Chapter 2. Philosophy of Science Underlying Engaged Scholarship

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*It is better to choose a philosophy of science than to inherit one by default.*

Many of us are practitioners—not philosophers—of science. We don’t think much about ontology and epistemology so that we can get on with the craft of doing research instead of talking about it. But underlying any form of research is a philosophy of science that informs us of the nature of the phenomenon examined (ontology) and methods for understanding it (epistemology). Whether explicit or implicit, we rely on a philosophy of science to interpret the meanings, logical relations, and consequences of our observational and theoretical statements. Many of us inherit the philosophy of science that underlies the research practices of our teachers and mentors. Inheriting a philosophy of science is understandable if an orthodox view of the scientific method exists and is simply taken for granted by the scientific community. While such consensus may have existed among social scientists in the 1960’s and early 1970’s, the past 30 years have witnessed a major deconstruction and revision of traditional views of social science.

As discussed in this chapter, critics argue that social science cannot be objective, rational, and cumulative because language, culture, social norms, political ideologies, mental biases, and selective perception constitute the inputs and processes of science. Science is an intensely human social process, and hence subject to all of these factors that limit the capabilities for social science to be objective, rational, and cumulative. Since the demise of the ‘Received View’ of positivism in the 1960’s and 1970’s other philosophies of science—such as relativism, pragmatism, and realism—have been developing and are competing for adoption by social scientists. They provide a repertoire of alternative ways to interpret the nature of things we study and the methods for doing so. Practitioners of science, in turn, are influencing how these philosophies are developed and expressed in their research.

This chapter attempts to provide a synthesis of the reciprocal relationship between the philosophy and practice of science by undertaking a brief historical review of four philosophies of science—positivism, relativism, pragmatism, and realism. It provides a discussion of how key ideas from each philosophy inform engaged scholarship, and how the practice of engaged scholarship might influence these philosophies of science. Engaged scholarship requires a comparative understanding of different philosophies of science. An understanding of a complex problem or phenomenon being investigated can be enhanced by engaging the perspectives of diverse scholars and stakeholders. Appreciating these diverse perspectives often requires communicating across different philosophical perspectives. It also requires maintaining the diverse intellectual differences which not only create an opportunity for arbitrage, but also for a productive interplay of perspectives, models, and world views (Alvesson & Sköldberg, 2000).

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1 Putnam (1962) referred to logical positivism and logical empiricism as the received view.
This chapter also emphasizes that the philosophy underlying our scientific practice is a choice, and should not simply be a default inherited without question from our teachers and mentors. Understanding the implications of this choice is important not only for engaged scholarship, but for any reflective and responsible scientific inquiry. We turn to philosophy of science to provide us with the conceptual tools and frameworks to reflect on our practice, and to understand alternative ways to do social science.

Before reviewing four alternative philosophies of positivism, relativism, pragmatism, and realism, it is important to clarify in a reflexive spirit that our own version of engaged scholarship adopts a critical realist perspective. This view takes an objective ontology (i.e., reality exists independent of our cognition) and a subjective epistemology. More specifically, this perspective is based on the following principles.

- There is a real world out there (consisting of material, mental, and emergent products), but our individual understanding of it is limited. In general, physical material things are easier to understand than reflexive and emergent social processes.
- All facts, observations and data are theory-laden implicitly or explicitly. Social sciences have no absolute, universal, error-free truths, or laws as any scientific knowledge.
- No form of inquiry can be value-free and impartial; each is value-full. Some methods are better warranted than others depending on the phenomenon.
- Knowing a complex reality demands use of multiple perspectives.
- Robust knowledge is a product of theoretical and methodological triangulation where evidence is not necessarily convergent but might also be inconsistent or even contradictory.
- Models that better fit the problems they are intended to solve are selected allowing an evolutionary growth of knowledge.

**Alternative Philosophies of Science**

We turn now to a brief historical review of positivism, relativism, pragmatism, and realism. Table 2.1 summarizes the discriminating characteristics of these four philosophical schools, and provides an outline of the review discussed below. In addition, the appendix to this chapter contains a glossary of key philosophical terms that may be a useful reference while reading the chapter. The four philosophies of science are featured in this chapter not only because they influence our view of engaged scholarship, but also because they reflect many of the current practices and debates among social scientists.

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2 Ontology focuses on the nature of things, while epistemology deals with how we gain knowledge about these things. Campbell (1988) points to a circularity problem in these definitions because any ontological description presupposes an epistemological one, and vice versa. ‘Ontology has to do with what exists, independently of whether or not we know it.'
ontologically objective (implicitly assumes an objective world independent of cognition) due to its construal of an empirical reality devoid of metaphysical entities, and epistemologically objective due to its emphasis on correspondence between statements and reality using *inductive* verification. In contrast, relativism is ontologically subjective due to its construal of a socially constructed reality and adopts a subjective epistemology due to its denial of an objective and impartial representation of social reality. Pragmatism includes philosophers, who take either objective or subjective views of ontology, but all adopt a subjective epistemology that emphasizes the relation between knowledge and action—knowledge is ‘truthful’ to the extent that it is successful in guiding action. Finally, realism adopts an objective ontology (there is a reality out there independent of cognition) and an objective or subjective epistemology. In short, positivism and relativism represent the outer limits of philosophical thought with their contrasting ontology and epistemology, and hence, bracket the discussion of pragmatism and realism, which lie in-between positivism and relativism.

The choice of these four philosophical schools and their labels was based in part on the historical development of the philosophy of science as an academic discipline. According to Boyd (1991) and Suppe (1977) it began with the logical positivists. Subsequent literature largely developed in reaction to it, such as social constructivism, which is placed under the relativist label and scientific realism, which is placed under the realist label. Understanding how these different perspectives developed in reaction to each other provides a useful first step in appreciating, selecting, and possibly synthesizing a philosophy of science that overcomes some of the concerns and criticisms of contemporary skeptics and hopefully initiates a process of reflexivity.

Before beginning, we admit that you may interpret the philosophies of science reviewed here very differently, and may disapprove of the choice of perspectives and the labels used to frame our discussion. We say this in an open and reflexive spirit of choosing and synthesizing the philosophy of science that fits your scholarly practice. We do not presume that this chapter captures the breadth and depth of perspectives needed to make a well-grounded choice or synthesis. However, we do hope to raise awareness that the particular philosophy of science that is practiced is, and ought to be, a critical choice, rather than a default. Further study in the philosophy of science may be needed to make this choice.

**Background**

Human beings have a unique capacity to represent reality and reflect upon it. This capacity coupled with the desire to control nature prompts scientific inquiry, or what Reichenbach (1963) called ‘the art of correct generalization.’ The goal of this art is to create knowledge—not mere opinion—that can be generalized across space and time. Philosophy of science examines the conceptual foundations and methods of this process of scientific inquiry.

3 In previous drafts we received critical feedback on a variety of ways to classify and label the many philosophies of science. We confess to not having found a solution that adequately reflects and is sensitive of the philosophical identities of various scholars. In particular, we appreciate and are sympathetic of the critical feedback from interpretive, postmodern, and hermeneutic scholars who objected to our grouping of their perspectives under the label ‘relativism.’ One reviewer said she ‘felt offended’ by the label because of a pejorative ‘anything goes’ ethical connotation associated with the term ‘relativism.’ This is not our intent. Following Suppe (1977), Laudan (1984) and McKelvey (2002a), we use relativism as an ‘existence concept’ of the philosophical perspectives that view reality as socially constructed and that ‘deny the existence of any standard or criterion higher than the individual by which claims to truth can be adjudicated’ (McKelvey, 2002b: 896).

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Like most forms of Western intellectual thought, the history of philosophical thought of science can be traced back to the ancient Greeks. Reichenbach (1948; 1963), for example, begins his historical lineage with the debate between the *rationalists* and the *empiricists*. The rationalists believed that reason was the sole source of reliable knowledge. Reason was able to control empirical observations and order them into a logical system that made the prediction of future observations possible.

One of the first rationalists--also known as an *idealists*--is Plato (427-347 BC). He believed that an ‘idea’ exhibits the properties of objects in a perfect way, and thus we learn about these objects through their respective ideas not through the objects themselves. The laws of ‘ideas’ govern and provide reliable knowledge of the physical world. Plato’s student, Aristotle (384-322 BC), similarly believed that the mind was the source of those laws. The leading rationalist of the *Enlightenment* period and the founder of modern philosophy, Rene Descartes (1596-1650), argued that the distinctive feature of *rationalism* was a belief that the laws that control the physical world can only be discovered through the reasoning of the mind (Russell, 1972). Implicit in this assertion is the distinction between observer and the world, also referred to as *Cartesian Dualism*. However, Descartes never denied completely the contributions of empirical observations to our knowledge of the physical world. He relied on logical *deductive rules*, beginning with a set of axioms or premises considered to be true to infer valid conclusions about the world. For example, if all swans are white, and the particular bird that we observe is a swan, then we deduce that the bird is white.

In contrast, empiricists believed that sensory experience was the sole source of reliable knowledge. The most devout empiricist was Francis Bacon (1561-1626), recognized as the pioneer in the logical systematization of the scientific inquiry (Russell, 1972). He, as well as the ancient Greek philosopher Democritus (460-370 B.C) and 18th century philosophers John Locke (1632-1704) and David Hume (1711-1776), attempted to replace the rationalist method of *deduction* with *induction* as the proper method for attaining reliable knowledge of the physical world. Induction starts with the enumeration of past and present empirical observations to draw inferences about the physical world. For example, if all the swans we observe are white, then we conclude that all swans are white.

