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WISSENSCHAFTLICHER REALISMUS

Zur empirischen Unterbestimmtheit von Theorien (Texte)

1 Quine: [Empirical Underdetermination of theories]

Theories can differ utterly in their objects, over which their variables of quantification range, and still be empirically equivalent, as proxy functions show [...] [Pursuit of Truth, 96]

A proxy function is any explicit one-to-one transformation, f, defined over the objects in our purported universe. By 'explicit' I mean that for any object x, specified in an acceptable notation, we can specify fx. Suppose now we shift our ontology by reinterpreting each of our predicates as true rather of the correlates fx of the objects x that it had been true of. Thus, where 'Px' originally meant that x was a P, we reinterpret 'Px' as meaning that x is f of a P. Correspondingly for two-place predicates and higher [Pursuit of Truth, 31 f.]

One ontology is *always* reducible to another when we are given a proxy function f that is one-to-one. The essential reasoning is as follows. Where P is any predicate of the old system, its work can be done in the new system by a new predicate which we interpret as true of just the correlates fx of the old objects x that P was true of. Thus suppose we take fx as the Gödel number of x, and as our old system we take a syntactical system in which one of the predicates is "is a segment of". The corresponding predicate of the new or numerical system, then, would be one which amounts, so far as its extension is concerned, to the words "is the Gödel number of a segment of that whose Gödel number is." The numerical predicate would not be given this devious form, of course, but would be rendered as an appropriate purely arithmetical condition. [Ontological relativity and other essays, 57]

[Ein Beispiel:] We have on the one hand our commonsense conception of infinite space and rigid bodies that move freely without shrinking or stretching, and on the other hand the conception of a finite spherical space in which those bodies shrink uniformly as they move away from center. Both conceptions can be reconciled with all possible observations; they are empirically equivalent. Yet they differ, this time, more deeply than in the mere choice of words. The theory with the finite space makes crucial use of a theoretical term that admits of no counterpart in the theory with the infinite space – namely, 'center of space'. [Pursuit of Truth, 96 f.]

We hardly seem to be warranted in calling them [two theories related by a proxy function] two theories; they are two ways of expressing one and the same theory. It is interesting, then, that a theory can thus vary its ontology. [Pursuit of Truth, 96]

2 Boyd: [The plausibility of the evidential indistinguishability thesis]

3.2 Explanation Rehabilitated The conception that instruments, designed with the help of theoretical understanding, can extend the range of the senses so as to provide information about unobservable phenomena surely has to be a component of any even

remotely plausible defense of scientific realism. Still, by itself the idea that instruments can extend the senses is inadequate as a rebuttal to the basic underdetermination argument. Here's why. The basic idea behind the extending-the-senses approach to defending scientific realism is that – as scientists' knowledge of unobservable phenomena improves and as instrumental design becomes more sophisticated – measurement and detection would become possible for phenomena hitherto beyond the reach of reliable detection and measurement; think of going from light microscopes, to electron microscopes, to x-ray crystallography devices (which can produce images of atomic structures within crystals).

That has to be the realist's conception, but consider the effect of underdetermination arguments. Suppose that, at some stage in the process of the improvement of theories and instruments, certain phenomena, D, posited by existing theories are detectable by the extended senses, but others are not. Let T be the total science of the time, and let $T^\star$ be a theory empirically equivalent to T with respect, not to their observational consequences, but with respect to their consequence regarding the phenomena in D. The basic underdetermination argument can be repeated with respect to T and $T^\star$, leading to the conclusion that T does not reflect any knowledge of phenomena outside D. Thus there is no evidential basis for any extension of measurement and detection beyond D. Since this argument is applicable at any stage of any supposed extension of the senses, it challenges – in the name of knowledge empiricism – any extension of the senses.

