

Inductivism, Hypothetico-Deductivism, Falsificationism and Kuhnian Reconciliation

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Inductivism, hypothetico-deductivism, falsificationism and Kuhn's paradigm shifts differ in approach and scope within the scientific community. Although there are similarities between aspects of the four approaches, there are major divisions between the three and how they attempt to construe, and view, scientific progress. From the onset, the three theories differ greatly in interpreting the statement "science is based on facts." An important topic of significance is how the competing theories might view pseudo-science and its relationship with, in particular, astrology and creation science. Nonetheless, each theory possesses persuasive and critiqueable features that have helped shape the landscape of human scientific endeavor and laid the foundation for their own modification.

Inductivism proposes and rests on a common understanding of the laws of the universe. To the inductivist, there are laws of nature, uniformities that govern these laws. Inductivism claims that "facts" are observable, and that theories *should be* derived from these facts by observation. Anyone with similar training will most likely see the same facts as another under similar circumstances. In essence, these observable facts are "objective." The inductivist places a very high degree of faith into the senses, and it is the senses, to the unbiased and unprejudiced observer, that relay these facts to the qualified observer. Inductivism has another major tenant worth noting: "Facts are prior to and independent of theory," according to Alan Chalmers (1999, p. 4). The old phrase "seeing is believing" carries much credence with inductivism. Interpreting Chalmers's claim to inductivism explores a key aspect to the inductivist: laws are fixed, uniform and objective. They are not dependent on a particular theory for them to be facts in the first place, they are simply facts, independent of the observer.

Hypothetico-deductivism rejects the context of discovery so crucial to the inductivist. As the inductivist places a high degree of credibility in the senses and observation to derive observable facts from the perceptions, the hypothetico-deductivism resists this notion. Hypothetico-deductivism asserts that "facts" are not always

observable. In microbiology, physics, and other fields, things are more often too small to be observed by the human eye alone, not to mention microscopic organisms that have been discovered in recent years. Furthermore, a hypothetico-deductivist would point to the fact that many things have come to scientists not by observation, but rather by accident, through dreams, visions and preexisting theories. Hypothetico-deductivism rejects the notion that facts are neutral and objective. Facts are theory-laden and dependent. Human eyes are not passive receptors, and this criticism is only confirmed upon showing the same picture to two people, getting two different results.

The context of discovery, so important to the observationally dependent inductivist is set aside, scientific progress is interpreted by examples of accidental discovery, confirmed conjectures, and theory derived hypotheses. Hypothetico-deductivism requires no such specific process, instead relying on confirmation of a particular theory. The more a scientific theory is confirmed, the better, and every subsequent test that reaffirms the original hypothesis gives more credibility to the original theory. Theories are thus confirmed, not proven, yet every instance that lends support corroborates the theory. The claim that all ravens are black is confirmed with every black raven encountered, giving more support to the claim that all ravens are black.

It is necessary to discuss the nature of scientific discovery and how this might be interpreted by both inductivism and hypothetico-deductivism. There are several questions that are substantive to both inductivism and hypothetico-deductivism alike. As Chalmers is able to illustrate, "Science is derived from the facts' could be interpreted to mean that scientific knowledge is constructed by first establishing the facts and then subsequently building the theory to fit them" (1999, p. 41). As he later points out, can we really derive facts from deductive logic? Arriving at new facts does not seem likely from deduction alone. Bertrand Russell used another famous critique of inductivist derivation. A turkey is fed every morning at the same time, 9 AM. The turkey safely concludes "I am fed every morning at 9 AM," until Christmas Eve when the turkey is killed at 9 AM, showing a fault in the reasoning here. It seems that even inductive arguments as well have major obstacles to overcome.

Chalmers gives three possible attempts to sidestep the aforementioned obstacles to inductive reasonings, deeply embedded in both hypothetico-deductivism and inductivism relating to the context of discovery and deriving "facts."

1. The number of observations forming the basis of a generalization must be large.

2. The observations must be repeated under a wide variety of conditions.
3. No accepted observation statement with the derived law.

Understanding the critiques of inductivism and the problem with deriving facts from observations, the same deductive problem faces hypothetico-deductivism in the form of the infamous Raven's Paradox. Under hypothetico-deductivism, the statement "All ravens are black" is confirmed with every black raven discovered. The problem with this claim is equivalence, which is "all non-black things are non-ravens." The immediate problem with the paradox is that one could easily find objects that are both non-black and non-raven. Although philosophers and logicians have proposed many defenses to the paradox at hand, it serves as a necessary critique of hypothetico-deductivism's fundamental tenant, the theory of confirmation and its logical foundation.