Although rational deduction and empirical induction remain with us today, both forms of inquiry suffer from numerous shortcomings. In particular, Reichenbach (1963) discussed three major shortcomings: (1) the assumption of rationalism that the premises in a deductive argument are true without resorting to sensory observation, (2) the assumption of empiricism that all knowledge is based on sensory experience while it is clear that the method of induction is not a product of sensory experience, and (3) the assumption of empiricism that the limited past and present observations provide a basis to predict future observations. This last shortcoming was one of the major contributions of Hume in specifying the problem of induction.

The rationalist cannot solve the problem of empirical knowledge because he construes such knowledge after the pattern of mathematics, and thus makes reason the legislator of the physical world. The empiricist cannot solve the problem either; his attempt to establish empirical knowledge in its own right as derived from sense perception alone breaks down because empirical knowledge presupposes a non-analytic method, the method of induction, which cannot be regarded as a product or experience. (Reichenbach, 1963: 90-91).

Immanuel Kant (1724-1804) attempted to reconcile the rationalist and empiricist views by synthesizing their respective contributions. He contended that there exist *synthetic a priori* principles of the physical world that preclude any sensory experience. This synthetic a priori consists of *axiomatic principles* such as the premises of geometry or causality that are assumed to be ‘given’ to
the human mind. Furthermore, he contended that axiomatic theorizing can be used to derive other synthetic statements about the physical world that act as regulative mechanisms to organize sensory experience and subsequently create knowledge. Thus, with the synthetic a priori, Kant believed he showed that knowledge was a combination of a priori and a posteriori principles, or a combination of rationalism and empiricism.

Kant's contributions occurred during a period of cultural development in the eighteenth century known as the Age of Enlightenment. The Enlightenment was characterized by liberation from the theo-centric view and replaced by an anthropocentric view that emphasized human reason as the sole means to understanding the world (Popkin, 1999; Russell, 1972). It was in this cultural context that Auguste Comte (1798-1857) coined the word positivism as a philosophy aimed at showing that human knowledge had reached a stage of development that transcends religious dogma and places hope in the progressive accumulation of knowledge using the empirical sciences and specifically physics as the model of all sciences. Years later logical positivism emerged in Germany as an extension of the Enlightenment, a synthesis of the scientific development of the nineteenth and early twentieth centuries, and a reaction to G. W. Hegel’s (1770-1831) metaphysics, which sought to explain reality in terms of abstract metaphysical entities that did not have any empirical manifestation. According to Johnson and Duberley (2000), the three major rationalist tenets used by the positivists were: subject-object dualism (Cartesian dualism—the world is independent of the subject), truth as an agreement of the mind with reality, and truthful knowledge is to correctly represent reality in the mind. In addition, the three empiricist tenets used by the positivists were: induction as the mode of reasoning to gain knowledge of reality, reduction of reality to empirical data, and reduction of causality to Humean constant conjunction.

**Logical Positivism**

Logical positivism emerged from the Vienna Circle--Moritz Schlick (1882-1936), Rudolf Carnap (1891-1970), and Herbert Feigl (1902-1988), and the Berlin School--Hans Reichenbach (1891-1953) and Carl Hempel (1905-1997). These pioneering scholars were mainly scientists and mathematicians who became philosophers. Logical positivism rejected Kant's a priori elements in science due to their analytic nature/self-referential character, adopted a blend of positivism, empiricism, instrumentalism, and benefited from the contributions of Frege, Russell, and Whitehead in mathematics and Wittgenstein in language. It construed the role of philosophy as the analysis of science from a logical perspective using what was known as a language of verifiable propositions (Blumberg & Feigl, 1948). According to Suppe (1977), the goal of logical positivism was to eliminate all metaphysical entities from philosophy and science that implied ontological neutrality (i.e., emphasis on epistemology) (Niiniluoto, 1999). From August Comte, it adopted the privileging of science (and specifically physics) as a model for all other sciences. From Ernest Mach (1838-1916), logical positivism adopted a radical empiricist attitude whereby the only source of knowledge

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4 Hume defined causality as a product of habitual experience. The four conditions to ensure causality are: constant conjunction (two events are constantly associated with each other), antecedence (events occur sequentially in time), contiguity (both events are spatially in the same location), and necessity (no alternative observation). The last condition, necessity, was problematic since it was impossible to observe all instances of the phenomenon under investigation and thus any universal law from a finite number of observations can never be certain.

5 Another form of logical positivism was logical empiricism, which substituted the ontological neutrality of the former with a realist ontology (i.e., that there exist a partial mind-independent reality). One of the most ardent logical empiricists was Herbert Feigl (a member of the Vienna circle) at the University of Minnesota who founded the Center for the Philosophy of Science, and was instrumental in diffusing logical positivism in the United States during the first half of the twentieth century.
of the physical world was sense observation. From Henri Poincare (1854-1912) logical positivism adopted instrumentalism, which denied theoretical terms any referential value\(^6\). From Gottlob Frege (1848-1925) and Bertrand Russell (1872-1970) logical positivism adopted logic as a means to analyze science and accepted the analytic nature of mathematics. It is this development in mathematics that led to the demise of neo-Kantianism and the synthetic a priori (Ayer, 1982) since the latter relied on mathematics as a source for knowledge of the physical world. Finally, from Ludwig Wittgenstein (1889-1951), logical positivism adopted the verifiability theory of meaning, which states that understanding the meaning of a proposition consists of understanding the circumstances in which it could be verified or falsified. In the remainder of this section, we will focus on some of the main positivistic tenets followed by some of its earliest critics.

According to Boyd (1991), the verifiability theory of meaning, or verificationism, was a doctrine used by logical positivism to address the demarcation problem between science and non-science (metaphysics). One implication of verificationism was the distinction between science and mathematics/logic. Science was considered to be the only source of synthetic knowledge of the world based on empirically observable terms. Mathematics and logic were considered to be sources of analytic knowledge. Giere (1988: 26) illustrates this relationship between theoretical and observational terms in Figure 2.1. He points out that logical positivism distinguished scientific theories from pure axiomatic logic or mathematics by the empirical interpretation of non-logical terms and the use of correspondence rules to explicitly link theoretical terms with observational terms.

The standard doctrine was that the meaning of theoretical terms is totally a function of the meaning of the observational terms together with purely formal relations specified by the axioms of the theory. The result is instrumentalism with regard to the theory part of theories. Theoretical terms do not refer to real entities; they are mere instruments for organizing claims about the things referred to by observational terms. The view of scientific theories was typically pictured as in Figure 2.1. (Giere, 1988: 26)

<Figure 2.1>

Another implication of verificationism was the separation between the genesis of a theory and its validity. The genesis of a theory was viewed as the context of discovery, which was believed to be the concern of psychology and history. The validity of a scientific theory provided the context of justification, which was believed to be the concern of logic and philosophy. Implicit in this separation is the independence of the social, psychological, and economic factors influencing the scientist and his or her scientific theories. Reichenbach states:

What we wish to point out with our theory of induction is the logical relation of the new theory to the known facts. We do not insist that discovery of the new theory is preformed by a reflection of a kind similar to our expositions; we do not maintain anything about the question of how it is performed--what we maintain is nothing but a relation of a theory to facts, independent of the man who found the theory. (1938: 382)

This led logical positivism to focus attention on theories as finished products waiting to be justified and to ignore factors in the genesis of theories (Suppe, 1977: 125). In Weick’s (1999) terms, logical positivism was concerned with theory, rather than the process of theorizing as discussed in Chapter 4.

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\(^6\) Referential value refers to the existence of unobservable entities in the physical world, which are represented using theoretical terms in science.
Furthermore, logical positivism emphasized induction as a means of developing empirically verifiable generalized propositions from empirically verifiable particular propositions.

Logical positivism formulates research questions and hypotheses in propositional form and necessitates the use of empirical tests to verify these propositions through careful control (manipulation) to avoid confounding conditions and outcomes. The researcher is assumed to be independent of the objects observed in the world, and capable of studying the objects without influencing, or being influenced by, them. When influence in either direction (threats to validity) is recognized or suspected, various strategies are followed to reduce or eliminate it. Inquiry takes place ‘through a one-way mirror’ (Guba & Lincoln, 1994: 110) in a sort of correspondence between our thoughts/signs and reality. By following rigorous experimental procedures, values, and biases are prevented from influencing outcomes and empirical truth is established through replicable findings. This view of a researcher is discussed later as a ‘God’s Eye’ frame of reference.

Suppe (1977) provides an extensive discussion of the criticisms of logical positivism. Only a brief summary of selected criticisms can be mentioned here. One of the earliest criticisms of logical positivism was by one of its pioneers, Hans Reichenbach (1948) of the Berlin School. He argued that logical positivism could not adequately solve the problem of induction and subsequently the predictive nature of science. The problem of induction is that in using it, it is never possible to arrive at a single theory. The positivistic belief that science, by induction, can ultimately converge on the ‘real’ truth is thus brought sharply into question.

Quine (1951) asserted the impossibility of having a clear distinction between analytic and synthetic statements and furthermore, the reduction of complex propositions into clear observational terms. He examined a difficulty first raised by Duhem (1962) that a theory cannot be conclusively falsified, because the possibility cannot be ruled out that some part of the complex test situation, other than the theory under test, is responsible for an erroneous prediction. This difficulty is called the Duhem/Quine thesis (Chalmers, 1999: 89).

Popper (1959) showed that logical positivism fails to provide an adequate answer for the demarcation problem. Popper replaced positivism's induction and verification with abduction and falsification. Following the pragmatist, C.S. Pearce, Popper argued that the process of developing a theory does not begin with an inductive enumeration of observational data, but rather with creative intuition (as will be discussed in Chapter 4). Furthermore, he avoided Hume's radical skepticism by showing that any process of verification (proving) is illusory and should be replaced with a process of falsification (dis-proving). The process of falsification leads to an epistemological Darwinism where the fittest of theories survive empirical refutation. Like Popper, Donald T. Campbell argued for an evolutionary growth of knowledge in which the scientific community selects those models that better fit the problems they are intended to solve (see the section on realism).

