶ the existence of galaxies
- B ▶ the existence of space curvature
- C ▶ the existence of atoms
- D ▶ the existence of gravitational waves

Choose from the following options. This item will be graded.

iClicker Question

How, according to Popper, should we test a theory?

- A ▶ by induction
- B ▶ by abduction
- C ▶ by deduction
- D ▶ by obduction

Choose from the following options. This item will be graded.

iClicker Question

What distinguishes, according to Popper, a scientific problem from a non-scientific problem?

- A ▶ the scientific problem can be answered one way or another by a proof
- B ▶ the scientific problem is stated such that there is a method for verification
- C ▶ the scientific problem is stated to make it possible for a hypothesis to be falsified
- D ▶ the scientific problem can be solved a priori, without reference to experience

Sherlock Holmes

Holmes walks into the old second hand store and looks across the counter. The man standing there glances up before returning to his bookkeeping. Holmes turns to his companion and says, "That, my dear Watson, is the man we are looking for." "But Holmes, how on Earth can you know such a thing? You've not even spoken to him!" "Ah, but you see Watson, it is simple. I noticed that his beard is ragged and untrimmed, but its style implies that it is usually well kept. This means that he had little or no time this morning to undertake his usual particulars. He is wheezing slightly, showing that he was out of the shop this morning in the dense smog we have been having all over London. And, of course, he is wearing the stolen watch on a chain in his waistcoat." "Eee Gads Holmes, I just don't know how you do it!", exclaims Watson.

Deductive, Inductive, and Abductive Syllogisms

Deductive	Inductive	Abductive
All men are mortal;	Socrates is a man;	All men are mortal;
Socrates is a man;	Socrates is mortal;	Socrates is mortal;
∴ Socrates is mortal.	∴ All men are mortal.	∴ Socrates is a man.

The Problem of Induction

You see many white swans. What is your justification for believing that all swans are white? You may say, "I've used induction all my life, and it has worked really well—after seeing many white swans, the next swan was always white, so induction is predictive!" However, your reasoning is circular. You have used inductive reasoning to justify inductive reasoning.

The Problem of Induction

Karl Popper expresses this objection as follows: if in science we use inductive reasoning (as Hans Reichenbach claims), then there must be such a thing as an inductive principle. This principle cannot be a logical truth, for it is logically possible that induction fails.

Bertrand Russell, "On Induction"

The man who has fed the chicken every day throughout its life at last wrings its neck instead, showing that more refined views as to the uniformity of nature would have been useful to the chicken.

Something which is true not by logic alone is sometimes called a synthetic truth. Logic does not disallow the possibility of its negation being true. Propositions (the kind of thing that can be true or false) are therefore necessarily true (necessary), contingently true or false (possible), or necessarily false (impossible), although you need to be careful with these attributions (men and U.S. presidents).

The Problem of Induction

If the principle of induction is both a general law and a synthetic truth, the only way to justify it is by induction! Therefore, if induction is at the heart of science, science is in danger of cardiac arrest. Popper's solution: ditch induction. Science is based on deductive reasoning. (Kant had a similarly ingenious solution for this problem: the synthetic *a priori*; but Kant was famously wrong about some things that he thought were synthetic a priori truths, such as that space is Euclidean. A proposition is true a priori if you can know that it is true without reference to experience.)

Scientific Method

Just as Mill did for ethics, Popper formulates a two-step procedure
for science based on art (the creation of hypotheses) and
experiment. The first step has echoes of the hermeneutic method
in it: there is an "irrational element" and "creative intuition"
(Henri Bergson). A scientific theory is first formulated "by
intuition, based upon something like an intellectual love
(Einfühlung) of the objects of experience" (32).

Four Tests of a Scientific Hypothesis

1. test the internal logical consistency of the system
2. test the character of the hypothesis—is it empirical or tautological?
3. test how the hypothesis stacks up against already existing scientific theories—is it stronger or weaker or inconsistent with them?
4. test deductive implications (modus tollens) (32f)

Testing does not confirm a theory or make it more probable. It only corroborates it. Both Relativity Theory and Quantum Mechanics are extremely well-corroborated, but mutually incompatible in their present version. GRT, for example, was yet again corroborated last year by the discovery of gravitational waves.

