

Scientific Realism

Seminar 9: Philosophy of the
Sciences

Wednesday, 23 November 2011

Readings (on course website)

Required Readings:

'Realism and anti-realism' by Samir Okasha

Optional Readings:

i) 'Constructive Empiricism' by Bas Van Fraassen

ii) 'Realism versus Constructive Empiricism' by Alan Musgrave

(Epistemic) Scientific Realism

- i) Scientific theories (typically) are about a mind-independent reality; and

- ii) We are justified in believing that our best scientific theories are at least approximately true.

An example of one of our best scientific theories: The atomic theory of matter

- i) Ordinary objects like chairs and tables are made up of atoms
- ii) Each atom has a nucleus at its centre containing protons and neutrons which is “orbited” by electrons
- iii) Electrons behave such and such when they are in such and such energy states

A version of (epistemic) scientific anti-realism: Phenomenalism

Phenomenalism (or Idealism): Ordinary objects (like chairs and tables) and theoretical objects (like electrons) are “mental constructions” built up out of actual and possible sensory experiences.

Given phenomenalism, even if our best scientific theories are true, they are not about a mind independent reality

Motivations for and problems with phenomenism

Phenomenalism is motivated by arguments for skepticism about the external world

Problem 1 with phenomenism: It is intuitively implausible

Problem 2 with phenomenism: It is very difficult to define 'chair', 'electron' etc in terms of sensory experience

Another version of (epistemic) scientific anti-realism: (epistemic) Constructive Empiricism

- i) Scientific theories are about a mind-independent reality
- ii) We are justified in believing what our best scientific theories say about the observable state of affairs
- iii) We are not justified in believing what our best scientific theories say about unobservable state of affairs

Van Frassen's alternative definitions

Scientific Realism: The **aim** of science is to provide **true** theories that describe a mind-independent reality

Def: A theory is empirically adequate iff it is compatible with all the observable facts

Constructive Empiricism: The aim of science is to provide theories that describe a mind-independent reality that are empirically adequate

Problems with Van Fraassen's alternative definitions

- It is not totally clear what 'the aim of science is p' means
- The arguments realists and anti-realists give support epistemic scientific realism and epistemic scientific anti-realism, rather than Van Fraassen's scientific realism and scientific anti-realism

Epistemic Constructive Empiricism and the aim of science

If epistemic constructive empiricism is true,
then:

- i) Scientists **should** aim to produce empirically adequate theories rather than true theories
- ii) Scientists **should** regard the unobservable components of their theories as useful fictions for determining observational facts

The 'No Miracles' argument for scientific realism

N1) Our best theories are empirically successful (they make excellent predictions about the observable behaviour of objects and have important technological applications)

N2) It would be an extraordinary coincidence if N1 was true and yet our best theories weren't at least approximately true

N3) Our best theories are approximately true

Example

The atomic theory of matter:

- i) Allows us to predict how laser behave, and
- ii) Allows us to develop laser technology so that lasers can be used to correct our vision, attack our enemies with laser guided missiles, and so on.

This empirical success would be a miracle unless the atomic theory of matter was at least approximately true.

Response to the 'No Miracles' argument

Many of the best scientific theories in the past were empirically successful, but turned out to be not even approximately true.

Examples of falsified theories that were empirically successful

- i) Ptolemy's theory of planetary motion: the sun and the planets (other than the Earth) travel around the earth in cycles and epicycles.
- ii) Fresnel's theory of light: Light consists of wave-like vibrations in an invisible medium called the ether, which permeates the whole universe

Reply

Empirical success is not just a matter of fitting the known observational data.

Empirical success also requires allowing us to predict new (and surprising) observational data that were previously unknown

Problem with this reply

Fresnel's theory of light did make novel surprising true predictions. But since the ether does not exist, Fresnel's theory is not approximately true.

Possible response: The ether does exist, it is the entity general relativity calls spacetime. So Fresnel's theory is approximately true after all.

The observable/unobservable distinction

Maxwell Grover (1962) argued that ‘observable’ is a vague term like ‘bald’.

Def: A term is vague iff it has “borderline cases”, where a borderline case is one where it is unclear whether the term applies even though all for relevant facts are known

Consequence: If ‘observable’ is vague then constructive empiricism is also vague

The vagueness of 'observable'

Which of the following events our observations:

- i) Looking at something with the naked eye
- ii) Looking at something through a window
- iii) Looking at something through a low powered microscope
- iv) Looking something through a high-powered microscope
- v) "Looking" at an electron in a cloud chamber

The problem for constructive empiricism

Given 'observable' is vague, which precisification of constructive empiricism should we believe? And why?

Van Frassen's answer: A state of affairs is observable (on the precisification relevant to constructive empiricism) iff it can be seen by the naked eye (of a human)

Underdetermination

Def: T is empirically equivalent to T' iff T and T' entail the same observational propositions

If T is one of our best theories, and there will be many other theories which

- i) are empirically equivalent to T ,
- ii) are incompatible with T , and
- iii) do not approximate T .

The turtle example

A theory that is empirically equivalent to the atomic theory of matter: Ordinary objects like chairs and tables are made up of tiny turtles which are squished together and which behave in such a way that it seems as if the atomic theory of matter is true.

The underdetermination argument against scientific realism

U1) If T is empirically equivalent to T', then we are justified in believing T only to the same degree as we are justified in believing T'

U2) If T is one of our best scientific theories, then there is an empirically equivalent theory that is incompatible with it and does not approximate it

U3) For any best scientific theory T, we are only justified in believing T to the same degree as some empirically equivalent theory that is incompatible with it and does not approximate it, and hence we are not justified in believing T

Response to the underdetermination argument

U3 is false: T might be empirically equivalent to T', but we might be more justified in believing T than T' because it is simpler

Reply: This response presupposes that it is more likely that the world is simple rather than complex. But there is no reason to believe this.

Problem for constructive empiricists

A version of the underdetermination can also be applied against constructive empiricism.

All we need to do is to replace 'empirically equivalent' with 'entails the same observed states of affairs as'.