Along with Popper, Norman Hanson held that a major defect of logical positivism was that it confines attention only to the finished product of scientific theorizing and gives no attention to the process of reasoning whereby laws, hypothesis, and theories receive their tentative first proposal (Hanson, 1958: 71). In ‘Patterns of Discovery’ Hanson (1958) extended the work of Peirce (see pragmatism) to develop the logic of scientific discovery. He emphasized that theories are not discovered by inductively generalizing from data but rather are retroactively inferred hypotheses from conceptually organized data. Hanson viewed observations and facts as theory-laden, and notions of causality as reflecting a certain form of conceptual organization. Causation is not a property of the physical world; it is a way people make sense of the world. He developed a logic of discovery (retroductive reasoning) that reflects the process in which scientific conjectures and laws are developed.

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Relativism

We use relativism as a general term denoting a set of alternative philosophies of science that emerged in reaction to, or in denial of, positivism. The set includes many variations: historical relativism, social constructivism, postmodernism, critical theory, and hermeneutics. This grouping of philosophies into a single category is based on our judgment, since we cannot cover all their individual viewpoints. However, the perspectives included in our broad category of relativism all break away from the positivist assumption that scientific knowledge is a cumulative, unmediated, and complete representation of reality. They deny a solution to the demarcation problem; emphasize the intertwining between the genesis and validity of a theory, view reality as socially constructed, and the goal of social science as that of understanding what meanings people give to reality, not only to determine how reality works. Furthermore, they reject the positivistic belief that scientific methods provide a way to develop an objective ‘Truth’ of the concrete reality in the world. Instead, they believe that scientists construct an image of reality based on their interests, values, and viewpoints in interaction with others. From this standpoint, observations and data give us ‘nothing more than facts. The truth (small t) is what we make consensually of these facts. And in the social world, truth is therefore collectively constructed. . . . Truth referents are not in the facts but in the collective interpretation of the facts’ (Gioia, 2003: 288). We now examine some of the main tenets of the varieties of relativism: historical relativism, social constructivism, postmodernism, critical theory, and hermeneutics.

Some of the first critics of positivism were the historical relativists (Toulmin, 1953; Kuhn 1962, 1970; Feyerabend, 1962, 1975) and social constructivists (Bloor, 1976; Latour & Woolgar, 1986). Kuhn (1962, 1970), a historical relativist, called into question the belief that scientific knowledge is cumulative. He argued, instead, that the development of science is dependent on the sociological paradigm agreed upon within the scientific community. He replaced the a priori cognitive structures of Kant with a paradigmatic view that reflected the set of beliefs, values, assumptions, and techniques that guided the scientist. Kuhn viewed scientific knowledge as progressing in a cycle of three phases. The first phase is normal science, where one particular paradigm has control over a scientific community. The second phase is a crisis where abnormal or inexplicable observations arise. Finally, the last phase is revolutionary science where a new paradigm replaces the old paradigm. The replacement of the new paradigm is through a consensus of the scientific community and not through correspondence with reality as had occurred with positivism. Furthermore, the acceptance of a new paradigm presupposes incommensurability with other paradigms because of the absence of an agreed-upon, objective criterion for comparing the truth claims of alternative paradigms.

In a similar way, Toulmin (1953), Feyerabend (1962, 1975), and other historical relativists argue for the idea of a socially constructed nature of scientific knowledge. However, they differ in some historical interpretations and conclusions. For example Toulmin construed scientific theories as neither true nor false but more or less adequate answers for observed irregularities. These irregularities occur when the current theories break down or are unable to provide an adequate answer. Moreover, the development of new scientific theories is based on a Weltanschauung, which is an evolving socio-conceptual framework similar to Kuhn’s paradigm. However, unlike Kuhn’s view that paradigms change all at once, Toulmin construed the change in Weltanschauung as more or less gradual.

Perhaps the strongest negation of positivism is postmodernism, which is skeptical of modern science, technology, and social transformations produced by the Enlightenment. The demarcation between modern and postmodern eras is unclear, but it is claimed to have started with Nietzsche in
the late nineteenth century (Dallmayr, 1987; Sim, 2001) and reached its epitome in the second half of the twentieth century during a period of unprecedented socio-economic and technological transformation. Postmodernism is an eclectic school of thought that encompasses post-industrialism, post-capitalism, and post-structural forms of thought. One common theme is skepticism about the major foundations of Western thought, and in particular positivism being a product of the scientific and mathematical developments of the nineteenth and early twentieth century (Alvesson & Deetz, 1996; Sim, 2001). This skepticism undermines the attainment of truth, the criteria determining truth, and even its very existence. It is based on anti-essentialist and anti-foundationalist notions about the nature of reality and the ways of knowing reality respectively. Overall, postmodernism denies positivism’s logical turn to the analysis of science through the use of propositions, blurs the distinction between observable and theoretical terms, and more importantly denies the distinction between the genesis and validity of a theory.

**Anti-essentialism** refers to a rejection of the essence of phenomena and the causal mechanisms underlying them. The essentialist notion is the cornerstone of scientific inquiry. As Sim (2001) suggests, essentialism regards the attainment of truth, meaning, and origin as its goal. This parallels the Hobbesian and Humean critiques of Aristotelian essences, which consisted of the distinction between ‘what’ an object is and ‘how’ it is. Hence, postmodernism rejects the possibility of capturing the essence of the phenomenon and subsequently rejects its existence.

**Anti-foundationalism** refers to the rejection of foundational or self-evident beliefs required in the pursuit and acquisition of knowledge. Hence, postmodernism rejects the basis of epistemology that asserts the existence of self-justifying or self-evident first principles that guide scientific inquiry.

Postmodernism’s anti-essentialist and anti-foundationalist rejections have implications for our conception of the word ‘truth,’ which lacks a common intrinsic feature that permits us to judge our theories. According to Rorty (1979), the conception of truth has become nothing but a sign of approval or agreement given to promote one theory over others (Engel, 2002). An extension of this particular theme lies at the heart of Jean Baudrillard’s denial of the possibility of distinguishing between reality and simulation in our postmodern world (Sim, 2001). According to Baudrillard, the world is a ‘simulacra,’ where reality and simulation are intertwined and undistinguishable (as often experienced when playing virtual reality games).

According to Cahoone (1996), postmodernism denies the distinction between the presence of an entity and its representation. One aspect of this criticism stems from the complexity, difficulty, and to a certain extent impossibility of representing the world in an unmediated and holistic fashion. Another aspect stems from the denial of linguistic essentialism whereby language is viewed as a mirror to objectively represent the presence of an object (Hassard, 1994; Alvesson & Deetz, 1996). An example is Jacques Derrida’s deconstruction, which denies the possibility of using language to represent reality. He supports his denial by demonstrating that we think only in signs and that the process of signification is an endless shifting from sign to sign which can never be terminated by reducing the signifying process to some transcendental starting-point or end-point. This leads Derrida to state that there is nothing outside the text which is represented. Furthermore, Rorty claims that different languages constructed within different socio-cultural contexts are incommensurable and thus knowledge is incommensurable. This inevitability of incommensurability means that a consensus as a generalizable epistemic standard is rejected.

Next Cahoone (1996) argues that postmodernism attempts to show unity as plurality whereby entities are shown to be a product or function of their respective relationship with other entities. Hence, any apparent unities are implicitly repressing their dependency on and relations to others. A proponent of this view is Jean-Francois Lyotard, who rejects the grand theoretical enterprises or
‘grand narratives’ that serve only to justify our actions. He believes in a multiplicity of alternatives to explanation or mini-narratives, where any claim to a unitary or linear progression is a suppression of other possible alternatives. Scientific knowledge becomes a plurality incapable of legitimizing itself and based on multiple language games (Gasche, 1988). As discussed in the next section, this notion of selves is rooted in the William James’ construal of pragmatic philosophy.

Postmodern theorist and feminist scholars (such as Martin, 1990) have deconstructed and surfaced a number of voices or interests that are typically ‘marginalized’ in positivistic accounts of social organization or behavior.

In the guise of technocracy, instrumental rationality has pretenses to neutrality and freedom from the value-laden realms of self-interest and politics. It celebrates and ‘hides’ behind techniques and the false appearance of objectivity and impartiality of institutionalized sets of knowledge, bureaucracy, and formal mandates. Not surprisingly, technocracy is promoted by each of the management ‘specialisms’ as they claim a monopoly of expertise in their respective domains. Human resource specialists, for example, advance and defend their position by elaborating a battery of ‘objective’ techniques for managing the selection and promotion of employees (Hollway, 1984; Steffy & Grimes, 1992). Strategic management institutionalizes a particular way of exercising domination through legitimizing and privileging the ‘management’ of the organization-environment interface, producing some actors as ‘strategists’ and reducing others to troops whose role is to subordinate themselves to implement corporate strategies (Shrivastava, 1986; Alvesson & Willmott, 1995). The concept of technocracy draws attention to some of the darker and more disturbing aspects of so-called ‘professional management.’ It points to a restricted understanding of human and organizational goals; those that are identified and validated by experts. By associating management with technocracy and its instrumentalization of reason, the domination of a narrow conception of reason is at once exposed and questioned. (Alvesson & Deetz, 1996: 203-204)

Hence, what positivists’ thought were impartial, objective, and value-free accounts of science, relativists have shown to serve the interest and values of people in power. Moreover, Zald (1995) claimed that ‘Most of the “brute facts” that are subject to enumeration in positivistic social science gain their force because of the cultural/social meanings in which the subjects participate. Explanation in the causal sense must give way to, or be embedded in, hermeneutic unveiling and interpretation’ (Zald, 1995: 456).

