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REMARKS ON RESEARCH TACTICS AND PHILOSOPHY OF SCIENCE

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In *Tactics of Scientific Research* (Sidman, 1960/1988) I expressed my opinion that most philosophers of science know little or nothing about how scientific research is actually carried out. It appeared to me that the philosophy and the tactics of science had little to do with each other. My own exposition of behavioral research methodology seemed, therefore, even to me, philosophically irrelevant. It puzzled me that Willard Day, originator and editor of the philosophically oriented journal *Behaviorism*, thought anything I had to say might be of interest to philosophers of science; I was somewhat mystified when he asked me to write what turned out to be my *Remarks* columns.

As usual, however, Willard's thinking was well ahead of my own. This became evident to me once more when I recently became acquainted with a point of view that changed my original conclusion that research methodology and philosophy are unrelated. Interestingly enough, I came across this new—for me—point of view in the writings not of a professional philosopher or scientist but of an engineer who examines such topics as the construction of bridges, tunnels, highways, and other striking products of engineering, along with the design history of commonplace objects like toothpicks, pencils, paper clips, and chimneys. Because of the lucidity and rationality of his writing, I have learned more about bridges than I ever thought I would want to know. I have also learned much that was new to me regarding what engineering is all about. The writer is Henry Petroski, who numbers among his many publications regular contributions to *The American Scientist*. There, I was introduced to his conviction that the engineering profession's most fundamental activity is design (see, for example, Petroski, 2003).

What most of us admire about engineering are its products. Petroski, however, believes that planning and design are more important features of engineering than are the final products, whether paper clips or bridges. In his own words, he stresses ". . .the importance of design as procedure as well as of product," and "Thinking about how to accomplish something is in fact the essence of design. The plan is as important as the path; the journey as critical as the goal" (Petroski, 2010).

This bit of philosophy about physical engineering made me wonder, first, "What about behavioral engineering?" The politically correct term for *behavioral engineering* is *applied behavior analysis*, whose products are new patterns of

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behavior: For example, children who have been considered unable to learn even simple academic skills come to show the behavioral changes that we call *learning*; the institution of new behavioral routines in a dangerous workplace reduces the frequency of accidents there; applying positive rather than negative consequences to children's actions reduces the likelihood of juvenile delinquency. In these and other examples of behavioral engineering, the products are, of course, important, but to understand those products requires an understanding of the procedures used to bring them about. To paraphrase Petroski, designing the procedures we use to create a behavioral product is at least as important as the product itself.

What is the relevance of all this to the methods and philosophy of experimental and theoretical behavior analysis? We must ask, first, "What are the products of the science?" For experimentalists, the products are data; for theoreticians, theories. Because I myself am more of an experimenter than a theorist, let us look first at experimentation. Generalizing Petroski's view from engineering to experimental science, we would have to say that the design of experiments is a more important scientific activity than are the products—data. Could this be so? If so, how is it relevant to the philosophy of the science of behavior analysis?

Philosophically, science is based on empiricism, that is to say, on evidence obtained through sensory experience that is recordable and therefore demonstrable. Many philosophers and scientists take the framing of hypotheses as the defining characteristic of science and interpret empiricism as the testing of hypotheses and theories against observable data. I believe this is too narrow a view. How about the framing of questions that can be answered empirically as the defining characteristic of science? The questions can arise from many sources: from theory, from previously obtained data, from the need to solve a practical problem, or just from idiosyncratic curiosity about some feature of nature. Scientifically valid answers to such questions depend on experiments. Therefore, a principal activity of scientists is the design of experiments. The evaluation of scientific data depends on the validity of the experimental design. Applying to science Petroski's philosophy of engineering, the design of experiments is critical for the evaluation of the experimental product—data. We can never evaluate the significance of any data without knowing design details of the experiment that produced those data.

An understanding of and an acquaintance with methodological details are crucial for any judgment of an experiment's validity, generality, and overall significance. Knowledge of research design is therefore basic to a philosophy of science, a requirement for any philosopher who wishes to evaluate a particular science's place in any more general world view. For example, one of philosophy's fundamental questions is "What is the nature of truth?" One cannot answer this question just by citing the products of scientific activity—data and theories. If the methods used to arrive at the data and theories were faulty, a philosopher who looked only at a science's final products would draw unjustified conclusions. Philosophers of science must know not only what scientists have concluded about their data but must also understand the methodology of the science, that is to say, how the data were arrived at.

Thorough acquaintance with scientific design is therefore a necessity for philosophers of science. I speak here not of statistical design but of what researchers actually do in producing their products, as described classically for physiological and medical sciences by Bernard (1865/1949). More recently and more specific to behavior analysis are Johnston & Pennypacker (2009) and Sidman (1960/1988). The latter two, often cited as research design texts, are also texts on the philosophy of behavioral science. Philosophers cannot judge the truth value of any behavior analytic data or any theory derived from such data without first understanding how those particular data were arrived at. Such philosophical questions as the nature of cognition, mentalistic psychology vs. behaviorism, classical behaviorism vs. radical behaviorism, the rationality of conduct, the definition of knowledge, and so on cannot be answered by appeal to data without first evaluating in detail the methods used to obtain those data.

For example, most philosophers (and psychologists) treat cognition as a phenomenon that is built into the psyche and they ask questions about its role in such other phenomena as perception, communication, reasoning, intellectual activities, and so on. Behavior analysts, however, treat cognition as a name that summarizes a set of activities, mostly learned. Instead of accepting cognition as a built-in phenomenon, they do experiments that demonstrate how to teach the activities that constitute cognition. From the point of view that we ourselves construct cognition by means of specifiable operations, any philosophical treatment of cognition requires an understanding of those operations, that is to say, of how the construction of cognition is designed.

Does an understanding of this necessity for philosophers of science to acquaint themselves with design details have any utility for experimental behavior analysts? Not necessarily. But for those of us who would like to see the significance of our work extend beyond our own narrow field, the potential relevance of our experimental designs to philosophical concerns can influence the ways we arrive at design details and describe them to others. For example, in simple and conditional discrimination experiments we would not just specify how many stimuli we presented for subjects to choose from on each trial, but we would also explain how we arrived at that particular number of stimuli. Philosophers could then understand why data obtained from experiments that presented subjects with only two stimuli per trial might yield incorrect interpretations of the learning process and therefore of how knowledge is acquired. That is to say, potential relevance to philosophy is a good reason to prefer clarity over brevity in our scientific publications. It is up to us to help philosophers evaluate the significance of behavior analytic science to broader concerns about knowledge, conduct, and truth.

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