- Steady State theory vs Big Bang theory

  radio waves bright radio sources are found more numerously in far-away galaxies

  CMB before the universe broke up into chunks (stars and galaxies), it emitted radiation that can still be measured as cosmic microwave background

Hume's problem and Kant's problem. How do we distinguish between scientific questions and metaphysical speculation? The problem with positivism (verificationism) is that it pours out the baby with the bathwater. Universal statements about nature are as nonsensical and meaningless as Hume's "metaphysical twaddle" because positivists fail to give rules for how they might be established empirically (the problem of induction).

Poppers solution: falsifiability as a criterion of demarcations.

Unrepeatable, Unique Events

When Popper talks about science, his favourite example is always theoretical physics with its universal laws. Many theories in science are about singular statements: climate change, evolution, extra-terrestrial life, expanding universe.

Karl Popper

Any controversy over the question whether events which are in principle unrepeatable and unique ever do occur cannot be decided by science: it would be a metaphysical controversy. (46)

Here is an example of a prediction by evolutionary theory (although, if it were experimentally falsified, it wouldn't falsify evolutionary theory): high-ranking mothers should give more parental care to sons; low-ranking mothers to daughters.

The Role of Tradition

I have friends who claim that they have never experienced a
supernatural phenomenon, but that they know and trust other
people who have told them about experiencing a supernatural
phenomenon. Popper's verdict is clear:

> *Can any statement be justified by the fact that K.R.P. is
> utterly convinced of its truth? The answer is no. (46)*

One problem that Popper faces is that falsifications are also
subjectively experienced unique events. "There can be no ultimate
statements in science: there can be no statements in science which
cannot be tested" (47). Statements of higher levels of universality
are tested by statements of lower levels of universality, ad infinitum.

$$\frac{A \supset C \quad \neg C}{\therefore \neg A} \text{ is valid but } \frac{A \wedge B \supset C \quad \neg C}{\therefore \neg A} \text{ is not.}$$

Falsification fails if you can introduce an auxiliary hypothesis (Duhem-Quine problem: it is impossible to test a scientific theory in isolation). Popper's solution: a scientist is not trying to keep a theory alive. Popper favours a view of science in which only the fittest theories survive.

Ill-Posed Questions

Immanuel Kant: Critique of Pure Reason

For if the question is absurd in itself and demands unnecessary answers, then, besides the embarrassment of the one who proposes it, it also has the disadvantage of misleading the incautious listener into absurd answers, and presenting the ridiculous sight (as the ancients said) of one person milking a billy-goat while the other holds a sieve underneath.

Ill-Posed Questions

Rudolf Carnap: Intellectual Autobiography

Most of the controversies in traditional metaphysics appeared to me sterile and useless. When I compared this kind of argumentation with investigations and discussions in empirical science or in the logical analysis of language, I was often struck by the vagueness of the concepts used and by the inconclusive nature of the arguments. I was depressed by disputations in which the opponents talked at cross purposes; there seemed hardly any chance of mutual understanding, let alone of agreement, because there was not even a common criterion for deciding the controversy.

Ill-Posed Questions

Rudolf Carnap: Intellectual Autobiography

Many theses of traditional metaphysics are not only useless, but even devoid of cognitive content. They are pseudo-sentences, that is to say, they seem to make assertions because they have the grammatical form of declarative sentences, and the words occurring in them have many strong and emotionally loaded associations, while in fact they do not make any assertions, do not express any propositions, and are therefore neither true nor false.
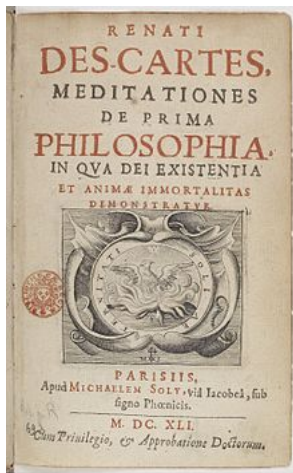
Meditations on First Philosophy (subtitled *In Which the Existence of God and the Immortality of the Soul Are Demonstrated*) is a treatise by René Descartes first published in 1641 (in Latin).

