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# A Defense of Empirically Equivalent Theories and Theory Choice



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## ABSTRACT

A scientific theory doesn't pop into existence out of nowhere. A community of researchers is involved. Previous theories, anomalies confronting the current running theory, and alternative hypotheses, must all be considered. Far from the view that empirical equivalence poses a worrisome underdeterministic threat to scientific rationality (and even scientific realism), I argue EE is part of the evolutionary nature of science. A fallibilistic outlook toward our theories and the endorsement of abductive inference as descriptive of the movements within science dissolves the problem of the empirical equivalence of scientific theories by evidence. Borrowing a bit from C.S. Peirce and Karl Popper, I will illustrate how both scientific rationality and scientific realism remain unscathed by the charge that two or more competing theories leads to deadly under-determination.

The problem of Empirical Equivalence (EE) is utterly dissolvable with C.S. Peirce's abductive/IBE method of inference. The problem can be reduced to phases in the evolution of science. To illustrate how the problem deflates, one need only look at phlogiston and the shift from Bechler's to Scheele's theory. The context, much like Kuhn's paradigm shift, is that EE is a state of affairs that scientific researchers face in the field that can lead to underdetermination (UD). Ties always seem to resolve themselves, although there are still questions of why. Laudan and Leplin show that according to UD, it may be the case that science does not have all the answers – the upshot is we don't have them *right now*.

Much like the Sociology of Scientific Knowledge, UD arguably tests our very faith in scientific rationality, its privileged epistemic status. According to the pessimistic meta-induction, we are not warranted in asserting scientific theories. The stance known as Scientific Realism (SR) is in jeopardy here, especially concerning unobservable objects, which science often posits to explain phenomena. There are many forms of scientific realism, although we might want to focus on the question of whether or not science is rational. There are three forms of UD: contrastive, holistic, and transient.

Laudan and Leplin conclusively showed in their 1991 essay "Empirical Equivalence and Underdetermination" that all forms of UD were transient.<sup>i</sup> They also show that contrastive UD is philosophically uninteresting and poses no threat to SR. Holistic UD can be reduced to the evidence we have at some particular time. Using the oxygen v. the phlogiston theory, one can argue that although both the oxygen and phlogiston theory were EE at time  $t_1$ , say, before Joseph Priestly's work, that tie was broken at time  $t_2$  –definitely, after Lavoisier adopted it. This type of scenario occurs in other disciplines such as astronomy, and at various different times throughout history. I proposed a solution showing that empirical ties always break and that ties can be time-indexed formal sentences.

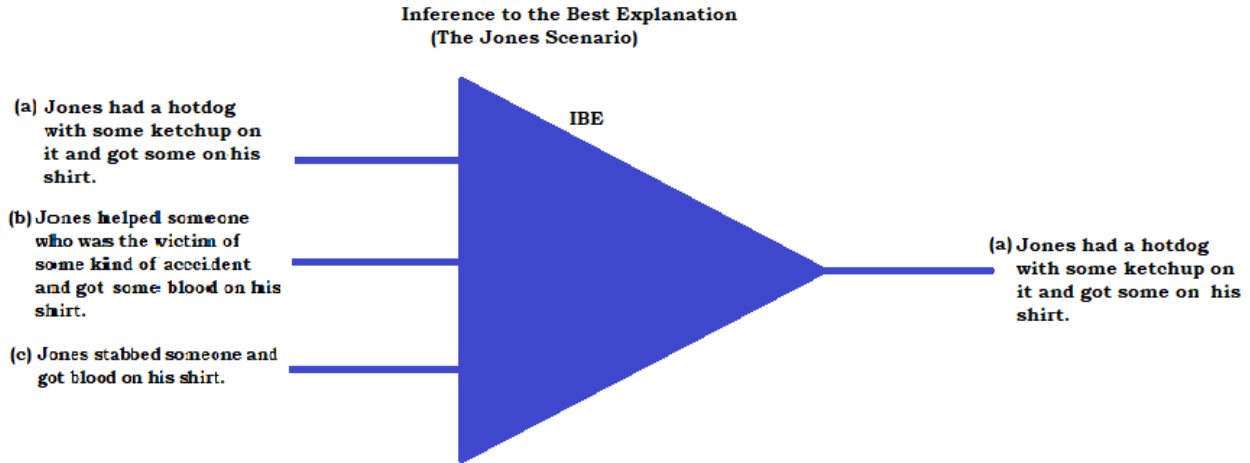
If we take an evolutionary view of science, perhaps Thomas Kuhn's paradigm shifts in his 1962 *Structure of Scientific Revolutions* do not appear so daunting.<sup>ii</sup> At times  $t_2$  the theory that has survived the most and more crucial tests should be the one we epistemically prefer in contrast to the falsified and untested rivals.<sup>iii</sup> Conceivably, this evolutionary view could be adapted to verificationist rather than corroborationist views, although the argumentation surrounding verification is thick. Popperian falsificationism furnishes us with the concepts of fallibility, and

