Second Equal Prize

Constructive empiricism – a pragmatic alternative to realism and positivism

By Graham Cooper

Constructive empiricism (CE) is an anti-realist philosophy of science proposed by Bas van Fraassen. As the name suggests, CE is based on empiricism – the idea that all the knowledge we have about the world is obtained through observation. The word 'constructive' points to the fact that, in van Fraassen's view, science progresses as scientists build testable theories and models to represent the phenomena that we can observe. (Closer to Truth video, (3:00))

Several of the premises underpinning CE have been strongly criticised, but I believe this approach gives a more realistic account of science and its theories than either realism or positivism.

CE differs significantly from positivism, the previously dominant school of anti-realism, which dismissed talk of entities we cannot see as meaningless. By contrast, CE accepts that scientific theories may need to refer to unobservable entities and concedes that it can be rational to believe in them, although it says there is no obligation to do so.

Scientific realists, on the other hand, are generally committed to the existence of unobservable entities. As Ladyman explains, realism demands "a metaphysical commitment to a mind-independent world of observable and unobservable objects; a semantic commitment to the literal interpretation of scientific theories and a correspondence theory of truth; and, finally, an epistemological commitment to the claim that we can know that our best current theories are approximately true, and that they successfully refer to (most of) the unobservable entities they postulate, which do indeed exist." (Ladyman, p159)

In contrast to other anti-realists, such as sceptics and social constructivists, constructive empiricists accept the metaphysical and semantic components of this definition but deny the epistemic component. For them, acceptance of a theory does not entail belief in the entities that it postulates. They also insist that there is no need to believe good theories to be true.

So, while CE and realism both involve belief in a mind-independent world, the former's claims about the nature of science and the goals of scientific theories are far more modest than those of the realists. Van Fraassen clarifies the distinction as follows:

“Science aims to give us, in [realism’s] theories, a literally true story of what the world is like; and acceptance of a scientific theory involves the belief that it is true”. CE, on the other hand, holds that: “Science aims to give us theories which are empirically adequate; and acceptance of a theory involves as belief only that it is empirically adequate”. (Van Fraassen (1980) p6)

A theory can be said to be empirically adequate when it “saves the phenomena”, i.e., “when what it says about observable objects, events and properties is true”. (Curd, Cover & Pincock, p1238)

CE also breaks with realism in rejecting the demand for explanatory power as a criterion when choosing between scientific theories. Van Fraassen sees no significant value in explanation if it leads to no gain in empirical predictions. He says: “the true demand on science is not for explanation as such, but for imaginative pictures which have a hope of suggesting new statements of observable regularities and of correcting old ones”. (Van Fraassen in Curd, Cover & Pincock, p1077)

Personally, I find the epistemic modesty of CE – focussing on empirical adequacy rather than truth – very appealing. As Larry Laudan has pointed out, many theories that were once considered highly successful have since been found to be false (Laudan in Curd, Cover & Pincock, p1120); so, humility seems in order when making claims for our current best theories.

The Standard Model of elementary particles is a good example. This theory has enabled us to treat cancer, build computers, generate nuclear power and much else. It is one of the most tested theories in history. Yet, according to cosmologists, the movement of galaxies strongly suggests that the physical matter built from these elementary particles collectively represents only about 5% of the matter in the universe. (CERN website, Dark Matter) It is surely, therefore, more plausible to claim that the theory is empirically adequate than that it is true.

Nonetheless, numerous criticisms have been levelled against CE and some of the major ones are discussed below.