Rational Reconstruction

Rational reconstruction refers to the way Rudolf Carnap (a logical positivist) was trying to solve the problem of demarcation. According to Carnap, a sentence needs to be part of a linguistic framework. Here are some examples:

- "five plus seven is twelve" is a sentence in the linguistic framework of mathematics, its truth follows from the rules of the linguistic framework
- "I have hands" is a sentence in the linguistic framework of observable things such as tables, chairs, bodies, etc.
- "The positron is the antimatter counterpart of the electron" is a sentence in the linguistic framework of unobservables in theoretical physics (Dirac predicted its existence using mathematics, Carl David Anderson took a cloud chamber picture of its trail in 1932)

Rational Reconstruction

The truth and falsity of a sentence can only be evaluated within a linguistic framework, thus the meaningless of the skeptic's quest to show that "I have hands" cannot be justified. Linguistic frameworks need clear rules about verification, thus statements such as "the church is the bride of Christ" are problematic (and with it all of hermeneutics?).

Since what it is to be real is to be an element of the linguistic framework, it makes no sense to ask the question whether the linguistic framework is real. However, it is permitted to ask the *pragmatic* question how effective, simple, fruitful, efficient, and conducive to the aim for which the language is intended the linguistic framework is (Penelope Maddy, 70).

Principle of Tolerance

Rudolf Carnap: The Logical Syntax of Language

It is not our business to set up prohibitions, but to arrive at conventions. In logic, there are no morals. Everyone is at liberty to build her own logic, i.e. her own form of language, as she wishes. All that is required of her is that, if she wishes to discuss it, she must state her methods clearly and give syntactical rules instead of philosophical arguments.

The French chemist Joseph Louis Proust noticed at the end of the 18th century that two tin oxides (known today as tin monoxide and tin dioxide) would split up into tin and oxygen at the following ratios:

	tin	oxygen
tin oxide I	88.1%	11.9%
tin oxide II	78.7%	21.3%

This means that if you were to reconstitute the tin oxides, you would use 100 grams of tin and 13.5 grams of oxygen or 27 grams of oxygen respectively. The ratio of the oxygen for the different tin oxides is 1:2. Chemists found these small ratios at some regularity and began to wonder if they were representative of the atomic structure of matter (abduction).

Brownian Motion

An Italian scientist, Amedeo Avogadro, proposed in 1811 that no matter how heavy a gas is, at constant temperature, volume, and pressure it comprised the same number of molecules. Indeed, when you mix two litres of hydrogen with one litre of oxygen you get two litres of water vapour.

If we were to use this as proof for the atomic structure of matter, it would be circular, because Avogadro's Law presupposes the atomic structure of matter. Abductively speaking, however, the atomic structure of matter hypothesis makes sense of the data, while the alternative fluid structure of matter hypothesis lacks an explanation.

Brownian Motion

Albert Einstein, a German physicist, used Brownian motion to deliver the final piece of discriminating evidence in favour of atoms/molecules. Here is an illustration of Brownian motion:

https://upload.wikimedia.org/wikipedia/commons/c/c2/Brownian_motion_large.gif

Einstein modeled Brownian motion using differential equations. Jean Perrin, a French physicist, conducted experiments that confirmed Einstein's results (the equations successfully predicted the observations). Even though no one has ever perceived an atom, Einstein and Perrin's work is as close to a scientific proof of the existence of atoms as you will get.

Rudolf Carnap Atoms do not exist in the linguistic framework for "things" (medium-sized objects that humans can perceive; J.L. Austin called them "middle-sized dry goods"). They only exist in the linguistic framework of particle physics.

Carnap's clash with Einstein was more over the nature of space than over the existence of atoms. Carnap thought that despite the overwhelming evidence in favour of the gravitational curvature of space (see Eddington's 1919 experiment), ultimately it was a convention.

Penelope Maddy Maddy resists all two-level philosophies:
Descartes' mind-body dualism; Kant's transcendental
and empirical speculation; Carnap's distinction
between the analytic and the synthetic; Popper's
demarcation between science and metaphysics.

Maddy is in many respects an epistemological monist: the way we
know in philosophy, science, and even logic is one (Gadamer's
method?). The way we know about atoms is not in principle
different from the way we know about whether we have hands.
Perrin's painstaking scientific work cannot be relegated to the
realm of linguistic convention.

DEDUCTION

mammals
cats
Socrates

Deduction moves downward:
- Begin with **general** concepts
- Apply to something more **specific**
- **Conclude** with something that was "contained" in the earlier concepts

All cats are mammals,
Socrates is a cat
Therefore, Socrates is a mammal.