Falsificationism offers radically different approaches to the beliefs outlined above. Agreeing with the hypothetico-deductivist, falsificationists would also reject the strict context of discovery, although this is not entirely accurate, as will be discussed later. To falsificationism, just because you confirm a hypothesis does not mean you've given enough confirmation. A problem apparent from the three attempted solutions to overcome obstacles to confirmation persists: how many observations must be witnessed before a theory is confirmed? A problem for the falsificationist is that no specific number of confirmations will make any hypothesis true. A body of science must be *falsifiable*. A theory must be open to testing; although confirmation is important, it is not the principle factor. Kepler's theories could have been falsified, Einstein's groundbreaking work could have/still could turn out to be false, and this is, according to the falsificationist, what makes science "science."

Falsificationism would also reject the notion that science is based on observable facts because a falsificationist must be prepared to reject previous theories for new ones, and this is how scientific progress is made. Scientific progress, to the falsificationist, is a never-ending quest to falsify previous theories for better ones – the more falsifiable the better. This notion follows to some degree with the hypothetico-deductivist at confirmation, but in a different way. Confirmation does not yield new evidence; rather, theories can be shown to turn out incorrect. The notion of scientific progress for the falsificationist rests on the premise that scientific theories are *tentative*. This poses a problem for inductivism because supposedly science is based on "objective" facts, which of course would not be tentative at all. Since theories are based on facts, there is no need to falsify them in the way the falsificationist has suggested. For

hypothetico-deductivism, although science is not based on facts, progress is made by confirmation of preexisting theories, which presupposes theories are to precede these "facts" as construed by inductivism.

Various criticisms have been offered of falsification that are necessary for the task at hand. There have been historical examples of theories proposed from a more hypothetico-inductivist approach that have shed light on some problems with falsificationism. Should one completely abandon one's theory outright if contrary evidence is shown against it? A strict falsificationist would have rejected the idea that a planet may lie beyond Uranus because it conflicted with previous laws set forth by Newton or Kepler. A conjure was proposed that another planet may lie beyond Uranus which would explain the deviations in Newton and Kepler's theories. It would turn out that Urbain Le Verrier had many difficulties convincing his colleagues that such was the case, however, the theory turned out to be true, showing that *a given counterexample does not always falsify the original hypothesis*. This shows how a theory may be hidden from falsificationism under other complex assumptions. Many theories in the history of science would have been rejected in their infancy under the strict sense of falsificationism, the discovery of the planet Neptune being a small example. The same could be said about calls to reject Newton's gravitational theory because of Mercury's irregular orbit. However, such attempts were deflected because of causes in other theories. To "throw the baby out with the bath water" is not too far off here. Complexities involving various theories give rise to falsificationism and how it attempts to deal with these inadequacies.

Considering these vast differences and similarities between the three approaches, it is interesting to consider the varying interpretations of two examples of considerable interest, creationism and astrology. Inductivism seems to be more accepting, by definition, of such pseudo-sciences. If inductivism claims to be based on "observable facts" then the senses might give credit to creationism and astrology. Inductivism often employs abductive reasoning, the attempt to provide the best explanation with a given set of circumstances. Inductivism appears to be the most receptive out of the competing views thus far to creationism and/or astrology, as they are often relied upon because of the "best possible explanation" outlined above.

It's rather difficult for hypothetico-deductivism to incorporate these pseudo-sciences, not necessarily because of a difference in the context of discovery, but rather its approach to confirmation. Can creationism really be confirmed? With regard to astrology, it looks

easy to confirm anyone's daily horoscope based on the often vague, general fortunes found in the daily newspaper. It appears possible to confirm astrology by reading, "All Leos will have plenty of luck today." Hypothetico-deductivism may or may not accept astrology and creationism based on the theory of confirmation, but it seems to raise numerous questions about whether or not one can really confirm claims made by either of the two pseudo-sciences. It begs the question, does confirmation in this sense really ever, or can it ever, confirm such instances? Hypothetico-deductivism seems to leave this question unanswered in its definition and approach to confirmation, instead leaving it up to an individual to determine.