Critical theory emerged from the Frankfurt school. Its founders included Max Horkheimer (1895-1973), Theodor Adorno (1903-1969), and Herbert Marcuse (1898-1979). They adopted a Marxist framework to oppose the destructive effects of capitalism. The aim of critical theory was to diagnose the problems of modern society and identify the nature of the social change needed to produce just and democratic societies. Critical theory shares some commonalities with postmodernism although a key difference is that it maintains hope that knowledge can lead to emancipation and progress. Habermas (1979; 1984; 1987; 1990), a second generation critical theorist, adopts a conventionalist position that deploys a consensus theory of truth, as a regulative standard to assess the extent of systematically distorted communication. He also avoids extreme relativism because he assumes that through ideal speech communication, we might attain a consensual view of truth.

The last major relativistic perspective reviewed here is hermeneutics. Originally focused on interpreting the meaning of the Scriptures, hermeneutical philosophers expanded their scope into
philology (the science of linguistic understanding and the study of interpretative processes and beings) and many additional areas beyond biblical interpretation, including the social sciences. Although positivists focused almost exclusively on epistemology, hermeneutical philosophers (such as Heidegger, 1927; Gadamer, 1975; and Bernstein, 1983) emphasized that epistemological issues are strongly related to the ontological positions we might take.

As against the positivists who assumed it is possible to gather knowledge about entities that are observed independent of the observer, hermeneutics questioned this shallow approach to epistemology:

It argues that how we view the existence of objects in the extra-mental world is a function of how we frame our own existence and relationship with the environment. (By ‘extra-mental reality,’ I mean the world as it exists independently from how an individual perceives it.) Our perception of the outside world is a function of how we perceive our own position in and relationship with the phenomena – in the past, present, and future. We therefore, need a better understanding of the reference frames we use to make sense of this relationship and the extent to which these frames confuse us or help us clarify and focus our thought processes – especially if we want to develop a proper understanding of the processes taking place in the world. (Hendrickx, 2002: 341)

Margaretha Hendrickx applies this hermeneutical perspective by contrasting a positivistic ‘God’s Eye frame’ with a relativist ‘participant frame’ that Mr. Jones, a hypothetical management researcher, might take to conduct research. Hendrickx (1999: 344) uses Figure 2.2 to illustrate ways that Mr. Jones might make connections between Popper’s (1979) ‘Three World View’: (1) a material world illustrated by the globe, (2) a world of mental states and processes by the human figure, and (3) an emergent world of products of individual and collective human minds, represented by the book.

In the God’s Eye frame, ‘the world consists of some fixed totality of extra-mental objects. There is exactly one true and complete description of “the way the world is.”’ Truth involves some sort of correspondence relation between words or thought-signs and external things’ (Putnam, 1981: 49). Here, the researcher views him or herself as a value-neutral observer of real things existing in the world (illustrated by arrow 1). Arrow 2 stands for the relation between the researcher’s mental interpretation of the observations and his or her mental model as represented by linguistic signs in a text. Arrow 3 represents the relation between the linguistic signs in the text and the real-world phenomena.

The God’s Eye point of view inspires Mr. Jones to think of his relationship with phenomena under investigation as one of the sides of a triangle (Figure 2.1). He functions in this triangle as a (very complicated) mirror. His research activities may be broken down in primarily three tasks, ‘observing,’ ‘describing,’ and ‘verifying.’ First he inductively observes what is happening in the world. The reflected photons fall on his eyes’ retinas and induce an electron cascade that leads to the creation of photograph-like images of the phenomena in his brain. Via a very complex set of biochemical and neurological reactions, these images are translated in patterns of dots on paper or digital signals stored on a computer disk. Mr. Jones describes what he observes in the world. He then generalizes his empirical findings in hypotheses and deductively tests (and observes) whether the postulated relations hold true.
This triangular reasoning squeezes Mr. Jones out of the world, so to speak. He believes that with proper training, he is capable of transcending his own subjectivity, as if he was able to turn his values and preferences off as easily as he turns his computer on to write up his research findings. It is the job, the duty, of Mr. Jones to publish articles with ‘true’ descriptions of what happens in corporations. He believes that it is possible to obtain the value-neutral state of mind of an outsider. . . . He perceives his relationship with these as independent of time, space, and mind, as if he is like God. . . . He believes that what he sees is the way the phenomena in the extra-mental world are. (Hendrickx, 1999: 342-343)

A participant frame of reference views the researcher as an active participant in the domain he attempts to study and understand. Although this frame has also been called the ‘internal’ view (Evered & Louis, 1981) and ‘pragmatists’ worldview’ (Putnam, 1981; Rorty, 1982), Hendrickx (1999: 375) prefers the term ‘participant’ for being neutral on us-vs.-them and inside-vs.-outside dichotomies that are implicit in the God’s Eye frame. Figure 2.3 presents Hendrickx’s depiction of the participant frame.

<Figure 2.3>

Mr. Jones now thinks of himself as participant in a discourse about ways to help companies succeed in the long run [the research problem being investigated]. He perceives himself as a voice in a universal conversation, in which the various points of view of actual persons reflect their various interests and purposes (Putnam, 1981: 49-50). One of these purposes is to find the most clarifying lens with which to discover [and represent the problem and its resolution].

In the participant worldview, a management researcher explicitly acknowledges that he is the product of a certain history and culture. Thus, Mr. Jones realizes that he knows as much as he learned from the books that he read, the experiences he underwent, and the conversations in which he participated. He has come to terms with the subjective nature of what he knows and understands the futility of attempting to reason in a value-neutral way. Instead, Mr. Jones talks openly about his research values and investigates whether they make sense after all. Mr. Jones attempts to understand whether or not his espoused values are the values he actually uses in his research. He also wants to know the extent to which his values in use are consistent with values benefiting the human species as a whole (Campbell, 1979: 39; 1982: 333-334). His values motivate him (Campbell, 1993: 36). He looks upon his research questions as issues with practical consequences for him, his neighbors, and the top management teams he studies. (Hendrickx, 1999: 346)

Hendrickx illustrates Mr. Jones’ participant frame of reference in a quadrangle, as depicted in Figure 2.3. As a participant, the researcher performs the roles of an investigator and author with other co-investigators, co-authors, or readers engaged in the discourse. The extra-mental real world and the text or model represents the material and socially-constructed worlds, respectively, that the participating researcher(s) and others construct by experiencing, talking, listening, reading, and writing.

So, compared to the God’s Eye view, where the Other is either an onlooker like Mr. Jones, or alternatively, someone down there to be observed, the participant frame of references does not classify readers and writers as a function of whether they know
less or more; rather it implies that they know something different. (Hendrickx, 1999: 346-347)

Hendrickx (1999: 341) concludes by advocating the participant frame of reference and rejecting the God’s Eye frame. She states that a God’s Eye frame tends to encourage an authoritative and dogmatic attitude on the part of the author, which promotes close-mindedness and intolerance of alternative perspectives. Such an attitude is not conducive to listening to and learning of the viewpoints of others about the real-world phenomenon or alternative ways to represent it. A participant frame of reference requires an open-minded attitude that encourages engagement and learning with others.

**Pragmatism**

Pragmatism is an American philosophical school of thought that emerged in the late 19th century with Charles Sanders Peirce (1839-1914). In an article, ‘How to Make our Ideas Clear,’ Peirce (1878) introduced the term *pragmatism*, a term derived from Kant and traced back to the Greek word action. Pragmatism sought to reconcile rationalism and empiricism by showing that knowing and doing are indivisibly part of the same process. In philosophy of science, pragmatism was viewed as an alternative to logical positivism and was aligned with instrumentalism, which is the view that scientific theories are not true or false but are better or worse instruments for prediction (Misak, 2001). Some philosophers went further to assert that Peirce's thought not only provides an alternative to logical positivism but actually repudiates, in advance, some of its major developments (Rorty, 1961). According to Meyers (1999) pragmatism espouses three theories: (1) a theory of the mind, where beliefs are hypotheses and ideas are plans of action, (2) a theory of meaning, where ideas can be clarified by revealing their relationship with action, and (3) a theory of truth, where beliefs are true when they succeed in guiding action and prediction. Pragmatism is multifaceted and seems to vary according to each pragmatist (Lovejoy, 1908). To minimize confusion we focus on the main arguments and criticisms of three pioneering pragmatists--Peirce, James, and Dewey--and two contemporary scholars--Rorty and Rescher.

Peirce introduced the pragmatic maxim of ascertaining the meaning of an idea in terms of the practical consequences that might conceivably result from the truth of that conception. The sum of these consequences constitutes the meaning of the conception (Rescher, 2000: 9). Peirce viewed meaning as an inference for repeatable actions, both as habitual behavior in a reoccurring situation over time and as generalizations of actions to larger contexts or different situations (Dewey, 1916). In his article ‘Fixation of Belief,’ Peirce states that the function of beliefs is to commit us to action. This criterion for truth bears not only on the success of the application, but also on the extent to which it sustains a long term commitment from the scientific community. Peirce acknowledged the fallibility of inductive scientific inference. Instead, he proposed a method of scientific discovery through systematic observation and creative inference.

Peirce introduced abduction or retroduction as a creative mode of discovery that follows neither inductive nor deductive modes of inference. ‘Induction was widely believed to be the basic process in science. Peirce denied this, arguing that induction serves not to initiate theory but rather to test it’ (Mounce, 1997: 17). As discussed in Chapter 4, abduction is a hypothetical inference, framed to solve a problem. The new conception is not final. Further inquiry will reveal problems that can be solved only by framing a fresh conception (Mounce, 1997: 17).

