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Karl Popper and the Call for Academic Discipline

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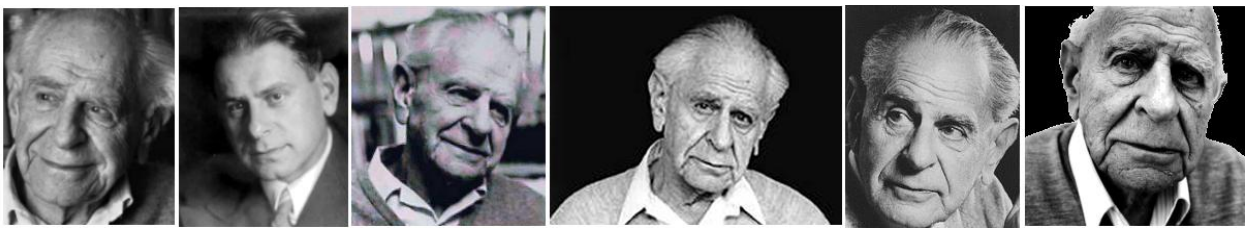

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Abstract

Karl Popper was a philosopher that criticized traditional views of how knowledge was purported to support scientific and philosophical hypotheses. This paper analyzes the influence Popper had on how knowledge is used to support science.

With respect to the formation of theories, the traditional view is observations are the basis of hypotheses that form rules that can be extended past the observations and original experimental constraints and assumptions. This approach causes several problems. The *problem of demar*cation concerns our inability to draw the line between statements of science and those that are pseudo-scientific, or religious in nature. There is no clear point where science ends and conjecture starts, so how do we know how much reverence to give particular theories? The *problem of induction* asserts that universal laws are based on specific assumptions, but yet are extrapolated out through an induction process to cover circumstances not originally observed. The assumption that the law applies to new, unobserved circumstances is a risky one and must be supported by new assumptions not verified by the original observations.

Researchers still view scientific hypotheses as theories that are proven out by observations during controlled experiments. Popper, however, flipped this view around and argued that any theory was simply a hypothesis that had not yet been disproved. Science is said to be a struggle between competing theories. Every imperfect theory is thought of as a representation of reality that became preeminent by surviving the scrutiny of scientists as they experiment and observe the real world. Rigorous testing eliminates weaker theories, leaving the strong theories to survive. The longer theories survive, the more they are scrutinized and refined to accommodate new findings. Thus, researchers submit their hypothesis to severe testing to expose any flaws in the underlying theory.

Although ideas certainly flow from observations, Popper makes a convincing argument that the observations can never be a basis for validating theories due to the problems of demarcation and induction. After some analysis, this paper adopts his contention that a theory cannot be verified through testing, but rather, the test results merely indicate that a theory has not been disproven and should be provisionally retained as the best available theory until it is eventually falsified.

Contents

Introduction

During the early parts of the 20th century an Austrian intellectual circle analyzed important scientific and philosophical theories of the time from a unique, collaborative perspective. Karl Popper[1] was a philosopher that participated in the circle and criticized traditional views of how knowledge was purported to support scientific and philosophical hypotheses. Most people viewed scientific hypotheses as theories that would be proven out by observations during controlled experiments. Popper flipped this view around and argued that any theory, even one as well–established as Newtonian physics, was simply a hypothesis that had not yet been disproved[2]. Popper viewed science as a struggle between competing theories. Every imperfect theory was thought to be a representation of reality that became preeminent by surviving the scrutiny of scientists as they experimented and observed the real world. Rigorous testing was said to eliminate weaker theories, leaving the strong theories to survive. The longer theories survived, the more they would be scrutinized and refined to accommodate new findings. Popper refers to this as "error elimination," in which researchers submit their hypothesis to severe testing to expose any flaws in the underlying theory[3]. This paper analyzes the influence Popper had on how knowledge is used to support science.

Background

In the summer of 1953 Popper gave a lecture[4] at Cambridge as part of a course on developments and trends in contemporary British philosophy. The text of the speech was recorded and originally published in 1957[5]. A review of this lecture gives us good insight into Popper's views on the use of knowledge to support scientific findings. In *Conjectures and Refutations*, Popper is concerned that conclusions are drawn lightly in the scientific discovery process. He notices that theories are being espoused and no advocacy process is strengthening their interpreted meaning. Quite the contrary, at the first sign of inconsistency with observed behavior, dramatic assumptions are made that explain the theory to the

[1] Sir Karl Raimund Popper (1902-1994), was an Austrian-born, British philosopher generally regarded as one of the greatest 20th century philosophers of science and especially noted for the scope of his intellectual influence. Popper viewed science as a struggle between competing theories. Every imperfect theory was thought to be a representation of reality that became preeminent by surviving the experimental scrutiny of scientists.

