Introduction

The operant behaviorism of B. F. Skinner

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Of all contemporary psychologists, B. F. Skinner is perhaps the most honored and the most maligned, the most widely recognized and the most misrepresented, the most cited and the most misunderstood. Some still say that he is a stimulus–response psychologist (he is not); some still say that stimulus–response chains play a central role in his treatment of verbal behavior (they do not); some still say that he disavows evolutionary determinants of behavior (he does not). These and other misconceptions are common and sometimes even appear in psychology texts (e.g., Todd & Morris 1983). How did they come about, and why do they continue? The present treatments may help to clarifly some of the misunderstandings.

The articles sampled here represent a range of Skinner's work (in the treatments, each article is referred to by its abbreviated title). The first but most recent, "Selection by Consequences" ("Consequences," Skinner 1981), relates operant theory to other disciplines, and in particular to biology and anthropology. The second, "Methods and Theories in the Experimental Analysis of Behavior" ("Methods"), outlines some of the basic concepts of operant theory in the context of a discussion of methodological and theoretical issues; it is an amalgamation of revised versions of "The Flight from the Laboratory" (Skinner 1961) and "Are Theories of Learning Necessary?" (Skinner 1950) and a portion of the preface to *Contingencies of Reinforcement* (Skinner 1969). "The Operational Analysis of Psychological Terms" ("Terms," Skinner 1945) is the earliest work treated; its special concern is with the language of private events, and many features of Skinner's analysis of verbal behavior are implicit in it. "An Operant Analysis of Problem Solving" ("Problem Solving," Skinner 1966a) continues the interpretation of verbal behavior in distinguishing between rule-governed and contingency-shaped behavior. "Behaviorism at Fifty" ("Behaviorism-50," Skinner 1963) addresses the status of behaviorism as a philosophy of science, and points out some of the difficulties that must be overcome by any science of behavior. "The Phylogeny and Ontogeny of Behavior" ("Phylogeny," Skinner 1966c), the last of the works sampled, considers how evolutionary variables combine with those operating within an organism's lifetime to determine its behavior.

Biography [*see also* "Appendix: Biographical Sketch . . ."]

Burrhus Frederic Skinner was born on March 20, 1904, in Susquehanna, Pennsylvania. After majoring in English at Hamilton College, he tried a career at writing but gave it up after finding he had nothing to say. Having a long-standing interest in human and animal behavior and some familiarity with the writings of Watson, Pavlov, and Bertrand Russell, he then entered the graduate program in psychology at Harvard University (Skinner 1976). There he began a series of experiments that led to more than two dozen journal articles and culminated in *The Behavior of Organisms* (1938). In the manner of *The Integrative Action of the Nervous System* (Sherrington 1906) and *Behavior of the Lower Organisms* (Jennings 1906), the work presented a variety of novel research findings and provided a context for them. The extensive data illustrated many properties of reinforcement and extinction, discrimination and differentiation; the concept of the three-term contingency was to become the cornerstone for much else that would follow.

In 1936, after three years as a Junior Fellow in the Harvard Society of Fellows, Skinner moved to the University of Minnesota. His basic research continued, but during World War II he also worked on animal applications of behavior principles, including the training of pigeons to guide missiles (Skinner 1960; 1979). Although the project never got beyond demonstrations, a major fringe benefit was the discovery of shaping, the technique for creating novel forms of behavior through the differential reinforcement of successive approximations to a response.

Another product of those days was the Aircrib, which Skinner built for his wife and his second daughter (Skinner 1945). It was a windowed space with temperature and humidity control that improved on the safety and comfort of the ordinary crib while making the care of the child less burdensome. It was not used for conditioning the infant (contrary to rumor, neither of Skinner's daughters developed emotional instability, psychiatric problems, or suicidal tendencies). Soon after came the utopian novel, *Walden Two* (1948). Some who later criticized the specifics of that planned society failed to observe that its experimental character was its most important feature: Any practice that did not work was to be modified until a more effective version was found.