General concepts are "bigger", and they are funneled down to smaller, specific instances. Think of one sum being "deducted" from another (subtracted, reduced, *made smaller*). Deduction can also "stay at the same level" of generality instead of descending to something specific.

a priori

Deduction is *a priori*:
Essentially, we learn nothing new from a deductive inference, because the premise(s) already "contained" the conclusion. So, the **prior** information sufficed to demonstrate the conclusion. You can know whether it's valid or not just by thinking about it.

If cats are mammals, I must be a mammal too.

Socrates the cat

INDUCTION

swans in general
observed swans

Induction moves upward,
like deduction **inverted**:
- Begin with something **specific**
- Infer from specifics to a **general** rule or concept

All swans we've seen have been white
Probably, all swans everywhere are white

When we see many specific instances (such as the sun rising each day), we use induction to infer that something is true of all things in that category (i.e. the sun will rise everyday). It's like the specifics "grow" beyond themselves to become a broader concept.

a posteriori

Induction is *a posteriori*:*
The premises do not "contain" the conclusion the way deductive premises do—remember that induction moves upward from small to large. Thus, you cannot demonstrate that the conclusion is true "ahead of time", just from the premises—you have to go out and check the world to see how things are. Observations made *after* the argument, i.e. **posterior** to the argument, **post**-argument, could either support or undermine the conclusion.

Oh, hi Natalie Portman.

↓ Analytic

Analysis is a process of taking something apart to look at its separate components—the original Greek *analysis* means to break up, unfasten, or release.

We can know that analytic propositions are true by taking apart the concept being analyzed: like **deduction**, it moves "downward" (or stays at the same level) from **containing** concepts to **contained** concepts. Also like deduction, analysis is *a priori*, because you can tell that it's true just by thinking.

* One exception is mathematical induction, which is *a priori*. Arguably, that kind of induction is really another form of deduction, however.

bachelor
unmarried   man

Synthesis is a process of bringing things together. "Photo-synthesis" is the process where organisms combine (synthesize) other elements and light (photo) to obtain energy. Food synthesizers in Star Trek created new items by mixing together other components.

↑ Synthetic

are bachelors unhappy?
bachelor   unhappy

Synthetic propositions are any propositions that are not analytic: you cannot know that they are true merely by examining concepts. "Bachelors are unhappy" is synthetic, because the definition of "bachelor" doesn't include unhappiness: the proposition brings unrelated concepts together, lifting them "upward" to a new piece of knowledge, like **induction**. Also like induction, most synthetic propositions are *a posteriori*, because you can only learn they are true through experience, not just by thinking.

Kant, however, argued that there are *a priori* synthetic truths.

d o w n w a r d ↓

↑ u p w a r d

Immanuel Kant Many solutions that Kant presents for philosophical puzzles depend on his idea that there are synthetic a priori truths: truths that do not follow from the rules of language but can be recognized without reference to experience. Examples are the reliability of induction (solving Hume's problem of induction), mathematical truths, and (yes, that's embarrassing) the Euclidean nature of space.

Willard Van Orman Quine Quine wrote a passionate and
influential paper about Carnap's analytic/synthetic
distinction, inspiring naturalists (the philosophical
kind) such as Penelope Maddy.

In philosophy, if you are a naturalist, you believe that reality is
exhausted by nature (there aren't any real things that are not
natural) and the way to find things out about real things is to use
scientific method.

Choose from the following options. This item will be graded.

iClicker Question

What does Foucault identify as a problem with modern discourse about sex?

- A ▶ modernity is too body-focused (instead of mind-focused) in its sexuality
- B ▶ we talk about sexual desire too much (the endless mill of speech)
- C ▶ we don't talk about sex enough (repressed sexual desire must be articulated)
- D ▶ men want sex, women want conversation (gender imbalance with respect to verbal and sexual intimacy)

Choose from the following options. This item will be graded.

iClicker Question

According to Foucault, modern discourse about sex is intimately linked to

- A ▶ the economic and political problem of population
- B ▶ the fear of sexually-transmitted disease
- C ▶ an erosion of monogamy due to homosexuality
- D ▶ the Christian dogma of the Trinity