[2] Sull, D. (2010), Karl Popper's Experimental Loop, published at Don Sull's blog, Professor of Management for the London School of Business, viewed at: http://blogs.ft.com/donsullblog/2010/04/01/karl-poppers-experimental-loop.

3 Id., Sull (2010), p. 1, para. 6.

4 Popper, K. R. (1953), "Science: Conjectures and Refutations," lecture given at Peterhouse, Cambridge, 1953. Reprinted in K. Popper, Conjectures and Refutations, London, Routledge, 1963; 3rd Ed., 1969.

5 Mace, C. A. (1957), "Philosophy of Science: a Personal Report," in British Philosophy in Mid-Century, C.A. Mace (ed.)

observations, but dilute it to the point of becoming vague and meaningless[6]. By making their interpretations and prophecies sufficiently vague, advocates of the theory were able to explain away anything that might have been a refutation of the theory had it been described more precisely.[7] Popper notes "[i]n order to escape falsification they destroyed the testability of their theory."[8] He expressed genuine concern about how advocates of these theories could rationalize any current news or happenings as further proof of the theory. He simply was not comfortable with how lightly conclusions could be drawn. This point was hammered home when Popper stated, "[i]t is a typical soothsayer's trick to predict things so vaguely that the predictions can hardly fail: that they become irrefutable."[9]

By analyzing the theories of Freud,[10] Adler,[11] Marx[12] and Einstein,[13] Popper noticed a contrast of Einstein's theory with the other three. The other three, which is how I'll refer to them, had an

[6] Id., Popper (1953), p. 3, para. 11.

[7] Id., Popper (1953), p. 3, para. 11.

[8] Id., Popper (1953), p. 3, para. 11.

[9] Id., Popper (1953), p. 3, para. 11.

[10] Sigmund Freud (1856 – 1939) was an Austrian neurologist who founded the discipline of psychoanalysis. The *Theory of Psycho-Analysis* provided a radically new approach for analysis and treatment of "abnormal" adult behavior. Freud's approach recognized that neurotic behavior is not random or meaningless, and analysis of the abnormal behavioral patterns could give analysts a meaningful and informative method for understanding the behavior.

[11] Alfred Adler (1870 – 1937) was an Austrian medical doctor and psychotherapist that founded the school of individual psychology and developed the widely known concept of the "inferiority complex." Along with Sigmund Freud and others he founded the Vienna Psychoanalytic Society, but was later excised by Freud who found his ideas too contrary. Having broken away from the psychoanalysis ranks, Adler formed the independent school of psychotherapy and personality theory. He emphasized the importance of equality in preventing various forms of psychopathology, evaluation of the unconscious, and development of social interest and democratic family structures for raising children. He also conceptualized will power as the individual's creative power to change for the better and was a supporter of the feminist movement. Adler's teachings have had an enormous effect on the disciplines of counseling and psychotherapy as they developed.

[12] Karl Heinrich Marx (1818 – 1883) was a German philosopher, historian and revolutionary known for developing theories about society, economics and political class struggles that are collectively known as "Marxism." He believed that all society progresses through class struggles and was very critical of capitalism, which was said to be run by the wealthy purely for their own benefit. He believed in socialism and argued that society should be governed by the working class in a workers state. In 1845 he became a leading figure of the Communist League, published *The Communist Manifesto* in 1848, and moved to London (after being exiled from Cologne) in 1849, where his family was reduced to poverty. Although not very well known during his lifetime, his ideas have since played a significant role in the development of social science and the socialist political movement.

"apparent explanatory power,"[14] and these "theories appeared to be able to explain practically everything that happened within the fields to which they referred." Popper was dissatisfied with the lack of academic discipline philosopher's were demonstrating as evidence when he stated "I could not think of any human behavior which could not be interpreted in terms of either theory."[15] While proponents hailed this characteristic of being reaffirmed by all observations as the strongest argument in favor of the theories, Popper noted the apparent strength was in fact a weakness. By watering them down so they fit all observations, the theories became irrefutable and could not be advanced through scientific scrutiny.