Peirce’s belief in science and the oneness of truth was rooted in an ontologically realist stance. He defends his realist stance by arguing that there is no reason to believe that a mind-
independent reality does not exist. He suggests this belief is harmonious with our practice of science. He states:

There are real things, whose characters are entirely independent of our opinions about them; those realities affect our senses according to regular laws, and, though our sensations are as different as our relations to the objects, yet, by taking advantage of the laws of perception, we can ascertain by reasoning how things really are and any man, if he have sufficient experience and reason enough about it, will be led to the one true conclusion. (Peirce, 1878: 21)

Peirce intended pragmatism to be a rational and empirical substantiation of knowledge claims (Rescher, 2000). He construed the meaning of a term or proposition as constituted by its practical consequences and its truth by its success to satisfy the intended aims. These aims, which included successful prediction and control, were the aims of science.

William James (1842-1910), a contemporary of Peirce, elaborates upon and alters Peirce’s philosophical approach in his seminal lectures in 1907 on Pragmatism (James, 2003). In these lectures, James describes the current dilemma of philosophy as a difference in temperament between rationalism and empiricism. He contends that individuals inevitably exhibit characteristics of both sides of the debate. Thus, in order to continue the abstractness of rationalism and the particularism of empiricism he proposes pragmatism:

You want a system that will combine both things, the scientific loyalty to facts and willingness to take account of them, the spirit of adaptation and accommodation, in short, but also the old confidence in human values and the resultant spontaneity, whether of the religious or of the romantic type. (James, 2003: 9)

For James, pragmatism provides a method to settle metaphysical disputes because through it one compares the practical consequences of adopting alternative views. Two alternative or rival views are identical if their practical consequences are identical. Thus, the goal of philosophy is to discover the difference between rival views based on their consequences to different individuals.

James described his version of pragmatism as being a compromise between empiricism (which claimed that an objective world commands thought) and idealism (which claimed that subjective thoughts construct the world). He construes pragmatism as a less objectionable but more radical version of empiricism. Pragmatism replaces abstraction, a priori reasons, and fixed principles with concrete facts and action. It is this emphasis on experience that James uses to depict action or practice, which lies at the heart of pragmatism, as a means for solving metaphysical problems and developing a theory of truth. He states:

Theories thus become instruments, not answers to enigmas in which we can rest. It agrees with nominalism for instance, in always appealing to particulars; with utilitarianism in emphasizing practical consequences; with positivism in its disdain for verbal solutions. (James, 2003: 24)

James adopted a realist ontology and asserted the existence of a reality independent of our cognition. He states, ‘The notion of a reality independent of either of us, taken from ordinary experience, lies at the base of the pragmatist notion of truth’ (James, 1908: 455). According to James, the truthfulness of a theory is evident through its success as an instrument that is loyal to past experience but also is able to transcend it to generate new facts and to hold so long as it is believed to be ‘profitable for our lives’(James, 2003: 34). In contrast to Peirce (who was influenced by Kant), James was influenced by the British
empiricists such as Locke, Hume, and Mill. James, therefore, viewed pragmatism quite differently from Peirce. While Peirce viewed pragmatism as a methodology for converging on a fixed standard, James invited pluralism. He entertained a diversity of views about a phenomenon that allowed not only for differences among individuals, but even different inclinations and viewpoints within individuals (Rescher, 2000: 19).

James interprets pragmatism as: (1) a method to solve metaphysical disputes by which one compares the practical consequences of adopting alternative views; and (2) a theory of truth where truth is verification, which is consistent with our beliefs and experience. Truth is made and can change over time. James refuses the rationalistic relationship between mind and world, which presupposes a passive reality. He contends that this relationship is and should be viewed as pragmatic, future looking, and dynamic, which presupposes an active reality in line with Darwinian evolution.

John Dewey (1859-1952), a student of Peirce, viewed pragmatism as a means to attain societal goals. While Peirce’s pragmatism was theoretical and oriented to natural science, and James’s was personalistic and psychological, Dewey’s pragmatism was communalistic and society-oriented. Dewey’s position was intermediate between Peirce and James and emphasized its social aspect by viewing truth as a ‘matter of communally authorized assertability’ (Rescher 2000: 27). Like Peirce, Dewey refers to his version of pragmatism as ‘instrumentalism,’ which is grounded in scientific realism as a means to remove doubt through social consensus.

The presupposition and tendencies of pragmatism are distinctly realistic; not idealistic. . . Instrumentalism is thus thoroughly realistic as to the objective or fulfilling conditions of knowledge. (Dewey, 1905: 324-325)

According to Rescher (2000), Dewey differs from Peirce in his conception of social consensus. Dewey’s view is that social consensus is not based on epistemic factors (empirical evidence) but on socio-political factors. Dewey contends that the success of theories is based on their ability to realize the goals of societal improvement and development.

Two contemporary pragmatists, Richard Rorty (1931- ) and Nicholas Rescher (1928- ), take clearly different views of pragmatism. Rorty (1980), influenced by James and Dewey, adopts a postmodern view of pragmatism. To Rorty, pragmatism is subjectivistic, anti-foundationalistic, and anti-essentialistic, where truth and validity lose any type of decisive weight and lack any generalizable epistemic standards. Rorty illustrates his anti-essentialism by arguing that truth does not have an essence or any type of isomorphic correspondence with reality. Therefore, any attempt at a progressive accumulation of truth is fruitless. For Rorty, the consequences of knowledge in practice provides a way to state something useful about truth. He believed that all the vocabulary of isomorphic pictures, models and representations of reality should be replaced with one of practical consequences and implied actions. Rorty states:

The whole vocabulary of isomorphism, picturing, and mapping is out of place here as indeed is the notion of being true of objects. If we ask what objects these sentences claim to be true of, we get only unhelpful repetitions of the subject terms – ‘the universe,’ ‘the law,’ ‘history.’ (1980: 723)

In making these remarks Rorty was probably reacting to the formal syntactical view of theories. However, other philosophers--such as Suppe (1989), Giere (1999), Morgan and Morrison (1999)--had a less relativistic response by replacing this syntactical view with a semantic view of theories. In this view models (rather than correspondence rules) provide the interpretation for the
As discussed in Chapter 6, models mediate between theories and data (Morrison & Morgan, 1999: 5).

Rescher (2000), following Peirce, adopts a more realistic view of pragmatism and repudiates Rorty’s relativistic pragmatism. Rescher proposes three steps to realign pragmatism with its Peircian roots: (1) pragmatism should be construed as a philosophical system that holds ‘success’ as epistemic for effective prediction, control, and explanation; (2) success is objective and independent of personal preferences; and (3) pragmatism is a method and not a doctrine.

Rescher emphasizes pragmatic success as inextricably intertwined with the scientific enterprise. Principles of efficacy in prediction and effective intervention in nature are essential to pragmatic success and are the foundations of scientific inquiry. Rescher provides a pragmatic justification for realism, which maintains that there is a real world—a realm of mind-independent, objective physical reality—out there, even though our abilities to understand it are severely limited. He emphasized that the stable aim of science is to provide useful models of reality. To Rescher (2003), realism is only justified by the fact that our knowledge of reality is itself fallible and we can never fully comprehend its complexity. The existence of a mind-independent reality is not the result of scientific inquiry, but a presupposition of inquiry. As discussed in the next section, Rescher argues that it is pragmatically useful for scientific inquiry to presuppose realism.

Realism

Realism contends that there is a real world existing independently of our attempts to know it; that we humans can have knowledge of that world; and that the validity of our knowledge is, at least in part, determined by the way the world is. Realism is a philosophical theory that is partly metaphysical and partly empirical. It transcends experience but is testable by experience (Leplin, 1984). This section discusses some of the historical underpinnings of realism followed by some of its variations including: scientific realism, conjectural realism, realistic pragmatism, and critical realism (evolutionary critical realism).

Historically, realism was concerned with the existence of unobservable entities that lie beyond human perception. Rescher (1987) traces the debate regarding unobservables to three schools of thought: instrumentalism (historically known as nominalism), realism, and approximationism (historically known as conceptualism). As discussed before, instrumentalism rejects the existence of unobservables and regards any reference to such entities in scientific theories as a means or tool to help explain the observable phenomena. In contrast, realism accepts the existence of unobservables and contends that scientific theories reference and capture such entities as they exist in the real world. Finally, approximationism asserts the existence of unobservables; however, it contends that scientific theories roughly capture these unobservables as they exist in the real world. In other words, a weak form of realism adopts a loose isomorphic representation of reality, whereas the strong form of realism contends a direct isomorphic relationship, and instrumentalism repudiates any type of isomorphism.

Chalmers (1999) simplifies the debate to be between anti-realism versus realism. Anti-realism (like instrumentalism) restricts scientific theorizing to the observable and avoids any metaphysical/speculative claims. For anti-realism the criterion of success for a scientific theory is its ability to predict observable phenomena. Here theories simply serve the function of ‘scaffolding to help erect the structure of observational and experimental knowledge, and they can be rejected once they have done their job’ (Chalmers 1999: 233).

In contrast to positivism and relativism, scientific realism (a strong form of realism) contends that science develops statements that are true at both theoretical and observational levels of
phenomena. It claims that science continues to progress by attaining closer approximations of reality. ‘We cannot know that our current theories are true, but they are truer than earlier theories, and will retain at least approximate truth when they are replaced by something more accurate in the future’ (Chalmers 1999: 238).

Major criticisms of scientific realism were raised by relativists who questioned the belief in absolute truth and approximation to it (Toulmin, 1953; Kuhn, 1962; 1970; Feyerabend, 1962; 1975; Bloor, 1976; Latour & Woolgar, 1986). The completeness, correctness, and progressively-truer nature of scientific knowledge were at stake. Niiniluoto (1980: 446) states, ‘No one has been able to say what it would mean to be “closer to the truth,” let alone offer criteria to determine such proximity.’

