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# Kyle Stanford on The Problem of Unconceived Alternatives

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## A Problem for Underdetermination

The relationship between theory and evidence is one of the core issues in the philosophy of science. The Duhem-Quine thesis proposes that what is experience tested is not a single scientific theory, but rather a whole theory composed of the theory itself and auxiliary hypotheses, experiments or boundary conditions. When confronted with contradictory evidence, scientists do not immediately abandon the original theory; instead, they attempt to adjust the auxiliary hypotheses, as well as the experiments or boundary conditions, to make the revised overall theory consistent with the observed evidence. However, based solely on observational evidence, we cannot directly choose among these empirically equivalent alternative adjustments. Also, Bas van Fraassen and Andre Kukla have proposed different algorithms for constructing empirically equivalent theories, thus presenting a form of comparative underdetermination.

However, Larry Laudan and Jarrett Leplin have criticized this view, arguing that what is referred to as empirical equivalence is only valid within a certain time frame. Some theories that were initially empirically equivalent may no longer have the same empirical consequences as the scope of observation changes and auxiliary hypotheses are modified.

Kyle Stanford agrees with the above critique of underdetermination, pointing out that the empirically equivalent theories conceived or constructed by philosophers are not the ones that scientists seriously consider or that are recognized as legitimate scientific theories by the scientific community. More importantly, underdetermination is merely a form of Cartesian skepticism, because if, in principle, we can construct empirically equivalent theories for any given theory, then choosing any theory would be impossible. The underdetermination argument falls into a skeptical dilemma, which undermines its uniqueness as a philosophical issue. Stanford notes that scientists are not troubled by underdetermination because the methods proposed by philosophers cannot quickly generate empirically equivalent theories that are scientifically serious, proposing any scientific theory requires a long period of exploration and refinement.

## The Problem of Unconceived Alternatives

Sklar has suggested that true underdetermination should only be a transient problem, not a permanent dilemma. Sklar believes that real underdetermination should be based on genuinely existing and incompatible hypotheses, rather than merely different expressions of the same hypothesis. At a given point in time, these real scientific hypotheses are equally supported by the existing empirical evidence as the current beliefs. This means that although, based on current prior possibilities and evidence, we cannot choose between these empirically equivalent hypotheses, the empirical evidence we may gather in the future could very well make one of these competing hypotheses our most preferred. However, some of these hypotheses may have already been proposed, while others are "unborn" hypotheses.

Kyle Stanford believes that Sklar's view reminds us that the theories available for our choice should be genuine theories, those recognized by the scientific community, rather than fictional theories or merely theoretical possibilities. Although Sklar was unable to fully articulate his thoughts or carry them through to completion, if we continue to delve into Sklar's ideas, we can see that true underdetermination should be a dilemma in human rational cognition. Stanford proposes and elaborates on a new form of underdetermination— the Problem of Unconceived Alternatives. He argues that, we cannot fully determine which scientific theory to choose, even the best one, because probability, there are theories we have yet to imagine or consider that are not only empirically equivalent to the existing theories with the existing available evidence, however, these well-confirmed and serious alternative theories, which offer better explanations and predictions of observable phenomena and are confirmed by new evidence, will be accepted by future scientific communities. They are the strongest competitors to the current theories, even though they have not yet been conceived by scientists and are thus merely potential theories. Stanford further points out that such underdetermination represents a recurrent epistemological dilemma: even if the scientific community temporarily accepts a particular scientific theory based on the confirmation of novel observational evidence, there always exists, based on the existing evidence, other theories that are equally well supported by the evidence and thus available for selection. These theories are ones that scientists at the time had not imagined.

## New Induction over the History of Science

The problem of unconceived alternatives is deeply involved in the debate between scientific realism and anti-realism. Clearly, this problem is meant to challenge scientific realism, because when better theories that are fundamentally different from the current best theories are certain to emerge in the future, we can no longer regard the current best scientific theory as truly or approximately true. Building upon and developing the pessimistic induction of anti-realism, Stanford proposes a new induction over the history of science. He attempts to support the problem of unconceived alternatives through a historical ostension strategy and argues for its universality in the field of fundamental theoretical sciences.

The anti-realist historical argument in science can be traced back to Poincaré's notion of the "bankruptcy of science". Laudan proposed the famous pessimistic induction, not directly inferring from the repeated failure of past theories that current theories will meet the same fate but rather employing the historical gambit strategy. This strategy targets the model of scientific realism's "success of science" and its case studies, arguing that they contradict the history of science. For instance, hypotheses like phlogiston, caloric, ether, and vitalism have long been disproven, and theories such as the spontaneous generation of life, the theory of static electric fluids, and the Humorism is now considered completely erroneous descriptions of the objective world. These theories' structures and models have been discarded by the current scientific community, providing a powerful rebuttal to the core argument of scientific realism's non- miracle argument.

