Positivism & Post-Positivism

Let's start our very brief discussion of philosophy of science with a simple distinction between ***epistemology*** and ***methodology***. The term epistemology comes from the Greek word epistêmê, their term for knowledge. In simple terms, epistemology is the philosophy of knowledge or of how we come to know. Methodology is also concerned with how we come to know, but is much more practical in nature. Methodology is focused on the specific ways -- the methods -- that we can use to try to understand our world better. Epistemology and methodology are intimately related: the former involves the *philosophy* of how we come to know the world and the latter involves the *practice*.

When most people in our society think about science, they think about some guy in a white lab coat working at a lab bench mixing up chemicals. They think of science as boring, cut-and-dry, and they think of the scientist as narrow-minded and esoteric (the ultimate nerd -- think of the humorous but nonetheless mad scientist in the *Back to the Future* movies, for instance). A lot of our stereotypes about science come from a period where science was dominated by a particular philosophy -- ***positivism*** -- that tended to support some of these views. Here, I want to suggest (no matter what the movie industry may think) that science has moved on in its thinking into an era of ***post-positivism*** where many of those stereotypes of the scientist no longer hold up.

Let's begin by considering what positivism is. In its broadest sense, positivism is a rejection of metaphysics (I leave it you to look up that term if you're not familiar with it). It is a position that holds that the goal of knowledge is simply to describe the phenomena that we experience. The purpose of science is simply to stick to what we can observe and measure. Knowledge of anything beyond that, a positivist would hold, is impossible. When I think of positivism (and the related philosophy of logical positivism) I think of the behaviorists in mid-20th Century psychology. These were the mythical 'rat runners' who believed that psychology could only study what could be directly observed and measured. Since we can't directly observe emotions, thoughts, etc. (although we may be able to measure some of the physical and physiological accompaniments), these were not legitimate topics for a scientific psychology. B.F. Skinner argued that psychology needed to concentrate only on the positive and negative reinforcers of behavior in order to predict how people will behave -- everything else in between (like what the person is thinking) is irrelevant because it can't be measured.

In a positivist view of the world, science was seen as the way to get at truth, to understand the world well enough so that we might predict and control it. The world and the universe were deterministic -- they operated by laws of cause and effect that we could discern if we applied the unique approach of the scientific method. Science was largely a mechanistic or mechanical affair. We use deductive reasoning to postulate theories that we can test. Based on the results of our studies, we may learn that our theory doesn't fit the facts well and so we need to revise our theory to better predict reality. The positivist believed in *empiricism* -- the idea that observation and measurement was the core of the scientific endeavor. The key approach of the scientific method is the experiment, the attempt to discern natural laws through direct manipulation and observation.

OK, I am exaggerating the positivist position (although you may be amazed at how close to this some of them actually came) in order to make a point. Things have changed in our views of science since the middle part of the 20th century. Probably the most important has been our shift away from positivism into what we term *post-positivism*. By post-positivism, I don't mean a slight adjustment to or revision of the positivist position -- post-positivism is a wholesale rejection of the central tenets of positivism. A post-positivist might begin by recognizing that the way scientists think and work and the way we think in our everyday life are not distinctly different. Scientific reasoning and common sense reasoning are essentially the same process. There is no difference in kind between the two, only a difference in degree. Scientists, for example, follow specific procedures to assure that observations are verifiable, accurate and consistent. In everyday reasoning, we don't always proceed so carefully (although, if you think about it, when the stakes are high, even in everyday life we become much more cautious about measurement. Think of the way most responsible parents keep continuous watch over their infants, noticing details that non-parents would never detect).

One of the most common forms of post-positivism is a philosophy called ***critical realism***. A critical realist believes that there is a reality independent of our thinking about it that science can study. (This is in contrast with a ***subjectivist*** who would hold that there is no external reality -- we're each making this all up!). Positivists were also realists. The difference is that the post-positivist critical realist recognizes that all observation is fallible and has error and that all theory is revisable. In other words, the critical realist is *critical* of our ability to know reality with certainty. Where the positivist believed that the goal of science was to uncover the truth, the post-positivist critical realist believes that *the goal of science is to hold steadfastly to the goal of getting it right about reality, even though we can never achieve that goal*. Because all measurement is fallible, the post-positivist emphasizes the importance of multiple measures and observations, each of which may possess different types of error, and the need to use ***triangulation*** across these multiple errorful sources to try to get a better bead on what's happening in reality. The post-positivist also believes that all observations are theory-laden and that scientists (and everyone else, for that matter) are inherently biased by their cultural experiences, world views, and so on. This is not cause to give up in despair, however. Just because I have my world view based on my experiences and you have yours doesn't mean that we can't hope to translate from each other's experiences or understand each other. That is, post-positivism rejects the ***relativist*** idea of the ***incommensurability*** of different perspectives, the idea that we can never understand each other because we come from different experiences and cultures. Most post-positivists are ***constructivists*** who believe that we each construct our view of the world based on our perceptions of it. Because perception and observation is fallible, our constructions must be imperfect. So what is meant by ***objectivity*** in a post-positivist world? Positivists believed that objectivity was a characteristic that resided in the individual scientist. Scientists are responsible for putting aside their biases and beliefs and seeing the world as it 'really' is. Post-positivists reject the idea that any individual can see the world perfectly as it really is. We are all biased and all of our observations are affected (theory-laden). Our best hope for achieving objectivity is to triangulate across multiple fallible perspectives! Thus, objectivity is not the characteristic of an individual, it is inherently a social phenomenon. It is what multiple individuals are trying to achieve when they criticize each other's work. We never achieve objectivity perfectly, but we can approach it. The best way for us to improve the objectivity of what we do is to do it within the context of a broader contentious community of truth-seekers (including other scientists) who criticize each other's work. The theories that survive such intense scrutiny are a bit like the species that survive in the evolutionary struggle. (This is

sometimes called the ***natural selection theory of knowledge*** and holds that ideas have 'survival value' and that knowledge evolves through a process of variation, selection and retention). They have adaptive value and are probably as close as our species can come to being objective and understanding reality.

Clearly, all of this stuff is not for the faint-of-heart. I've seen many a graduate student get lost in the maze of philosophical assumptions that contemporary philosophers of science argue about. And don't think that I believe this is not important stuff. But, in the end, I tend to turn pragmatist on these matters. Philosophers have been debating these issues for thousands of years and there is every reason to believe that they will continue to debate them for thousands of years more. Those of us who are practicing scientists should check in on this debate from time to time (perhaps every hundred years or so would be about right). We should think about the assumptions we make about the world when we conduct research. But in the meantime, we can't wait for the philosophers to settle the matter. After all, we do have our own work to do!

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