In 1945, Skinner assumed the chairmanship of the Department of Psychology at Indiana University. Then, after delivering the 1947 William James Lectures at Harvard University on the topic of verbal behavior, he returned permanently to the Harvard Department of Psychology (Skinner 1983). There he completed his book *Verbal Behavior* (1957) and, in collaboration with Charles B. Ferster, developed the subject matter of schedules of reinforcement (Ferster & Skinner 1957). Much else has been omitted here (e.g., *Science and Human Behavior* [1953] and teaching machines); the articles and books Skinner has since written are numerous. All but one of the articles treated ("Terms") are drawn from those later pieces; they constitute

a sample of his most seminal works. Many others are cited in the course of the treatments.

Operant behaviorism

Operant behaviorism (or radical behaviorism) is the variety of behaviorism particularly identified with Skinner's work. It provides the systematic context for the research in psychology sometimes referred to as the experimental analysis of behavior. Behavior itself is its fundamental subject matter; behavior is not an indirect means of studying something else, such as cognition or mind or brain.

A primary task of an experimental analysis is to identify classes of behavior on the basis of their origins. Some classes of responses, *respondents*, originate with the stimuli that elicit them (as illustrated by the stimulus–response relations called reflexes). Others, called *operants*, are engendered by their effects on the environment; because they do not require eliciting stimuli, they are said to be *emitted* rather than elicited. Admitting the possibility that behavior could occur without eliciting stimuli was a critical first step in operant theory. Earlier treatments had assumed that for every response there must be a corresponding eliciting stimulus. The rejection of this assumption did not imply that emitted responses were uncaused; rather, the point was that there are other causes of behavior besides eliciting stimuli. Adding operants to respondents as behavior classes did not exhaust the possibilities, but it was critical to recognize that the past consequences of responding are significant determinants of behavior.

The consequences of a response may either raise or lower subsequent responding. Consequences that do so are respectively called *reinforcers* and *punishers* (punishment has sometimes been confused with negative reinforcement, but positive and negative reinforcement both involve increases in responding; they differ in whether the consequence of responding is the addition to or removal of something from the environment, as in the difference between appetitive procedures and those involving escape or avoidance). The particular relations that can be established between responses and their consequences are called *contingencies* of reinforcement or punishment.

But the consequences of responding are also typically correlated with other features of the environment (some consequences of stepping on the brake pedal or the gas pedal, for example, depend on whether the traffic light is red or green). When a stimulus sets the occasion on which responding will have a particular consequence, the stimulus is said to be *discriminative*. If responses then come to depend on, or come under the control of, this stimulus, the response class is called a *discriminated operant*. Both respondents and discriminated operants involve an antecedent stimulus, but the distinction between them is crucial and depends on whether consequences of responding play a role. A response that depends only on the presentation of a stimulus, as in a reflex relation, is a member of a respondent class. One that

depends on the relations among the three terms – *stimulus*, *response*, *consequence* – is a member of a discriminated operant class. Thus, discriminated operants are said to be defined by a *three-term contingency*. The three-term contingency is often neglected by those who think of behavior change only in terms of the instrumental and classical procedures of earlier conditioning theories.

Much of the research that helped to establish this vocabulary was conducted in the experimental chamber that for a while was known as the Skinner box (that term was more often used by those outside than by those within the experimental analysis of behavior). Simple stimuli (lights, sounds), simple responses (lever presses, key pecks), and simple reinforcers (food, water) were arranged for studying the behavior of rats or pigeons. Many responses automatically have particular consequences (to see something below eye level, for example, we look down rather than up). But natural environments do not ordinarily include levers on which presses produce food pellets only when lights are on. Operant chambers were designed to create arbitrary *contingencies*; they were arbitrary, but only in this sense. As for responses such as the pigeon's key peck:

> Such responses are not wholly arbitrary. They are chosen because they can be easily executed, and because they can be repeated quickly and over long periods of time without fatigue. In such a bird as the pigeon, pecking has a certain genetic unity; it is a characteristic bit of behavior which appears with a well-defined topography. (Ferster & Skinner 1957, p. 7)

Given this recognition of genetic determinants in the specification of operant classes, it is ironic that some species-specific characteristics of lever presses and key pecks later became the basis for criticisms of operant theory. Perhaps these responses were not arbitrary enough. But given that the concern was to study the effects of the consequences of responding, it would hardly have been appropriate to have sought out response classes so highly determined in other species-specific ways that they would have been insensitive to their consequences.

