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Interpretation and Experimental-analysis: An Underappreciated Distinction

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Abstract

Behavior analysis and mainstream psychology differ fundamentally in their approaches to the explanation of complex behavior. This difference arises from psychology's failure to observe Skinner's distinction between experimental analysis and interpretation, a distinction that is honored in other sciences. Behavior analysis uses principles derived from the experimental analysis of basic processes to interpret (explain) more complex phenomena that cannot themselves be subjected to experimental analysis. In contrast, psychology uses principles inferred from the complex behavior itself.

Skinner distinguished between two complementary aspects of science—experimental analysis and interpretation. Failure to honor this distinction is at the core of the differences between behavior analysis and mainstream psychology. Experimental analysis can take place only when conditions permit manipulation and/or control of all antecedent variables and measurement of all consequences that enter into orderly functional relations with those antecedents (Skinner, 1966). This idealized state may be closely approximated only in the laboratory. In the specific instance of behavior analysis, the conditions for experimental analysis generally require the use of nonhuman subjects to control pre-experimental history. From this perspective, many experiments—including most worthy experiments—do not sufficiently approximate these idealized conditions to qualify as experimental analyses. Interpretation occurs when some phenomenon is observed under conditions that do not permit experimental analysis but to which the fruits of prior experimental analyses may be applied to explain the phenomenon. Complex behavior—especially human behavior—is almost always the domain of interpretation, not experimental analysis. As Skinner (1974) noted with regard to his efforts to explain human behavior:

> *"I am concerned with interpretation rather than prediction and control" (p. 21) ... As in other sciences, we often lack the information necessary for prediction and control and must be satisfied with interpretation, but our interpretations will have the support of the prediction and control which have been possible under other conditions"* (p. 194).

The distinction between experimental analysis and interpretation is present in all science and is not peculiar to the science of behavior, even when not explicitly stated. Consider mechanics in physics. The principles of mechanics as formulated by Newton are thought to be valid (on the macro level) for describing the motion of objects. Newtonian principles are based on experimental analyses conducted with balls rolling down inclined planes, swinging pendulums, and the like. In spite of their validity, the application of Newtonian principles to motion in the world outside the laboratory is often an instance of interpretation. For example, when a boulder tumbles down a hillside after a rainfall, all of the causes of its motion and all of the principles that describe that motion are presumably known. And yet, the specific path and final resting place of the boulder are uncertain. The particulars of the phenomenon cannot be completely described by Newtonian principles because the motion occurs under conditions in which the specific values of many variables are unknown (e.g., the irregularities of the hillside, the momentary coefficients of sliding friction at the changing interface between the boulder and the hillside, etc.). In spite of these uncertainties, Newtonian principles provide a satisfying explanation for the motion of the boulder, i.e., they enable us to "understand" the phenomenon. In Skinner's terms, Newtonian mechanics provides an interpretation of the boulder's motion. A major goal of experimental analysis in any science is to enable an interpretation of that larger world outside the laboratory. Indeed, all applications of behavior analysis to fields such as education and the remediation of dysfunctional behavior are instances of interpretation.

Explanation in Behavior Analysis vis-à-vis Psychology

Interpretations of behavior confront an even stiffer challenge than do interpretations of mechanics: Organisms are historical systems whose future states are dependent not only on their present state but also on their history of past states (cf. Smolensky, 1988). A force applied to a body having a specific mass and moving in a given direction at a given velocity will have the same effect whatever the prior location, direction, and velocity of that body. However, organisms that behave identically in a given situation may react differently to the same subsequent environmental event depending on their unique experiences. For example, failure may have little effect on the behavior of someone whose prior behavior has been largely successful but a devastating effect on someone whose prior behavior has been largely unsuccessful.

Skinner (1974) showed that he was sensitive to the different roles of history in sciences such as mechanics and behavior when he affiliated behavior analysis with biology and not physics. "The experimental analysis of behavior is a rigorous, extensive, and rapidly advancing branch of biology" (italics added) (p. 255) (cf. Hull, 1940). By so doing, Skinner allied behavior analysis with the unifying theme of all biology: Complexity is the cumulative product of basic selection processes acting over time. In the case of biology, the environment acts through the process of natural selection by the ancestral environment on a population of individuals to favor the survival of some and the demise of others. In behavior analysis, natural selection is complemented by the process of selection by reinforcement. In selection by reinforcement, the environment acts on a population of environment-behavior relations of a single individual to strengthen some relations and weaken others (Donahoe & Palmer, 1994).