Observables vs unobservables

CE’s account of empirical adequacy relies heavily on the distinction between observable and unobservable entities, but critics say the dividing line is difficult to draw. The issue was clearly highlighted by Grover Maxwell, who claimed that the various observation techniques – direct (unaided), wearing spectacles, looking through a telescope, using a

powerful microscope etc. – exist on a continuum, and that drawing a line between them is arbitrary. (Maxwell in Curd, Cover & Pincock, p1052)

Van Fraassen countered by saying that data obtained using telescopes, microscopes etc. are too "mediated by theory" and should therefore be treated as inferences rather than observations. (SisyphusRedeemed video 3 (4:18)). He acknowledged that 'observable' is a vague term, but said that, as long as there are unambiguous extreme examples of both observable and unobservable, that is sufficient for the distinction to be meaningful. I agree.

He also stressed that 'observable' should be understood as 'observable to us'. Human faculties have inherent limitations, he noted, and "it is these limitations to which the 'able' in 'observable' refers." (Ladyman, p188)

However, this seems to overlook the fact that human physiology can change over time. For example, it is widely believed that early homo sapiens had ultraviolet vision, rather than our current form of colour vision. (Bowmaker, (1998)). I think this makes the distinction between observable and unobservable a fragile premise on which to base ontological claims, but is less threatening to epistemological arguments.

Explanation vs Prediction

Realists say that theories that provide a satisfactory explanation of observable phenomena should be considered true. But van Fraassen notes that theories can provide helpful explanations even if they are false. The geocentric astronomy of Ptolemy is a good example. (Ladyman, p106)

He rejects the idea that scientific theories should aim for definitive explanations of observed phenomena, believing that scientific practice is essentially a pragmatic activity "enabling us to make good predictions about the world". (SisyphusRedeemed video 3, (2:55)) As a former physicist, I consider this more modest goal to be much more realistic.

Scientific realists are also mistaken, according to constructive empiricists, in thinking that scientific explanations are based on objective truths such as causation and laws of nature. Rather, they say, explanations are pragmatic and are based on facts, theories and, importantly, the context in which the explanation is made. Again, this seems a more realistic view and I think a study of key developments in the history of science shows this to be the case.

As van Fraassen has noted, scientists often use pragmatic virtues, such as simplicity and coherence, not just epistemic virtues, when choosing between theories. (Van Fraassen (1980), p89). These pragmatic factors are valuable, he acknowledges, but only insofar as they assist in the development of theories that are empirically adequate. They carry no weight in indicating the truth of what the theories say.

Inference to the Best Explanation

Another fundamental feature of realism that van Fraassen rejects is the type of reasoning known as Inference to the Best Explanation (IBE).

Realists generally argue that IBE is essential when confronted by the need to choose between multiple hypotheses that are all empirically adequate for explaining certain phenomena – the Underdetermination Problem. In such a situation, IBE says that "we should infer the truth of the hypothesis that gives the best explanation of the phenomena". (Ladyman, p209)

Realists then claim that IBE is not available to constructive empiricists, as the latter set little store by explanatory success. Therefore, their choice of the most empirically adequate theory can be based on nothing more than an arbitrary 'selective scepticism', the realists claim. (Ladyman, p220)

Van Fraassen, however, denies that underdetermination can be overcome using IBE. On his view, which I share, the use of explanatory power to choose between rival theories is not as decisive as the realists claim, as this power is pragmatic not epistemic, and because it relies in part on 'super-empirical' virtues such as simplicity and coherence.

IBE also underpins the 'No Miracles' argument of Hilary Putnam: "the positive argument for realism is that it is the only philosophy that doesn't make the success of science a miracle". Science's successes in predicting new phenomena and giving rise to new technologies would be miraculous "if the theories were not, in general, correctly identifying the unobservable entities and processes that underlie what we observe." (Ladyman, p213)

Van Fraassen rebuts this claim with reference to the Darwinian theory of evolution. "The success of current scientific theories is no miracle. ... For any scientific theory is born into a life of fierce competition ... Only the successful theories survive – the ones which in fact latched on to actual regularities in nature". (Van Fraassen quoted by Musgrave in Curd, Cover & Pincock, p1094)

Applying this same argument to the philosophy of science, I think constructive empiricism has proven itself to be fit for survival.

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