verisimilitude, which provide us with advantages as well as a more detailed description of our evolutionary account.

Pragmatism has never claimed strict, stark correspondence relation when it comes to their theory of truth. Peirce's abduction/IBE claims that a reasoning agent starts with many "conclusions" (he calls them "opinions"),<sup>iv</sup> and proceeds via IBE choosing the best opinion available out of our set of possible options. Three factors are important with abduction/IBE as our descriptive account of science as a rational human endeavor. These are non-empirical virtues, retrodution, and concomittances. Retrodution is the same process he calls "abduction" elsewhere in his writings.<sup>v</sup> He contrasts this with induction and deduction, both of which have been tried. Concomittances are anti-Humean, constant conjunctive past experiences used to form hypotheses.

IBE is undertaken with the use of non-empirical virtues to narrow down our hypotheses, according to the contemporary literature on the subject. It is also important to note that the ultimate conclusions are reached within the scientific community. Third, we should accept that with the adoption of Popperian falsificationism and corroboration, crucial testing may narrow down theory choice. This method was mentioned originally by Sir Francis Bacon in Book II of the *Novum Organum*, although I have seen this facet of his philosophy of science completely ignored by Bayesian critics.<sup>vi</sup> On the other hand, standardization of non-empirical virtues has been wanting, as in the case of *simplicity*, and other considerations may be more philosophically interesting as debates continue.

To illustrate IBE, imagine a scenario wherein your roommate, Jones, comes home after a baseball game with a red stain on his shirt. There are three plausible alternative hypotheses you formulate: (a) it is ketchup (b) he helped an accident victim and got some blood on his shirt (c) he stabbed someone. Jones is a slob, slightly overweight, and loves hotdogs with all the fixings. On closer scrutiny, the stain doesn't look like blood. There may be other factors that may suggest (a) as well.



It may be the case that you fail to even ask to get confirmation about his shirt, so there isn't even a valid claim toward a strict correspondent relation about our belief on the matter. Ultimately, we have a verisimilar theory that the stain was ketchup. On a macroscopic scale, Peirceans maintain this may be the best reasoning scientific communities have—an intersubjective truth predicate that is fallible.

This view notes a transient feature of the evolution of science. It will give us a time-indexed truth predicate. Cases of EE are broken in time according to our meta-induction. Rivals will be epistemically disregarded through IBE. Theories are fallible, not ultimately true. Our predicate is truth-like, and we are warranted in asserting our reigning theory despite Humean worries on this philosophical outlook. To quote Peirce “the opinion which is fated to be ultimately agreed to by all who investigate, is what we mean by the truth, and the object represented in this opinion is the real.”<sup>vii</sup> In the case of phlogiston, we can see this at work. Science is vindicated in the face of UD with the account of scientific discovery just outlined.

## REFERENCES

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<sup>ii</sup> Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 2012).

<sup>iii</sup>Cf. Karl Popper, *Conjectures and Refutations* (London: Routledge, 1963).

<sup>iv</sup>Charles Peirce, “How to Make Our Ideas Clear,” in *Popular Science Monthly* 12, (1878): 297.

<sup>v</sup>Francesco Bellucci & Ahti-Veikko Pietarinen “Charles Sanders Peirce” Logic, “Internet Encyclopedia of Philosophy. Retrieved from <<https://iep.utm.edu/peir-log/#H1>>.

<sup>vi</sup>See David Schwartz, “Crucial instances and Francis Bacon’s Quest for Certainty,” *HOPOS*, 2017. Retrieved from <<https://www.journals.uchicago.edu/doi/pdfplus/10.1086/691131>>.

<sup>vii</sup>Charles Peirce, "How to Make Our Ideas Clear," in *Popular Science Monthly* 12, (1878): 297.