There are "natural lines of fracture along which behavior and environment actually break" (Skinner 1935a, p. 40). "We divide behavior into hard and fast classes and are then surprised to find that the organism disregards the boundaries we have set" (Skinner 1953, p. 94). Operant theory is not compromised by demonstrations that some response classes are more easily established than others, or that some discriminations can be more easily established with some reinforcers than with others. Consequences are important, but they do not operate to the exclusion of other sources of behavior, including phylogenic ones. Phenomena such as autoshaping (producing a pigeon's pecks on a key by repeatedly lighting the key and then operating the feeder) were discovered in the course of operant research, and present no more of a problem to operant accounts than do the respondent conditioning phenomena studied by Pavlov.

The discovery that behavior could be maintained easily even when only an occasional response was reinforced led to the investigation of schedules of reinforcement. Schedules arrange reinforcers on the basis of the number of responses, the time at which responses occur, the rate of responding, or various combinations of these and other variables. In more complicated cases, different schedules operate either successively or simultaneously in the presence of different stimuli or for different responses. Reinforcement schedules have proven useful in such areas as psychopharmacology and behavioral toxicology. The performances generated by complex schedules are also sometimes analogous to performances that in humans are discussed in terms of preference, self-control, and so on (e.g., see "Methods").

In its extension to verbal behavior, a primary task of an operant analysis is again that of identifying the various sources of behavior. Its concern is with the functions of language rather than with its structure. In the *tact* relation, for example, an object or event is a discriminative stimulus that sets the occasion for a particular utterance, as when one says "apple" upon seeing an apple (tacting is not equivalent to naming or referring to; the relation called reference involves another class of behavior, called *autoclitic*). Through the tact relation, verbal behavior makes contact with events in the world. Other relations include (but are not limited to) the *intraverbal*, in which verbal behavior serves as a discriminative stimulus for other verbal behavior (as in learning addition or multiplication tables), the *textual*, in which written text provides the discriminative stimuli (as in reading aloud), and the *mand*, in which the verbal response specifies a consequence (as in making a request or asking a question). Any utterance, however, is likely to involve these and other relations in combination; verbal behavior is a product of multiple causation. Novel utterances may be dealt with by showing how their various components (words, phrases, grammatical forms) have each been occasioned by particular aspects of a current situation; novelty, in other words, comes about through novel combinations of existing verbal classes.

More important, these elementary relations are only the raw materials from which verbal behavior is constructed. A sentence cannot exist solely as a combination of these elementary units. Speakers report on the conditions under which they are behaving verbally (as when someone says, "I am happy to report that..."), they cancel the effects of their own verbal behavior (as when they include "not" in a sentence), they indicate its strength (as when they speak of being sure or uncertain), and so on. In each of these cases, some parts of the speaker's verbal behavior are under the discriminative control of the various other verbal relations. These processes, called *autoclitic*, are the basis for larger verbal units (e.g., sentences) and for the complexities of self-editing, logical verbal behavior, and so on. The nestings and orderings and coordinations of these processes are intricate, but they can nevertheless be accommodated by the discriminative stimuli and the responses and the consequences of the three-term contingency. This sort of

analysis is illustrated in "Terms"; although that article predated Skinner's development of the vocabulary of *Verbal Behavior*, these relations are implicit in it, and more is involved in it than simply the tacting of private events.

These and other aspects of operant behaviorism are discussed in the treatment that follow. For the commentators, the articles are the stimuli, their commentaries are the responses, and Skinner's replies are the consequences. For Skinner, the commentaries are the stimuli and his replies are the responses; some of the consequences will be evident only in the effects of the treatments on their readers. Other potential responses and consequences produced by these treatments are even more remote and also remain to be seen. To the extent that they may correct some misreadings of operant theory, they are steps in the right direction. Given that we have already taken more than a single step, our journey has begun. This is as it should be. There is much to explore and our journey will not be short.

Canonical papers of B. F. Skinner