Einstein's theory of gravity, on the other hand, had precisely the opposite characteristics. It was precisely stated and appeared to expose Einstein to potential embarrassment when scientists had a chance to refute it. In 1919, however, eclipse observations by Arthur Eddington brought the first important proof of the theory that light must be attracted to heavy bodies.[16] According to the theory, the apparent position of a distant fixed star near the sun (a heavy body if ever there was one) would shift slightly as light rays coming towards earth bent towards the sun. This shifting characteristic could not normally be observed since the stars are not visible during the daytime. So Einstein's theory, which enabled calculation of the shift, was verified during the eclipse when it was possible to take photographs of the stars and to note their position. Popper was impressed by the theory because of the risk involved in making such a prediction,[17] and, more importantly, because it was easily refuted with "certain possible results of observation" that, before Einstein, everybody would have expected.[18] The fact that

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[13] Albert Einstein (1879 – 1955) was a German-born theoretical physicist who discovered the theory of relativity, which caused a revolution in physics. Einstein noticed that Newtonian mechanics were being extended past the validity of their original assumptions and could no longer reconcile the laws of classical mechanics with the laws of the electromagnetic field. He therefore developed the theory of general relativity. In 1917, he applied the theory to model the structure of the universe as a whole, which led to his explanations of particle theory and the motion of molecules. Einstein received the 1921 Nobel Prize in Physics and became a U.S. citizen in 1940. He was also remembered for his influence in getting the U.S. to begin development of an atomic bomb during World War II.

[14] Id., Popper (1953), p. 2, para. 3.

[15] Id., Popper (1953), p. 2, para. 5.

[16] Sir Arthur Stanley Eddington (1882 –1944) was a British astrophysicist famous for his work regarding the Theory of Relativity. He wrote a number of articles which announced and explained Einstein's theory of general relativity. In the summer of 1919 Eddington led an expedition and observed the solar eclipse of May 29th, 1919, that provided one of the earliest confirmations of relativity, and he became known for his popular expositions and interpretations of the theory.

[17] Id., Popper (1953), p. 3, para. 1.

[18] Id., Popper (1953), p. 3, para. 1.

the rest of the scientific community would have expected a contrary result than Einstein's theory would yield invited scrutiny of it. Popper was convinced that "conjectures" had to be adjudicated and refuted. Only by withstanding the refutation could conjecture become a theory of substantive value.

The Problem of Demarcation

The problem with the methodology for using knowledge in science is one of "demarcation," that is of distinguishing between where science (like Einstein's theory of relativity) ends and where "pseudo-scientific character" begins[19]. Popper contended the *problem of demar*cation concerned where you draw the line between statements of science and those that are "simply pseudo-scientific" or religious in nature. There is no clear point where science ends and conjecture starts, so how do we know how much reverence to give particular theories? Popper went out of his way to explain that he did not associate the worthwhileness of a theory with how empirical its proof was. He did not want to imply that pseudo-scientific theories were of less value. But rather, he was concerned that these theories could not be scrutinized through adjudication before their value could be ascertained over time. Scientific theories could be tested quantitatively, but how can pseudo-scientific or philosophical theories get validated? Popper was questioning the reliance on informal observations in these circumstances.

The Problem Induction

The *problem of induction*, which was originally described by Hume,[20] asserts that universal laws are based on specific assumptions, but yet are extrapolated out through an induction process to cover circumstances not originally observed. The assumption that the law applies to new, unobserved circumstances is a risky one and must be supported by new assumptions not verified by the original observations. Hume argued that we cannot "support the proposition that those instances, of which we have had no experience, resemble those, of which we have had experience."[21] He therefore concluded, "we have no reason to draw any inference concerning any object beyond those of which we have had

[19] Id., Popper (1953), p. 4, para. 3.

[20] David Hume (1711-1776) was a Scottish philosopher, historian and economist remembered as one of the most important figures in the history of western philosophy. He authored *A Treatise of Human Nature* in 1739 which examined the psychological basis of human nature and concluded that desire, rather than reason, determines how people will react. Hume's contended that people have knowledge only of things they have direct experience in, that mental behavior is governed by customs, and that our use of induction is justified only by the constant combination of "causes and effects" that we have actual experience observing.

[21] Hume, David (1737), A Treatise of Human Nature: Being an Attempt to Introduce the Experimental Method of Reasoning into Moral Subjects, first published in Great Britain form 1739-1740. ,

experience."[22] Popper agreed with Hume's conclusion that induction could not be logically justified,[23] but identified errors in the underlying psychology theories that Hume had made popular.

Comparing the Problems of Demarcation and Induction

Interestingly enough, Popper found the *problem of induction* to be the same as the *problem of demarcation*. If we maintain focus on the proposition that theories can never be verified, but can only be provisionally retained until they are finally falsified, then the relationship between the two problems can be visualized. By extending the rule of hypotheses past the original set of constraints and assumptions, the problem of induction leaves us vulnerable to future scientific developments that negate the assumptions and falsify the theory.

