

REVIEW OF B. F. SKINNER'S THE BEHAVIOR OF ORGANISMS¹

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As I reread my review nearly 50 years later, I think of the circumstances. I had heard a paper by Fred at the Ithaca meeting of the APA in 1932, and recall the praise by Edna Heidbreder, who was sitting next to me, whose remark was that "He has a clean mind." The year before his book appeared, I had already cited eight of his published papers in a review of the conditioned response in relation to conventional learning experiments that appeared in the *Psychological Bulletin* (1937, 34, 61-102). It may be because of that the editor sent me Fred's book to review.

When I received the copy of his new book to review, I read it carefully, and soon reported on it orally before Lewis Terman's weekly seminar to get comments and questions before revising my review. I was pleased by Terman's excitement over the originality of Fred's approach.

Skinner proposes a system for the convenient formulation of behavioral data, and then proceeds to describe experiments which test the system. The book represents the culmination of a program of research originally projected in a semihistorical doctoral dissertation at Harvard on the concept of the reflex. The experimentation, concerned almost exclusively with the lever-pressing activity of rats, began to appear in 1930. The book summarizes previous reports and adds new data. In order to estimate the success with which the author achieved his purposes, tentative answers to three questions will be attempted: (1) What are the chief characteristics of the system which he proposes? (2) Of what significance are the experimental findings, both as a validation of his system, and in relation to the problems of psychology conceived in other ways? (3) Is the system as formulated and supported experimentally likely to become a competitor to other existing systems of psychology? These are difficult questions, which cannot be answered confidently. Yet to ask any less significant questions would be to underestimate the task which the author set himself.

1. *The Nature of the System.* Skinner proposes what is strictly a science of behavior, therefore neither a mental science nor a neural science. His system is in this respect in keeping with current trends as represented, for example, in the writings of Guthrie, Hull, Lewin, and Tolman. In none of these systems is there

recourse to neuroanatomy. Skinner takes a firm stand in favor of descriptive positivism, against hypotheses. "A purely descriptive science is never popular. For the man whose curiosity about nature is not equal to his interest in the accuracy of his guesses, the hypothesis is the very life-blood of science" (p. 426). "Deductions and the testing of hypotheses are actually subordinate processes in a descriptive science, which proceeds largely or wholly without hypotheses to the quantitative determination of the properties of behavior and through *induction* to the establishment of laws" (p. 437). In this he is, of course, outside the trends currently popular in psychology.

Since the structure of a descriptive system is determined by its subject matter, it is pertinent to inquire how the subject matter is selected. It is evident that two influences have directed Skinner's choice of representative behavior. In the first place, he believes that the reflex is the analytical unit which makes possible the scientific investigation of behavior (p. 9). The reflex is not to be thought of in neural terms, however, but is to be defined as a correlation between stimulus and response. The choice of the reflex as the analytical unit determines the general formulation of the 'laws' which include after-discharge, temporal summation, refractory phase, facilitation, inhibition, conditioning, extinction, and so on. It is evident that the laws are not discovered or formulated entirely *de novo*, but derive largely from Sherrington, Magnus, and Pavlov. They are all redefined operationally to apply to behavior without neurological implication, and

¹ This review is reprinted from *Psychological Bulletin* (1939), 36, 121-125.

as so defined they are not the laws of spinal reflexes. As stated, they do not appear to the reviewer to be laws at all, but collections of variables probably correlated in such ways that laws might be looked for. To describe them as laws of behavior is like speaking of a 'law of moisture' or a 'law of sunshine' as laws of growth at the stage when little more is known than that moisture and sunshine favor growth. The 'laws' do, however, direct the inquiry, and hence are surrogates for hypotheses. The choice of the rat's lever-pressing for food as the representative reflex was probably dictated by the desire to show that precise relationships much like those of the neurologists could be validated within behavior which physiologists would not be tempted to call reflex.

It would be a mistake to give the impression that Skinner makes a careless use of analogy in calling a rewarded act a reflex or in adopting the physiologist's names for the laws which describe this act. His is a formal and sophisticated system, and when he does violence to the contemporary socially accepted concept of the reflex, he knows very well what he is doing. Definitions are given with extreme care.

The real significance of the selection of a rewarded act as the representative behavior apparently became clearer to Skinner as the experiments progressed, for one of the more important distinctions did not appear in the published reports until 1937. This is the distinction between *respondent* behavior, which, like an ordinary reflex, is *elicited* by a precise stimulus, and *operant* behavior, which is not elicited by identifiable stimuli but may be said to be *emitted*. This is the behavior, sometimes called random or spontaneous, important in trial-and-error situations such as that which Skinner studies. Respondent behavior is significantly correlated with antecedent stimuli; the relations into which operant behavior enters are different. It is operant behavior which is strengthened when lever-pressing is rewarded. It does not matter what caused the rat to depress the lever the first time; once the operant response has produced food, the operant is strengthened. When operant behavior is correlated with a stimulus, the situation always involves discrimination. The discriminated stimulus is really only a cue or occasion for the behavior, not a true stimulus to elicit the behavior. The distinction between respondent and operant has been implicit in Thorn-

dike's work all along, but it did not become explicit because the use of 'situation' to cover discriminated as well as eliciting stimuli permitted a spurious application of the stimulus-response formula. This clear distinction is perhaps Skinner's most significant conceptual contribution. He hopes to correct the disproportionate emphasis upon respondent behavior by basing all of his work on operant behavior. Having formulated laws after the pattern of reflex physiology, Skinner's problem is to validate and quantify the laws within operant behavior.