Several variations of realism developed in response to the criticisms of relativists. Suppe (1977) argued that Kuhn’s view of rapid paradigm shifts was historically inaccurate, and rejected his claims of incommensurability among theoretical terms across paradigms. If paradigms are truly incommensurable, how is it possible that scholars compare different paradigms and communicate across the paradigms? Hacking (1983) argued that relativism inappropriately emphasizes the distinction between observable and unobservable entities while neglecting the scientific methods of experimentation that manipulate and control entities to reveal their effects.

Popper (1959) and his followers developed conjectural realism, a moderate realist position. This position emphasizes the fallibilism of scientific knowledge and acknowledges the discontinuous progression of science. Chalmers states:

So the conjectural realist will not claim that our current theories have been shown to be approximately true, nor that they have conclusively identified some of the kinds of things that are in the world. . . . Nevertheless, it is still maintained that it is the aim of science to discover the truth about what really exists, and theories are appraised on the extent to which they can be said to fulfill that aim. (1999: 240)

Rescher (2003) also responded to the relativists by providing a pragmatic explanation for realism and developing realistic pragmatism. Realistic pragmatism emphasized that the aim of science is to provide a useful model of reality. To Rescher (2003), realism is only justified by the fact that our knowledge of reality is itself fallible, and we can never fully comprehend its complexity. He points out that realism represents a presupposition for inquiry, not a result of it (Rescher, 2000: 126).

The commitment to a mind-independent reality is, all too clearly, a precondition for empirical inquiry—a presupposition we have to make to be able to use observational data as sources of objective information. We really have no alternative but to presuppose or postulate it. Objectivity represents a postulation made on functional (rather than evidential) grounds: We endorse it in order to be in a position to learn by experience. What is at issue here is not so much a product of our experience of reality as a factor that makes it possible to view our experience as being ‘of reality’ at all. As Emmanuel Kant clearly saw, objective experience is possible only if the existence of such a real, objective world is an available given from the outset rather than the product of experience--an ex-post facto discovery about the nature of things. (Rescher, 2000: 127)

Rescher (2000) develops six important reasons why a presumption of realism is needed for scientific inquiry.
1. Realism is indispensable for the notion of truth as a correspondence between our ideas and reality. A factual statement cannot be ascertained if there is no final arbiter independent of our cognizing. Rescher (2000: 130) states, ‘A factual statement on the order of “There are π mesons” is true if and only if the world is such that π mesons exist within it.’

2. Realism is indispensable for the distinction between our subjective thoughts and opinions of reality and reality the way it actually is. Rescher (2000: 131) quotes Aristotle: ‘... that which exists does not conform to various opinions, but rather the correct opinions conform to that which exists.’

3. Realism is indispensable for communication and inquiry within the scientific community. It is established that the scientific community shares a real world where there are real objects which would ‘... serve as a basis for inter-subjective communication.’ (Rescher, 2000: 134)

Realism is indispensable for communal inquiry within the scientific community. It would be absurd to have a shared focus of epistemic strivings that imperfectly estimate reality when there is no reality. He states, ‘We could not proceed on the basis of the notion that inquiry estimates the character of the real if we were not prepared to presume or postulate from the very outset a reality for these estimates to be estimates of’ (2000: 132).

4. Realism is indispensable for the very idea of inquiry is hinged upon the conception of an independent reality and the attempts to understand it, albeit not fully. He states, ‘Without the conception of reality we could not think of our knowledge in the fallibilistic mode we actually use – as having provisional, tentative, improvable features that constitute a crucial part of the conceptual scheme ...’ (2000: 132).

5. Finally, realism is indispensable because our conception of causality is dependent on our attempts to empirically understand the real world. ‘Reality is viewed as the causal source and basis of the appearances, the originator, and determiner of the phenomena of our cognitively relevant experience’ (2000: 133).

Bhaskar (1979; 1998a; 1998b; 1998c) developed a form of realism known as critical realism. He and his supporters viewed critical realism as a middle ground between positivism and relativism (Collier, 1994; Harvey, 2002; Kemp & Holmwood, 2003). From relativism, critical realism assumed an anti-foundational stance by acknowledging the fallibilism of our knowledge of reality that is conceptually mediated and theory-laden. It also rejected the existence of axioms or synthetic a priori principles that provided epistemic knowledge of reality (Cruichskank, 2002). From positivism, critical realism emphasized empirical experimentation. However, it denied the possibility of generalizing its experimental outcomes because reality is an open system consisting of underlying contingent structures. Moreover, it maintained a mind independent, stratified reality consisting of underlying structures and mechanisms that determined how things come to behave (transcendental realism). It also held that theoretical entities have referential value (i.e., theoretical entities genuinely reflect the way the world is).

To this critical realist perspective, Donald T. Campbell added an evolutionary view of the development and progression of scientific knowledge (Campbell, 1989a; 1989b; 1990a; 1991; 1995; Campbell & Paller, 1989; Paller & Campbell, 1989). He replaced Kuhn’s social constructivist interpretation of scientific development with a selectionist evolutionary epistemology. Scientific progress evolves via a process of blind variation and selective retention. Reality (as opposed to mere opinions) serves as an external arbitrator or common referent in editing beliefs and theories for winnowing out inferior theories. Campbell (1988: 447) states, ‘I am an epistemological relativist, but I am not an ontological nihilist.’ McKelvey (1999: 384) states, ‘His [Campbell] development of
According to Azevedo (1997), Campbell shows how the process of blind variation and selective retention of biological evolution applies to science. She states:

Campbell argues convincingly that reality plays a part in editing beliefs, particularly in the sort of environment in which the organism’s perceptual mechanisms evolved. Both biological evolution and scientific progress evolve via a process of blind variation and selective retention. Science, seen as a problem solving activity, is continuous with the problem solving activity of all organisms. (Azevedo, 1997: 92)

Campbell combined his selectionist stance with a validity-seeking hermeneutics to justify the validity of knowledge based on a consensus among the scientific community. Scientific communities generally do not reach consensus based simply on opinions and beliefs. Scientific communities vary, of course, on the standards used to reach consensus. In the social sciences, the standards or criteria used to reach consensus typically include sound logical arguments and empirical evidence to substantiate the claims that are made. While social scientists debate the nature of the arguments and evidence that they consider legitimate and persuasive, most are willing to accept that (1) science is a process of error correction, (2) science is based on evidence obtained from outside of the scientists about the world, and (3) while evidence is theory-laden and error-prone, it is nevertheless useful for discriminating between plausible alternative models for understanding a phenomenon in question. This basic method of comparing evidence and arguments between alternative claims is not undertaken to achieve an ultimate Truth; instead, it is to select among competing alternative claims about a question or problem at a given time and context. The theories and models that better fit the problems they are intended to solve are selected, whereas those that are less fit are ignored or winnowed out. Campbell argued that this successive process of comparative selection accumulates into an evolutionary growth of scientific knowledge by the scholarly community.

**Discussion and Implications for Engaged Scholarship**

In summary, logical positivism was an extension of the Enlightenment and modernism’s faith in objectivity, reason, and the progress of scientific knowledge. It emphasized sensory observation and induction as the foundation of scientific knowledge. Underlying this assumption is a value-free and neutral observer and language. It denied all metaphysical statements as having any correspondence with reality and considered them meaningless due to their failure to pass the verifiability theory of meaning or Verificationism. This also led to conflating epistemology with ontology. Positivism reduced causal relations or explanations of the Humean constant conjunction of events and emphasized the unity of science or the primacy of the physical sciences as the model for all sciences.

The perspectives that we included in relativism all reacted to positivism’s emphasis on certainty, its anti-metaphysical attitude, its reliance on sensory observation, and its modernistic values. Relativism represents a host of philosophical schools of which just a sampling was described including: historical relativism, social constructivism, postmodernism, critical theory, and hermeneutics. These schools converged on their construal of truth as being socially constructed and theory-laden. They adopted an anti-essentialist stance that denied science of its objectivity and empirical/rational basis and denied any privileged way of acquiring knowledge of it.

Pragmatism developed as an alternative to the historical debates between rationalism and empiricism although more recently variants of pragmatism provide an alternative to positivism.
attempted to reconcile the abstractness of rationalism with the particularism of empiricism. Some of its proponents even went further to suggest that it also provides an alternative to positivism which developed several decades later. Pragmatism is characterized by the relation of theory and praxis and specifically in the predetermined outcomes of an inquiry. Despite Lovejoy’s criticism of the varieties of pragmatisms, they shared a common construal of truth as the success in guiding action and prediction. Ideas were clarified by showing their relationship to practice. Unlike, positivism’s emphasis on induction, pragmatism embraced abduction as the mode of scientific discovery. Depending on the pragmatist, they adopted an objective or subjective ontology and epistemology or a combination of both.

Similar to pragmatism’s attempt to provide an alternative to the historical debates between rationalism and empiricism, realism was also an attempt to provide such an alternative. More recently, critical realism developed an alternative between logical positivism and the more relativistic positions. Also, similar to pragmatism and relativism, realism consisted of numerous perspectives which shared in common an objective ontology that presupposes the existence of a mind-independent reality and the ability of a theory to capture partial aspects of reality. In contrast to positivism and relativism, more contemporary forms of realism viewed truth as being a process of successive approximations of reality, or verisimilitude. Furthermore, it rejected the positivistic adoption of constant conjunction and the relativistic view of socially constructed causal relations, and replaced them with a realistic construal of causal mechanisms that exist independent of our knowledge. Contemporary forms of realism also acknowledge the fallibilism of scientific knowledge and attempt to explain the progression of knowledge using an evolutionary metaphor. Finally, most forms of realism adopt some form of subjective epistemology where there are no predefined or predetermined methodologies or criteria that provide privileged views of reality.

It is tempting to view the four philosophies, especially positivism and relativism, as incommensurate and antithetical to each other. If you adopt this view you will probably choose one philosophy that seems closest to your own preferences and condemn the others as ‘unscientific,’ ‘uncaring,’ or perhaps just ‘unrealistic.’ In contrast and like Schultt (2004: 79), we think there are significant benefits from adopting a more holistic research philosophy that is open to and integrates some of the differences of alternative philosophies of science.