Where hypothetico-deductivism leaves vagueness and uncertainty in its outlook on astrology and creationism, falsificationism seems to leave little room to consider astrology and creationism as science. Michael Ruse says that, "A body of science must be falsifiable...A theory must be open to possible refutation" (Ruse 1982, p. 75). It seems unlikely that astrologists and creationists offer their positions and theories up for refutation. Are creationism and astrology ever really falsifiable? Out of the three approaches, it seems falsificationism would clearly be the most critical. The claims given by creationists do not seem to be even testable, giving scientists claims that are not tentative or giving of new knowledge. Also, bending creationists' views around preconceived dogmatism is counterproductive to scientific progress in general. Refutation is key to falsificationism, leaving creationism and astrology dependent on abduction for credit, not interpretation of new evidence to confirm their theories.

As is evident, inductivism, hypothetico-deductivism and falsificationism differ in their outlook on scientific progress, interpretation of "facts," and their acceptance and/or denial of pseudo-sciences. Scientists do not always allow their own positions to be refuted and falsified. Although scientists can be dogmatic in their approach as well, many, and perhaps most, scientists subscribe to the falsificationist approach to science. Hypothetico-deductivism offers promise in its faith of scientific confirmation, and it has been demonstrated that it is, to some degree, compatible with falsificationism. Science must continue to progress through an open quest to put existing theories to the test, allowing preconceived notions of "facts," whatever they may be, up to scientific criticism and refutation.

Thomas Kuhn famously published *The Structures of Scientific Revolutions* in 1962, a publication that brought previous theories in the history and philosophy of science into a whole new context. Kuhn's ideas were a revolutionary step in the philosophy of science,

in that he proposed a new way to interpret the work of science. Nonetheless, with the three previously held positions in mind, Kuhn sought to propose a different yet similar approach to understand and decipher previous scientific discoveries and breakthroughs by coining the term "paradigm." Scientists work feverishly in a problem-solving mentality hoping to create anomalies within the specific paradigm. Kuhn calls this initial process "normal science." Normal science is where Kuhn places most scientists during their careers. Once these anomalies are detected, scientists enter a crisis mode and embark on what Kuhn calls "revolutionary science." It is in this period of revolutionary science that theories are checked, previously held formulations are re-analyzed and possible refutations are generated, for a new paradigm, or paradigm shift to occur.

Kuhn published his work at a time when Sir Karl Popper was in the process of championing falsificationism. The main theme involving Kuhn with the discussion at hand is if Kuhn's view of scientific progress, paradigm shift, and revolution is as incompatible as his critics make it out to be. Without having to recap all of Kuhn's views, a Kuhnian approach would reject, like the falsificationist, old theories for new and improved paradigms. In fact a central tenant to Kuhn's view is the new paradigm's treatment of previously held theories, which brings the discussion on scientific approaches full-circle. Paramount to Kuhn and falsificationism is the rejection of previously held theories that have been replaced by new ones. In that sense, Kuhn appears to make the same mistake that a falsificationist makes in prematurely rejecting theories because of an apparent falsified instance.

Where Kuhn seems to redeem himself with the falsificationist, and perhaps the other two theories, is where he talks about scientific progress in the latter part of the book.

First, the new candidate must seem to resolve some outstanding and generally recognized problem that can be met in no other way. Second, the new paradigm must promise to preserve a relatively large part of the concrete problem solving activity that has accrued to science through its predecessors. (1996, p. 168)

Who is to say that the four approaches do not still solve problems within science, stimulating and producing paradigm shifts? What Kuhn got right specifically is how he treats problems that can be met in no other way, not necessarily promoting his own scientific method, but *any and all approaches* that can solve the problem at hand. This is what science, and particularly the varying approaches can and should have in common. Solving problems *is* scientific progress.

It might seem tempting to support a particular scientific approach, and many scientists and philosophers alike are quick to cling to and promote a single approach and attempt to boast of its superiority over rival theories. However, within the context of scientific progress, it seems only fitting to assert that it has not been a collection of facts that has progressed humanity, but rather the attempt to make science better by trial and error, an idea not restricted to a particular approach. Science is the most important endeavor in the history of humanity, a bold claim that scientists have attempted to support. Science is progressing, basing its advancement on prior theories that have been confirmed and then perhaps refuted. In light of the three, perhaps four, theories, there are elements that could be incorporated to fit this furtherance of scientific discovery. However, mankind must accept failure as a necessary element of science. Bold claims, theories and conjectures and their possible refutation are fundamentally paramount for the future of scientific progress.

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