In biology, after selection processes have been identified through experimental analysis, they are used to interpret complex phenomena that occur under circumstances that do not permit experimental analysis—phenomena such as the evolution of species. Explanation (i.e., interpretation) in behavior analysis parallels explanation in evolutionary biology: (a) basic processes are identified and characterized through experimental analysis, (b) principles that summarize the effects of these processes are formulated and methods are devised that trace their cumulative effects, and (c) complex phenomena are said to be explained if the principles acting over time are sufficient to accommodate the observed effects. This mode of explanation differs from what occurs in mainstream psychology. In psychology, (a) complex behavior is subjected to experimentation (but not experimental analysis in the present sense), (b) inferences about basic principles are made based on observations of the complex behavior, and (c) the complex behavior is said to be "explained" if the complex behavior is necessarily implied by the principles.

The fundamental difference between behavior-analytic and psychological approaches to explanation becomes most apparent when complex phenomena are encountered that are inconsistent with their respective principles. In behavior analysis, complex phenomena that are inconsistent with basic principles prompt new experimental analyses. Perhaps the basic processes were incompletely characterized or perhaps additional basic processes remain to be uncovered. The central point is that the failure of existing principles to interpret complex behavior prompts new experimental analyses of simpler phenomena. By contrast, in psychology a complex phenomenon that is inconsistent with previously inferred processes prompts new inferences derived from further observations of that or other complex behavior.

The inferred-process approach is plagued by two classes of problems—formal and pragmatic. Formally, principles inferred from complex behavior are prey to logical circularity. That is, the principles that were inferred from the complex phenomena are then used to “explain” the very phenomena from which they were inferred. Because the logical/mathematical chain that extends from observation to inference and back again is typically lengthy, the circularity of the account is obscured. Although efforts may be made to validate the newly inferred processes by conducting new experiments, the methods used in the new experiments are often very similar those used in the original experiments. This practice permits reliability of findings to be mistaken for validity of principles. A second formal problem with the inferred-process approach is that inferences are incompletely constrained by behavioral observations; thus, the likelihood is small that any specific inference is correct. In general, a given instance of complex behavior is consistent with any of a large number of candidate principles (cf. Anderson, 1978; Donahoe, 2004; Townsend, 1972). As an example from Markov processes with hidden states—much simpler systems than the nonlinear neuromuscular systems of organisms—a prominent investigator has remarked: “I would think it is fundamentally hopeless to try to deduce the 'right' internal machinery from I-O [i.e., input-output] observations” (Jaeger, personal communication, May 9, 2001). That is, unobservable states, such as those occurring within an organism, cannot be validly inferred based solely on observations of external environmental and behavioral events.

The pragmatic problem is illustrated by the history of inferred-process theories: Such theories have relatively short half-lives—perhaps less than 10 years on the average. How many students have found that the “theory-du-jour” upon entering graduate school has become passé upon leaving? The consequence is that students become discouraged and, more fundamentally, that mainstream psychology lacks the cumulative nature typical of science. In the inferred-process approach, earlier principles are seldom refined by later experimental work but, instead, are replaced altogether. In behavior analysis, new findings rarely lead to the abandonment of earlier principles but more often to their supplementation. Consider the blocking experiment (Kamin, 1968; cf. vom Saal & Jenkins, 1970) in which it was demonstrated that a close temporal relation of a response to the reinforcer was not sufficient for behavioral change to occur. The reinforcing stimulus had also to evoke a behavior that was not otherwise occurring (Rescorla & Wagner, 1972; cf. Donahoe, Burgos, & Palmer, 1993; Donahoe, Crowley, Millard, & Stickney, 1982). In the new formulation of the reinforcement principle, temporal contiguity is not replaced as a requirement but is supplemented by the additional requirement of reinforcer-evoked behavioral change. The modern principle of the reinforcement incorporates both temporal contiguity and behavioral change in its statement. ***[Reinforcement research and the reinforcement principle are both treated in the next chapter, “Selection by Reinforcement.”]***

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