One view engaged scholarship as representing an example of such integration. Ontologically, engaged scholarship adopts Bhaskarian critical realism with its middle ground position between positivism and relativism and its layered/stratified/multi-dimensional, mind-independent reality. However; it also adopts Rescher’s realistic pragmatism to provide a pragmatic justification for its realist stance. With critical realist ontology, engaged scholarship adopts a Campbellian relativist evolutionary epistemology to understand the macro-level accumulation of scientific knowledge and its weak anti-foundationalist methodological stance where there are better warranted methods depending on the phenomenon. It also adopts triangulation across convergent, inconsistent, and contradictory data to understand the micro-level development of more robust scientific knowledge. However, the development of engaged scholarship’s philosophical underpinnings also benefited from other philosophical and metaphysical perspectives of which the most influential are discussed below.

1. Reflexivity

Postmodern and hermeneutic scholars have emphasized the interests, values, and biases that are served by researchers. No inquiry can be objective in the sense of being impartial and comprehensive by including a balanced representation of all stakeholders’ viewpoints. Critical theorists point out that meanings and interpretations of organizational life get played out in a context...
of power relationships. ‘Meanings are always politically mediated’ (Putnam, 1993: 230). Pragmatic and realist philosophers also emphasized the theory-laden nature of human perception, conceptualization, and judgment. The empiricist view was criticized because of the impossibility of pure, unmediated observation of empirical ‘facts’ (Mingers, 2004: 90). That being the case, engaged scholars need to be far more reflexive in their studies than positivists and empiricists have admitted. Reflexivity is characterized by different types of recursive turns each providing different insights and perspectives (Alvesson & Sköldberg, 2000).

2. Abduction

Peirce argued that induction serves not to initiate theory but rather to test it. The basic process in initiating theory was what he called abduction or hypothetical inference. As discussed in Chapter 4, this form of inference begins by engaging with the world and encountering an anomaly or breakdown that is inconsistent with our understanding or theory of the world. Abduction entails creative insight that resolves the anomaly if it were true. A conjecture developed through abductive inference represents a new plausible alternative to the status quo explanation of a given phenomenon in question. Because it might solve the problem, such an insight merits further development and elaboration as a defensible theory through deductive logic, and then testing through inductive inferences.

3. Science is an error-correction process of knowledge development.

It is easy to ‘throw out the baby with the bathwater.’ Philosophers of science have extensively criticized and rejected central tenets of logical positivism and empiricism, which had become the received view of science by the 1970’s. Despite the demise of the received view, McKelvey (1999) discusses a legacy of useful principles that withstood criticism and are clearly apparent in contemporary social science.

Many key ingredients of positivism nevertheless still remain in good standing among scientific realists, such as theory terms, observation terms, tangible observables and unobservables, intangible and metaphysical terms, auxiliary hypothesis, causal explanation, empirical reality, testability, incremental corroboration and falsification, and generalizable statements. . . . The received view is ontologically strong, in the sense that it posits an external reality and that successive scientific discoveries and theories over time more and more correctly describe and explain this reality; reality acts as a strong external criterion variable against which scientific theories are held accountable. (McKelvey, 1999: 386)

The most fundamental of these principles, we believe, is that science is an error-correction process that is based on evidence from the world rather than merely reflecting the scientist’s opinions of the world. Indeed, McKelvey (2002a: 254) asserts that ‘the singular advantage of the realist method is its empirically-based, self-correcting approach to the discovery of truth.’

However, the relativists, like the pragmatists Dewey and James, cautioned that ‘hard-and-fast, capital-T-Truth is simply an illusion’ (Westphal, 1998: 3). Ideas and beliefs are nothing but human constructions, shaped by social processes and procedures. Truth is that which gets endorsed and accepted in the scientific community. ‘Truth resides in agreement: social consensus does not merely evidentiate truth, but is its creator’ (Westphal, 1998: 3). We pointed out however, that social science communities do not reach consensus based simply on opinions; they rely on standards of sound and
persuasive arguments and empirical evidence for a scientific claim. The persuasiveness of an argument is a rhetorical question. Thus, in addition to logos, the other angles of pathos and ethos of the rhetorical triangle are important considerations (too often ignored) in communicating scientific findings.

4. Models as mediators

A key criticism of positivism was its syntactic view of theory (consisting of axiomatic first-order logical relations among theoretical terms, and correspondence rules that gave theoretical terms meaning in terms of their observational consequences). Suppe (1989), Giere (1999) and others replaced this syntactic view with a semantic view of theories in which models (rather than correspondence rules) provide the interpretation of social theories (Morrison & Morgan, 1999: 5). This criticism provides a key reason for including model development (in research design) as a core activity in the engaged scholarship process. The semantic view claims that models stand in a mediating relationship between theories and data. McKelvey (2002a) emphasizes that model-centeredness is a key element of scientific realism. He quotes Cartwright as saying, ‘The root from theory to reality is from theory to model, and then from model to phenomenological wall’ (Cartwright, 1983: 4). Like Morrison and Morgan, McKelvey views models as autonomous mediators between theory and phenomena.

Models are viewed as being fallibilistic and perspectival. Because data are theory-laden and error-prone, the challenge is to compare plausible alternative models given our current understanding of the subject matter instead of searching for an ultimate truth. As Giere (1999) explains, models represent alternative claims about a phenomenon in question given current understandings of it, rather than a universal objective theory of the world.

[Science] pits one model, or family of models, against rival models, with no presumption that the whole set of models considered exhausts the logical possibilities. This means that what models are taken best to represent the world at any given time depends on what rival models were considered along the way. And this seems, historically, a contingent matter. So the models of the world held at any given time might have been different if historical contingencies had been different. (Giere, 1999: 77)

Azevedo (2002) provides a pragmatic extension of using models for scientific problem solving. A scientific theory is operationalized as a model that is mapped onto reality (the problem). The test of a model is practical: how well does it serve as a map to guide action. Because the process of making and using maps is easily understood, the use of a mapping model of knowledge provides a powerful heuristic for determining the validity of scientific theories. Azevedo (2002: 725) points out that maps and models are constructed with interests in mind. They are selective representations of the world, and their content and format are selected according to their relevance to the problems they are intended to solve. Because the usefulness of a map model can only be assessed by how well it helps to solve the problem of the user, its validity is interest-related as well.

5. Relevance

Users of research knowledge--both scientific and practical--demand that it overcome the dual hurdles of being relevant and rigorous in serving their particular domains and interests (Pettigrew, 2001). However, different criteria of relevance and rigor apply to different studies because their
purposes, processes, and contexts are different. Pragmatists (particularly James and Dewey) emphasized that the relevance of knowledge should be judged in terms of how well it addresses the problematic situation or issue for which it was intended. Rescher (2000: 105) maintains that the relevance of knowledge about a problematic situation being investigated may entail any (or all) of the following questions:

- description (answering *what?* and *how?* questions about the problematic situation),
- explanation (addressing *why?* questions about the problematic situation),
- prediction (setting and achieving expectations about the problematic situation), and
- control (effective intervention in the problematic situation).

- emancipation (identifying the marginalized and repressed)

One criterion of research effectiveness does not fit all. Pragmatists have emphasized that different criteria of relevance and rigor apply to research undertaken to examine these different kinds of questions.

6. Engagement

A fundamental tenet of critical realism is that a real world exists out there, but our abilities to comprehend it are very limited. The ambiguous, ‘buzzing, blooming, confusing’ nature of reality exceeds the explanatory capabilities of any single theory or model that a researcher might devise. ‘In the absence of unambiguous foundational truth in the social sciences, the only sensible way forward can be conscious pluralism’ (Pettigrew, 2001: S62). As discussed in Chapter 1, pluralism requires engaging others from different disciplines and functions who can contribute different perspectives and models for understanding the problem domain being examined. Engagement not only requires a different conception of the researcher’s role, but also an extension of the philosophers’ consensus theory of truth.

Hermeneutics and relativism provide useful guidelines for engagement. Perhaps most fundamental is for researchers to jettison their God’s Eye view (illustrated in Figure 2.2) and adopt a participant frame of reference (shown in Figure 2.3) to conduct their studies. In a participant role, a researcher listens to and learns from others who have different perspectives that merit consideration for modeling or mapping a problem domain existing in the world. Moreover, relativism stresses the salience of divergent and often conflicting interests, values, and power of stakeholders in any study, and the impossibility of serving them all. One clear implication is the need for researchers to be reflexive in clarifying whose interests and values are served in their research engagements.

Engaging people from diverse backgrounds and perspectives represents a method of triangulating on a complex problem. Triangulation is the use of multiple sources of information, models and methods in a study. Research knowledge advances by comparing the relative contributions and perspectives provided by different models. Azevedo (1997) discusses how the coordination of multiple models and perspectives may reveal the robust features of reality by identifying those features that appear invariant (or convergent) across different perspectives. Azevedo reflects the established view in philosophy of science of developing reliable scientific knowledge by identifying those perspectives from a pluralist approach that converge on a common or consensual view of the phenomenon.
But the engagement of different stakeholders in a study often produces inconsistent and contradictory perspectives of a problem domain being examined. Pluralistic perspectives should not be dismissed as noise, error, or outliers—as they are typically treated in a triangulation research strategy. Chapter 9 discusses how these inconsistent and contradictory findings require an expansion of a consensus theory of truth that emphasizes convergence and agreement among investigators and reviewers in a scientific community on reliable and replicable findings. But many real-world problems contain inconsistent and contradictory principles. Rendering such problems as incommensurable denies their reality. Inconsistent and contradictory findings from different stakeholders involved in a study often represent truly pluralistic views of a problem domain that might be explained through methods of arbitrage (linking divergent bits of information and views) and paradoxical reasoning (to reconcile opposing and contradictory findings). As Suppe (1977) insightfully asked of Kuhn’s claims of incommensurability, if pluralistic perspectives are truly incommensurable, how is it possible that scholars (and practitioners) can compare different paradigms and communicate constructively across the paradigms? One implication of the practice of engaged scholarship is that philosophers of science need to expand their traditional explanations that emphasize convergent central tendencies to include explanations based on inconsistent findings through arbitrage and contradictory findings with methods of paradoxical reasoning.