With respect to the problem of demarcation, Popper asserted that science consists primarily of problem solving and argued that depending on observations as the first step in the formation of theories was a misguided practice. By way of a persuasive analogy he showed that observation is a selection process biased towards the research goals. There are no theory-free observations since all researchers are biased towards the results they hope to find, and typically hear and see what they want to hear and see.

To take Popper's argument one step further, to be worth something observations must be understood. To be understood, they must be seen and structured within the framework of a theory. Scientific theories then, in Popper's view, must be prohibitive in that they forbid by implication particular findings.[24] As such, a theory "can be tested and falsified, but never logically verified."[25] The distinction Popper made is it's not appropriate to infer that a theory can be verified through testing. But rather, test results merely indicate that a theory wasn't proven wrong and, as such, should be "provisionally retained as the best available theory until it is finally falsified....and/or is superseded by a better theory."[26] Similarly, since we cannot accurately draw the line between where science ends (and findings could theoretically be verified by quantifiable testing) and pseudo-science begins, no observation is free from the possibility of error. Popper found the possibility that we are influenced by our point of view very persuasive.[27] Once again, due to the bias of an observation that must necessarily be made within

[22] Id., Popper (1953), p. 6, para. 2, taken from Hume (1737), Treatise of Human Nature, Book I, Part III, Sections VI.

[23] Id., Popper (1953), p. 6, para. 2.

[24] Thornton, S. (2009), "Karl Popper", *The Stanford Encyclopedia of Philosophy (Summer 2009 Edition)*, Edward N. Zalta (ed.), viewed at: http://plato.stanford.edu/archives/sum2009/entries/popper/.

[25] Id., Thornton (2009), Chapter 3, para. 3.

[26] Id., Thornton (2009), Chapter 3, para. 3.

[27] Id., Popper (1953), p. 9, para. 1.

the construct of a theory, we are vulnerable to having our theories (which may be based on observation errors) falsified. The two problems therefore both lead to the same result.

Dogmatic Thinking and the Induction Problem

The problem with society is we are dogmatic. If someone hands us a nice theory, like Newton, for example, and it passes our initial testing, we tend to hold on to that theory and keep expanding its application until, at some point, we are so far beyond the theories original assumptions that it fails. Popper highlighted the danger dogmatic thinking has on society in that it can stifle progress. By believing too firmly in one, we reduce our perspectives as observers, and limit our ability to expand our knowledge by making new discoveries.

Deductive verse Inductive Research Methods

Methods of reasoning include the deductive and inductive approaches. Deductive reasoning goes from more general to more specific, while inductive reasoning involves moving from very specific observations to broader generalizations or rules.[28] A deductive argument is said to be valid "if and only if" the truth of the conclusion is a logical consequence of the premise. A sound argument is therefore "a valid deductive argument with a true premise."[29] Deductive arguments are very effective at falsifying postulated theories.

With deductive reasoning you have true assumptions and apply laws of nature to reach a conclusion. With inductive reasoning, you make observations and then define laws based on the observations by looking for relationships of entities. The scrutiny of science will determine if the relationships will be valid if the laws are extrapolated past the original observations.

Interestingly, while discarding the inductive reasoning process Popper did not use the phrase "if and only if" once. Although I find his analysis compelling, it seems odd he was able to show that theories should not be extended past the assumptions made during their original observations (i.e., by induction) without talking in depth about deductive reasoning.

Academic discipline

A convincing argument would have been made if Popper compared the strengths of the deductive research methodology to the weaknesses of the inductive approach, which he so eloquently described. Popper showed enormous academic discipline by not making the deductive arguments the focus of his analysis. This forced him to target the inductive process, which is where his real issues were.

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[28] Burney, Dr. S.M.A. (2008), "Inductive and Deductive Research Approach," briefing prepared for Department of Computer Science, University of Karachi, 3/6/2008.

[29] "Deductive Reasoning," Wikipedia encyclopedia, viewed at http://en.wikipedia.org/wiki/Deductive_reasoning on 4-29-2011.

Summary of Conclusions

With regard to the formation of theories, the traditional view was observations were the basis of hypotheses that formed rules that could be extended past the observations and original experimental constraints and assumptions. Although ideas can certainly be said to flow from observations, Popper makes a convincing argument that the observations can never be a basis for validating theories due to the problem of induction. He contends a theory cannot be verified through testing, but rather, the test results merely indicate that a theory wasn't proven wrong and should be provisionally retained as the best available theory until it is eventually falsified.