3.3 Explanation as Evidential Considerations such as these seem to have focused the attentions of realists on what we might call extra-experimental standards for theory assessment. To see what these are, let's examine the EIT mentioned earlier.[1]

Why would a knowledge empiricist defend the EIT? An obvious answer is that she might think that the only consideration which ever justifies accepting one theory, T, over a rival, $T^\star$, is that some prediction about observables obtained from T has proven to be true, whereas a prediction from $T^\star$ about the same experiment or observation has proven to be false.

But is anything like this right? Pretty obviously – and pretty obviously by empiricist standards – no. Here's why. Consider any case in which observations in some set, O, provide us with good scientific evidence to accept some theory, T, such that T applies to an range of observable cases not represented in O (that is, consider any case of scientifically justified induction). In any such case there will always be infinitely many pair-wise empirically inequivalent theories such that (a) each of them is empirically inequivalent to T and (b) each of them is compatible with all the observational data ever collected. This is just the Humean point that induction is not deductively valid. If we have sufficient scientific evidence to justify our accepting T, that evidence must justify our rejection of each of these other theories. [Note that this conclusion must be accepted whether one is an empiricist or a scientific realist regarding the interpretation of T and its rivals, since the theories in question are pair-wise empirically inequivalent and are empirically inequivalent to T.]

Let $T^\star$ be one of these rivals to T. $T^\star$ is empirically inequivalent to T, so it would be possible in principle to run a crucial experiment to discriminate between T and $T^\star$. But, rational standards for the assessment of scientific evidence dictate that we are justified in rejecting $T^\star$ even though no such experiment has been run! So, there must be rational standards for the assessment of scientific evidence in addition to the standards which

[1] [EIT = "evidential indistinguishability thesis": "there can be no evidence which rationally distinguishes between two empirically equivalent total sciences"]. Ergänzung mit Zitaten von Boyd

say that evidence for or against a theory can be provided by the success or failure of observational predictions derived from the theory. Let's call these standards extra experimental. They solve the equation (!):

> (!) T's observational predictions have been thus far confirmed + Y = There is good scientific evidence favoring the empirical adequacy of T,
>
> AND, both realists and empiricists agree, they are capable of adjudicating between competing substantive conceptions of the world (because they can adjudicate between empirically inequivalent theories).

So, realists and empiricists agree that it isn't true that rational standards for the assessment of scientific evidence dictate that choice between competing theories must always be based on the results of crucial experiments. Where does that leave the underdetermination argument against knowledge of unobservables?

Almost all scientific realist responses to empiricist anti-realism in the last three decades can be understood as variations on the idea that the solution to (!) – which empiricists must agree exists on pain of abandoning selective skepticism for skepticism about induction – also solves (!!):

> (!!) T's observational predictions have been thus far confirmed + Y = There is good scientific evidence favoring the (approximate) truth of T, even of its claims about unobservables.

Defenses of realism along these lines (see, e.g, Boyd 1983; Byerly and Lazara 1973; Lipton 1993; Miller 1987; McMullin 1984; Psillos 1999; Putnam 1972, 1975a, 1975b) deploy somewhat different resources, but one thing they have in common is that they reflect, and participate in, what might be called the rehabilitation of explanation in recent philosophy of science. An obvious reply to the EIT is that it ignores the role of explanation as an evidential standard: perhaps one, among a family of empirically equivalent theories, is to be preferred because it explains observable phenomena better than the others, even though it makes the same observational predictions. The standard logical empiricist treatment of explanation, the deductive-nomological account (see Hempel 1942, 1965; Hempel and Oppenheim 1948), responds by identifying the explanatory power of a theory with its predictive power.

Over the last several decades a great many philosophers have been critical of some aspects or other of this reduction of explanation to prediction (see, e.g., Boyd 1985; Kitcher 1981; Lipton 1991; Kitcher and Salmon 1989; McMullin 1984, 1987; Miller 1987; Salmon 1984, 1989). In the context created by this critical work, the notion of explanation, as an independent component of rational scientific methodology, has been to some extent rehabilitated.

[http://plato.stanford.edu/entries/scientific-realism/]