7. The social process of social science

Another important implication of the practice of engaged scholarship for philosophy of science is the social process of conducting research. Positivists might be excused for their admission of a separation between a scientific theory to be tested and the social, psychological, and economic processes in which such a theory might have developed. But an excuse for such a separation between the ‘logic of discovery’ and the ‘logic of testing’ a theory should not apply to relativism, pragmatism, and realism. Despite the calls for assessing research with intended actions of the users of research by pragmatists, for a pluralistic comparison of alternative models of a problem domain being investigated by realists, and for a social construction of the meanings of reality from different stakeholders by relativists, it is impressive how little attention philosophers from these different schools of thought have given to the social process in which these perspectives might be realized.

Perhaps philosophers of science have deferred this question to sociologists of science. Studies of working scientists by Garfinkel, Lynch, and Livingston (1981), Latour and Woolgar (1986), and Knorr-Cetina and Amann (1990) indicate that improvisation underlies the process in which scientists actually construct models, enact experimental runs, design and interpret data, report on their methods and findings, and assign credit for discovery. While such studies are useful descriptions of how scientists engage in their practices, they provide little guidance for action, except for the conclusion that scientists engage in what Levi-Strauss (1966) termed a bricolage, improvising with a mixed bag of tools and tacit knowledge to adapt to the task at hand. The process by which scholars might step outside of themselves and engage others to be informed of the problem domain being examined remains a black box. Subsequent chapters suggest possible ways to open this black box by suggesting means and ways to engage relevant stakeholders in problem formulation, theory building, research design, and problem solving.

Conclusion

In conclusion, the purpose of the historical review of key concepts and principles of positivism, relativism, pragmatism, and realism has been to identify some of the conceptual tools and frameworks to understand different views of science, to initiate a process of reflexivity in choosing a philosophy of science that suits your scholarly practice, and to gain a deeper understanding of the philosophical basis of engaged scholarship. We discussed how these philosophies of science have
influenced our views of engaged scholarship, and also indicated several areas where the practice of engaged scholarship might advance or extend philosophy of science. As stated at the beginning of this chapter and applied in subsequent chapters, we view engaged scholarship as based on the following key elements of a critical realist philosophy of science.

- There is a real world out there (consisting of material, mental and emergent products), but our individual understanding of it is limited. In general, physical material things are easier to understand than reflexive and emergent social processes.

- All facts, observations and data are theory-laden implicitly or explicitly. Social sciences have no absolute, universal, error-free truths or laws as any scientific knowledge.

- No form of inquiry can be value-free and impartial; each is value-full. Some methods are better warranted than others depending on the phenomenon.

- Knowing a complex reality demands use of multiple perspectives.

- Robust knowledge is a product of theoretical and methodological triangulation where evidence is not necessarily convergent but might also be inconsistent or even contradictory.

- Models that better fit the problems they are intended to solve are selected allowing an evolutionary growth of knowledge.
References


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Figure 2.1. A logical empiricist picture of a scientific theory

Figure 2.2: God's Eye Frame of Reference: Triangular Reasoning

Source: Hendrickx (1999, p. 344)
Figure 2.3: Participant Frame of Reference: Quadrangular Reasoning

Source: Adapted from Hendrickx (1999, p. 345)
<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Logical Positivism</th>
<th>Relativism</th>
<th>Pragmatism</th>
<th>Realism</th>
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<tr>
<td><strong>Definition</strong></td>
<td>Philosophical movement inspired by empiricism, instrumentalism and positivism. (Vienna Circle, Berlin School)</td>
<td>Contemporary intellectual movement characterized by its skepticism about the foundations of Western philosophy. (Historical relativism, Social constructivism, Postmodernism, critical theory, hermeneutics)</td>
<td>Philosophical movement characterized by the relation of theory and praxis and specifically in the predetermined outcomes of an inquiry. (Relativism - James, Dewey, and Rorty, Realism - Peirce and Rescher)</td>
<td>Philosophical movement characterized by the existence of a mind-independent reality and the ability of a theory to capture partial aspects of reality. (Conjecture realism, Structural realism, Realistic pragmatism, Critical realism…)</td>
</tr>
<tr>
<td><strong>Ontology</strong></td>
<td>Objective: Reality is the empirical world (the world of the senses i.e. the rejection of the metaphysical).</td>
<td>Subjective: Reality is socially constructed.</td>
<td>Subjective: similar to postmodernism. Objective: Reality places limitations and constraints on our actions.</td>
<td>Objective: Reality exists independent of our cognition. Thus, there is no basis to reject the metaphysical. (epistemic fallacy).</td>
</tr>
<tr>
<td><strong>Epistemology</strong></td>
<td>Objective: The correspondence between our statements and reality through inductive verification or deductive falsification.</td>
<td>Subjective: There is no privileged epistemology due to the incommensurability of discourses.</td>
<td>Subjective and dependent on practical consequences.</td>
<td>Subjectivist: There is no predefined or predetermined methodology or criteria to judge the veracity our knowledge.</td>
</tr>
<tr>
<td><strong>Knower</strong></td>
<td>Positivist: The knower is independent of the empirical world. (passive observer) Furthermore, the mind can mirror the empirical reality.</td>
<td>Constructivists: The knower is in the world and cannot stand outside of his/her socio-linguistic constructs to view it objectively.</td>
<td>Consequentialist: The knower has a priori cognitive frameworks which affect his/her perception of the world.</td>
<td>Perspectivalist: The knower has a priori cognitive frameworks which affect his/her perception of the world.</td>
</tr>
<tr>
<td><strong>Language</strong></td>
<td>Language is value free and provides a means to mirror and correspond to the empirical world. (Analytic/Synthetic distinction)</td>
<td>Language is self-referential i.e. it does not refer to any transcendental entity beyond itself. This presupposes its value and interest-laden nature.</td>
<td>Language is not self-referential but actionable and functions to meet the agent’s goals and purposes.</td>
<td>Language is not self-referential or theory neutral but describes albeit partially, the underlying mechanism and structure of a phenomenon.</td>
</tr>
</tbody>
</table>
Glossary

Abduction/ Retroduction/ retroductive reasoning: an inference to the best explanation. Its starts from a set of facts and infers the most likely hypothesis to explain the phenomenon.

Anti-essentialism (Anti-essentialist): metaphysical doctrine which denies that objects have an essence or substance which is a set of characteristics that are eternal and invariable.

Anti-foundationalism (Anti-foundationalist): epistemological doctrine which denies the existence of self-justifying or self-evident first principles which guide or provide the foundation of scientific inquiry.

Age of Enlightenment/Enlightenment: period in European history between the 17th and 18th century which was characterized by a liberation from the theo-centric view of the world and replaced by an anthropocentric view that emphasized human reason as the sole means to understanding the world.

Analytic/synthetic statement: a statement is analytical if it is just true in virtue of the meaning of its constituent words. A statement is synthetic if neither it nor its denial is analytical (Boyd, 1991: 4).

Axiomatic principles: primitive definitions or proposition whose truth is knowable prior to deduction or sense experience.

Cartesian Dualism: Descartes construed the world as consisting of an external reality and human thought. Both reality and thought were viewed as independent of each other and thus the differentiation between the subject and the object or dualism.

Deduction: an inference to a conclusion from a finite sequence of axioms or premises considered to be true. Deduction is a system-relative concept whereby it only has meaning relative to a particular set of axioms or deductive rules.

Deductive rules: (see deduction)

Empiricism (Empiricist): an epistemology that places primacy on experience as a source of human knowledge.

Epistemology: the study of nature and scope of knowledge or the theory of knowledge.

Falsification: the act of disproving a hypothesis or theory. Developed by Karl Popper.

Idealism (Idealist): philosophical doctrine that views reality as mind-dependent or only mental entities are real.

Incommensurability: refers to the impossibility of comparing new/other scientific paradigms due to the differences in standards, methods, terms, world views...Thus asserting the theory-dependence of observation and denying scientific knowledge any type of objective/rational progression.

Induction: an inference to a generalization from its instances. The claim in the conclusion goes beyond the claims enumerated or stated in the premises or instances.

Instrumentalism (Instrumentalist): philosophical doctrine that views concepts and theories as useful instruments for explaining or predicting phenomena.

Ontology: the study of the origin, nature and constitution of reality.

Problem of induction: according to Reichebach (1948) the problem of induction is the impossibility of arriving at one generalization from the enumeration of its observational instances.

Rationalism (Rationalist): philosophical doctrine that privileges reason as a source of acquiring knowledge.

Referential value: refers to the existence of unobservable entities in the physical world which are represented using theoretical terms in science.

Semantic view of theory: theories are mathematical structures or models that are defined using mathematical language pertaining to their subject matter.

Syntactical view of theory: theories consist of axiomatic first-order logical relations among theoretical terms, and correspondence rules that give theoretical terms meaning based on their observational consequences.

Synthetic a priori: statements about reality which are acquired prior to experience.

Transcendental idealism (Transcendental Idealist): philosophical doctrine which holds that our mind contributes to our experience of things and subsequently we cannot know how things truly are.
**Weltanschauung/Paradigm:** set of scientific and metaphysical principles which dictate the methods and standards by which theories are developed, confirmed, revised and refuted.