The respondent-operant distinction is an important one in setting up two types of conditioned reflex. Pavlov's variety is based on respondents, and because the correlation of response is with substituted stimuli, this is designated as Type S. Skinner's variety strengthens a response (an operant) by rewarding it, and to emphasize the response this is designated as Type R. Actually, Pavlov's experiments are not pure illustrations of Type S, but for expository purposes a fairly stereotyped description of Pavlov's experiment is used by Skinner. The distinction between these types is that made earlier by Thorndike between associative shifting and trial-and-error.

2. *The Experimental Data.* The bulk of the book is devoted to experimental findings in which the rate of response in the lever-pressing situation is correlated with many pertinent variables: drive, reinforcement, nonreinforcement, delayed reinforcement, periodic reinforcement, discriminatory stimuli, and differentiated response. The data are presented chiefly in the form of 148 figures, most of which are reproduced kymograph records. Many uniformities are demonstrated, confirming the position that lawfulness may be found in this situation. The result is lawfulness rather than new or reformulated laws. It is difficult to determine within a positivist system just what level of generality constitutes a law. The laws formally stated before the experimentation is reported are not resummarized after the data have been discussed. It is to be supposed that they were found adequate. If this interpretation is correct, the laws were merely definitions of variables to be investigated, and experimental verification means not that the laws are proved or disproved, but merely that the variables chosen were convenient to direct inquiry.

The real quantitative laws are not, then, the laws formally stated, but the equations which fit the reported curves in each specific instance. There is a uniformity about the eating rate under standard conditions which may be expressed by the law that $N = kt^n$, where N is the number of pellets eaten in time t , with k and n appropriate constants. This is never specifically called a law, but it is as near to one as any relationship which Skinner reports. There are many relationships of this kind which are important contributions both to the factual knowledge of behavior and to methodology in behavioral investigations. One or two illustrations may be added to indicate the richness of the data. After a single reinforcement (once receiving a pellet following lever-pressing), there follow a number of responses to the lever although pressing is no longer reinforced. This yields a characteristic extinction curve. Probably no other conditioning method provides as sensitive an indicator of the result of a single reinforcement. The concept of the 'reflex reserve' emerges, to be distinguished from momentary strength. The 'reflex reserve' is the potential number of responses to be made without further reinforcement: it might be called 'resistance to extinction,' in more conventional terminology, although this does not define it adequately. A further demonstration of considerable methodological interest is provided under the concept of 'periodic reconditioning.' When responses are reinforced every three minutes or every six or nine or twelve minutes, a characteristic uniform rate of responding results, represented graphically by a straight line of slope varying with the interval. The number of responses under standard conditions is relatively constant, say eighteen per reinforcement. This value is characterized as the 'extinction-ratio.' Because of the linearity of the response curve within periodic reconditioning, it is feasible to use this curve to test the influence of other variables, such as differences in drive. Periodic reconditioning is not to be confused with reinforcement at a fixed ratio. That is, if every tenth response is reinforced, the result is not uniformity of response, but acceleration. Ratios as large as one reinforcement for every 192 responses are reported; under these circumstances very high rates of responding occur, showing positive acceleration between reinforcements similar to that which would be predicted from Hull's

goal-gradient hypothesis. These few specimens can only suggest the great variety of relationships which have been explored, many of which are distinctly new and should be assimilated to the body of psychological knowledge.

3. *Estimate in Relation to Other Systems.* In choosing a representative sample of behavior, Skinner has been restricted by his bias in favor of the reflex. Having made the choice for operant behavior against respondent behavior he believes himself to have chosen more representative behavior than that usually chosen, i.e., by Sherrington and Pavlov (p. 438). Although he is outspoken in his denunciation of a science of behavior which subordinates itself to neural science, he is more conspicuously aware of neurologists and physiologists than of psychologists. Respondent behavior is, after all, not very prominent in Ebbinghaus, Freud, McDougall, the later Thorndike, Gestalt, and in many other behavioral systems less physiological than Skinner's. Had he chosen to modify their systems, rather than the systems of those working with reflexes, he might have developed an entirely different program, based on different representative behavior. It is interesting in this connection to note that he devotes a whole chapter to clarifying his service to neurology, with which he has broken, but he devotes only three pages specifically to the systems of other psychologists with which his work is coördinate. The statements about Lewin, Hull, and Tolman on these pages are intelligent, but cursory. Tolman's system is recognized as the nearest relative. Thorndike, another close relative, is ignored in this comparison.

It is unfortunate that Skinner did not do his readers the service of relating his system in greater detail to the experimental data of other investigators. His own comment is significant: "There is no implication whatever that this is the only important work that has been done in the field, but simply that I have had little luck in finding relevant material elsewhere because of differences in basic formulations and their effect on the choice of variables to be studied" (p. 47). If Skinner has been unable to relate his work to that of other investigators, how can a reader, coming fresh upon this new body of material, be asked to make the transitions? The difficulties in making the extensions of the system may result in the book's

being less useful, and perhaps less influential, than it ought to be.

That Skinner's task of going beyond his own experiment would not have been insurmountable is evident through the studies now beginning to appear from Hull's laboratory, in which Skinner's situation is used, but the results of

which are reported in accordance with more familiar conventions. The expedient of adding a second lever coordinates his situation with choice-point behavior, so important in other systems. It may be that these and related studies will result in bringing to Skinner's work the attention which it deserves.