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CONCEPT FORMATION AS A FUNCTION
OF OPERANT CONDITIONING

by
John R. Lawson

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and Associate Professor Gordon H. Henley

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APPROVED BY

DATE

Warren R. Baller

May 14, 1962

Gordon H. Henley

May 14, 1962

Robert W. Filbeck

May 14, 1962

Rex K. Reckewey

May 14, 1962

Howard E. Tempero

May 14, 1962

SUPERVISORY COMMITTEE

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CHAPTER I

INTRODUCTION

Definition of the Problem

In recent years, educational psychologists have become increasingly aware of the potential value of operant conditioning as a method that would lend itself readily, economically, and efficiently to the classroom setting. Evidence of this awareness may be seen in the ever-increasing number of articles on machine teaching and programmed learning that have been published in the professional literature during the past five years. Also, there are now seven companies manufacturing teaching machines in the United States and there are programs available for courses in almost every scholastic area from general psychology to foreign language.

The effects of operant conditioning on concept formation per se has, however, received almost no interest from educators or psychologists. It is to this problem that the present study is directed.

Purpose of the Study: It is the purpose of the investigations reported in the present study to evaluate the effectiveness of operant conditioning in the formation of concepts held by human subjects.

Theoretical Background

The central issue in the study of concept formation has been pointed out by Vinacke as follows: "We need to know what happens during the learning process to explain the acquisition of concept and also how the

resulting cognitive structures function in the mental activity of the individual." (1952, p. 98)

The issue of how concepts are acquired has been investigated only sparingly. The psychological literature reveals a paucity of empirical studies of concept formation. Underwood (1953) postulates three reasons for the dearth of research in the area:

"1 . . . many psychologists have felt that the process of thinking, being covert in nature, is somewhat beyond the reach of the experimental methods.

2 . . . the failure to get on with the experimental study of thinking may also reflect the procedural bias of many psychologists who prefer to start at the simpler level of behavior and work toward the more complex.

3. A third explanation for the status of research on thinking has been indicated by Heidbreder when she suggests that in most cases there has been a failure to ask effective questions. By effective questions she means those which are provoked by a theory, and those questions, it might be added, usually refer to the relationship between manipulable environmental conditions and changes in performance." (Pps. 431-432)

It should be noted that there has not been a complete lack of theorizing as to how concepts are formed. Bruner et al. (1956, p. 244) summarizes two theories of concept formation in the following statement.

"The principal psychological controversy has been between two views. There are those who urge that a concept psychologically, is defined by the common elements shared by an array of objects and that arriving at a concept inductively is much like 'arriving at' a composite photograph by superimposing instances on a common photographic plate until all that is idiosyncratic is washed out and all that is common emerges. A second school of thought holds that a concept is not the common element in an array, but rather is a relational thing, a relationship between constituent past processes."

Both views are dismissed as fruitless by these authors and a concept is defined as ". . . the network of inferences that are or may

be set into play by an act of categorization." (p. 244). The "common element" theory has been attacked by others including Dewey (1953, p. 157). Dewey's view is that concepts ". . . are general because of use and application, not because of their ingredients." A, perhaps, stronger statement is made by him in reference to common elements as he points out that "they (concepts) are not derived by taking a number of things, each of which is already understood and definite in meaning, and then comparing them one with another, point by point, until all different qualities are excluded and there remains a core which is common to all." (p. 155). Smoke also has argued against the common element hypothesis on the basis that it is oversimplified and states that "Concept formation is not such a process for it is both analytic and synthetic." (1932, p. 42).

Smoke contends the formation of concepts is a rational thing as indicated in the statement: "For the sine quo non of concept formation is response to relationships, not to some bare element." (p. 42). The composite-photograph or common-element theory does, however, predominate among psychologists and Vinacke (1952, p. 106) lists eight authors that explicitly state this view. The psychological literature is replete with definitions of the formation of concepts that include induction of common elements. Appropos of this, the following definitions should be cited. "The process of inductive concept formation, then, is the experiencing of one thing after another and the selective perception of certain aspects of the material as common to several

objects" (Leeper, 1951, p. 741). "Thus inductive concept formation requires that the individual recognize the common attributes among several objects and then supply it a name." (Deese, 1952, p. 270).

From a more purely theoretical point of view there are problems inherent in definitions of this kind. Bugelski has recently stated that: "The two-fold function of concepts or, rather, labels, is to permit grouping of many of some events or items on the basis of some common but specific features and on the other hand, to isolate or segregate specific items from a mass with some other features. The two-fold function was described as the process of abstracting (discriminating) and generalizing and the classical question about the hen and the egg occurred in this problem area. Do we first generalize and then abstract or vice versa?" (1960, p. 321). For purposes of the research described in the present study, a concept shall be defined as: a logical construct that may be used inter-personally. A concept is a logical construct that is transferrable through sign or symbol or both from situation to situation and is communicable from individual to individual. In this sense, a concept is not an esoteric idea. (After Heidbreder, 1946, p. 193).

Reinforcement:

The importance of the characteristics of reinforcement operations to the strengthening of a mode of behavior in the human organism has, in the last few years, received the attention of many psychologists

concerned with the practical as well as the theoretical aspects of learning. Porter, for example, writing about the conditions necessary for a contingency of reinforcement to be effective has said that:

" . . . certain conditions must be met: (a) reinforcement must take place immediately after a response has been made. . . . (b) the reinforcement must be made precisely contingent upon performance of the behavior that is being taught . . . (c) a sufficient number of reinforcements must be given." (1960, p. 270) Porter is referring to the reinforcement that does make machine learning successful; the rules, however, apply to all types of operant learning whether in animal or man. The fact that these conditions of reinforcement have been shown to apply to human learning situations is due principally to the work of B. F. Skinner. A review of the Skinnerian conditioning paradigm is necessarily deferred, but a statement made by Skinner concerning the role of reinforcement on changes that occur in the way in which humans behave does seem fecund to the present study. "The 'law of effect' has been taken seriously; we have made sure that effects do occur and that they occur under conditions which are optimal for producing changes called learning. Once we have arranged the particular types of consequence called reinforcement, our techniques permit us to shape the behavior of an organism almost at will." (1954, p. 94).

The way in which an organism is administered reinforcement may be classified in two primary categories or schedules. The first of these is temporal and reinforcement is adventitious upon some interval of time;