Stanford argues that we indeed have convincing cases supporting the problem of unconceived alternatives. He points out that the historical record of scientific research highlights the characteristics of theoretical development or shifts in the history of science: despite scientists' efforts to construct theories addressing empirical anomalies, they have consistently failed to conceive of alternative theories that were later confirmed and widely accepted. Stanford provides examples from the history of theoretical developments in fundamental sciences such as physics, chemistry, biology, and medicine, from ancient Greece to modern science:

### Physics

i. **Mechanics:** Aristotelian physics → Cartesian physics → Newtonian mechanics → contemporary mechanics.

ii. **Electromagnetism:** theory of electric and magnetic fluids → Electromagnetic ether theory → contemporary electromagnetism.

iii. **Thermodynamics:** caloric theory → contemporary thermodynamics.

iv. **Nature of light:** 18$^{th}$-century particle theory of light → 19th-century wave theory → contemporary quantum mechanics and the standard model.

### Chemistry

Early particulate chemistry → Stahl's phlogiston theory → Lavoisier's oxygen theory → Dalton's atomic theory → contemporary physical chemistry.

### Biology

i. **Embryology:** various versions of preformation theory → epigenesis theory.

ii. **Genetics:** Hippocrates' panspermism → Darwin's genetic panspermism → Weismann's germ-plasm theory → Mendel's genetic theory → contemporary molecular genetics.

iii. **Evolution:** Cuvier's static species theory or Lamarck's theory of spontaneous generation → Darwin's theory of evolution.

### Medicine

Humoral imbalance → miasma theory → germ theory of disease.

Each of Stanford's examples of theoretical development illustrates the massive and continuous transformations of scientific theories throughout history. He points out that in each series of theoretical developments, the available evidence equally supported both the previously accepted theories and the alternative theories that had not yet been conceived at the time, but which were eventually recognized and accepted by the scientific community. Such situations have indeed repeatedly occurred in the history of science.

## Representative Works

Stanford's representative works are "Exceeding Our Grasp: Science, History, and the Problem of Unconceived Alternatives" (Oxford University Press, 2006), "Pyrrhic Victories for Scientific Realism" (Journal of Philosophy 100, 2003, 553-572), "Scientific Realism, the Atomic Theory, and the Catch-All Hypothesis: Can We Test Fundamental Theories Against All Serious Alternatives?" (British Journal for The Philosophy of Science 60, 2009, 253-269),"Damn the Consequences: Projective Evidence and the Heterogeneity of Scientific Confirmation" (Philosophy of Science 78, 2011, 887-899.), "Catastrophism, Uniformitarianism, and a Realism Debate That Makes a Difference" (Philosophy of Science 82, 2015, 867-878), "Naturalism Without Scientism" (in The Blackwell Companion to Naturalism, Wiley-Blackwell, 2016, 91-108), "So Long and Thanks for All the Fish: Metaphysics and the Philosophy of Science" (in Metaphysics and the Philosophy of Science, Oxford University Press, 2017, 127–140), "Realism, Instrumentalism, Particularism: A Middle Path Forward in the Scientific Realism Debate" (in Contemporary Scientific Realism: The Challenge from the History of Science, Oxford University Press, 2021, 216–238).

## Resume

Kyle Stanford (1970-) graduated from University of California at San Diego in 1997 with a Ph.D. in Philosophy/Science Studies, under the direction of Philip Kitcher. He is an American philosophy professor in the Department of Logic and Philosophy of Science at the University of California, Irvine, who specializes in the philosophy of science (esp. the problem of Unconceived Alternatives and the debate on scientific realism and instrumentalism), history and philosophy of biology, and moral philosophy. Subsequently he served as the chair of department of logic and philosophy of science. And Kyle Stanford was a senior fellow in center for the philosophy of science university of Pittsburgh. In term of academic group, as a member of Philosophy of Science Association, Kyle Stanford had served as the chair of PSA Nominating Committee and the member of PSA Governing Board. In academic editing, Kyle Stanford was a series editor for Oxford Studies of Oxford University Press in the Philosophy of Science, and an editor and a member of the editorial board of the journal Philosophy of Science

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## Conflict of Interest

No conflict of interest.