A Study of Acquisition of Stimulus Matching

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A STUDY OF ACQUISITION
OF
STIMULUS MATCHING

by

Stanley George Smith

A Thesis submitted to the
Faculty of the School of Graduate
Studies in partial fulfillment
of the
Degree of Master of Arts

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INTRODUCTION

Psychologists are becoming increasingly more interested in the technological development and systematization of procedures for the study of performance on abstract concept acquisition, (Malott and Malott, 1967; Malott, Malott and Svinicki, 1967; Cumming and Berryman, 1965). Recently this interest has been directed to the conditional discrimination of stimulus matching.

The procedure of stimulus matching is such that the stimulus relationships of the discriminative stimulus changes in relation to the stimulus context in which it appears. Thus a correct response cannot be made solely on the basis of a single stimulus, but must be made on the basis of the relationship between two or more stimuli (Lashley, 1938). Therefore in order to receive reinforcement, the subject must respond to the matching stimulus conditions.

One aspect of discrimination training is the occurrence of superstitious behavior. This form of behavior is defined as behavior strengthened through reinforcing contingencies not explicitly arranged, but nevertheless effective in increasing the strength or frequency of the behavior (Ferster and Skinner, 1957).
Research in stimulus matching reports the presence of superstitious behavior (Berryman, Cumming, and Nevin, 1963) but does not report patterns which could be correlated with each discrete matching stimulus and/or neglects it completely (Skinner, 1950; Ginsburg, 1957; Ferster, 1958; Ferster, 1960; Cumming and Berryman, 1961; Ferster and Appel, 1961; Cumming and Berryman, 1965). However, in the literature on delayed matching, Blough, (1959) noted that specific superstitious response topographies were generated to each stimulus matching complex. A stimulus complex is defined in keeping with Mechner's (1959) recommendation that the total energy input to an organism at any point in time or space be designated as a single stimulus or stimulus complex.

With the seemingly controversial position that superstitious behavior holds in the research literature, it would be advantageous to attempt to closely examine the superstition issue in discrimination training. It can be hypothesised that there exists a transitional period in which a number of different superstitious topographies occur all of which mediate the correct response; and that after this transitional period a specific superstitious response topography develops...
which can be related to a particular stimulus complex.

To date, the developmental analysis of superstitious behavior has usually been explored within a setting of non-contingent positive reinforcement (Skinner, 1958; Morse and Skinner, 1957). It would therefore seem advantageous to examine the development of superstitious responses to stimulus conditions associated with aversive consequences.

The present research was conducted in an attempt to advance the knowledge of conditions which may underlie acquisition of stimulus matching and to advance a new one-key procedure.
METHOD

Subjects:

Two naive, adult, white Carneaux barren hen pigeons were used. They were maintained at approximately 70% of their free feeding weight. The primary reinforcement used was grain. Water and grit were available in the home cage.

Apparatus:

The experimental chamber was a 10 in. x 10 in. x 10 in. sound attenuated Lehigh Valley operant conditioning pigeon chamber. The front panel of the chamber contained a food magazine and one .75 inch plastic response key. Stimulus presentations on the key were accomplished by a projection system (one plane digital display unit, model #10495 from Industrial Electronics Engineers) mounted behind the key. Each effective response produced auditory feedback by operating a microswitch. A solenoid operated hopper was programmed to present grain reinforcement to the pigeons for 3 sec. One 7 w lamp was used for general illumination of the experimental chamber. Presentation and timing of stimulus conditions were controlled by a
digital solid state programmer. Selection of stimulus presentation was determined by the experimenter; and all presentations were scheduled by using a table of random numbers. Data recording was accomplished by observations of the experimenter and programmer counters.

Preliminary Training Procedure:

The birds were first magazine trained. After initial training, they were shaped to peck a key with a horizontal white line projected on it. Once the key pecking response was well established a discrete trial procedure with a 10 sec. inter-trial-interval (ITI) of blank key, house light on, was introduced. A response to the blank key during the ITI recycled the 10 sec. clock and re-established the above contingencies. When behavior stabilized to the above experimental conditions, the stimulus component of horizontal line was changed to the matching stimuli, on a divided key, of red-red (R-R) or green-green (G-G) were reinforced with a 3 sec. access to grain. Preliminary training was terminated upon the achievement of a stable rate of behavior and the following day matching procedures were instituted.
Stimulus Matching Procedure:

In the stimulus matching procedure a number of new stimulus manipulations or changes were made. Figure 1 provides a schematic representation of the matching procedure.

The contingencies maintained were:

(1) An inter-trial-interval (ITI) of 10 sec. with the stimulus conditions of blank key, house light on, was programmed. A no response contingency was maintained during this period by recycling the 10 sec. clock should a response occur;

(2) A key peck to matching stimuli red-red (R-R) or green-green (G-G) produced a 3 sec. access to grain and at the termination of the 3 sec. the next ITI was started;

(3) A key peck to non-matching stimuli, red-green (R-G) or green-red (G-R) produced a 10 sec. timeout (TO) and at the termination of the TO the next ITI was started. The TO procedure consisted of a complete blackout of the experimental chamber and was used as an aversive stimulus (Leitenberg, 1965);
Figure 1. A schematic representation of the matching procedure.
ITI NO RESPONSE
10 SEC. CONTINGENCY
(BLANK KEY)
(HOUSE LIGHT ON)

RESPONSE
MATCHING STIMULI
(RED-RED)
(GREEN-GREEN)
REINFORCEMENT
3 SEC.
RECYCLES TO
NEXT ITI

RESPONSE
NON-MATCHING STIMULI
(RED-GREEN)
(GREEN-RED)
TIME-OUT
10 SEC.
CHAMBER BLACKED-OUT

NO RESPONSE
NON-MATCHING STIMULUS
3 SEC.
RECYCLES TO ITI

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(4) If the key peck to non-matching stimuli was inhibited by the subject, the presentation of the non-matching stimuli lasted only 3 sec. and at the termination of the non-matching stimuli the next ITI was started.

An experimental session was defined as 100 random stimulus presentations. There were 50 matching presentations of which 25 were R-R and 25 were G-G. Also presented were 50 non-matching stimuli consisting of 25 each of G-R and R-G. The criterion for learning was set at 40 or above inhibited responses to the non-matching stimulus presentations in one experimental session. All trials were used for data analysis.
RESULTS

The preliminary training procedure was effective in producing positive transfer of the no response contingency in the inter-trial-interval (ITI) to the stimulus matching procedure since neither bird responded in the ITI during the early sessions. Also both subjects responded to the matching stimuli presented.

Acquisition of inhibition to non-matching stimuli green-red (G-R) and red-green (R-G) are shown in Fig. 2. In Fig. 2 the total number of correct inhibited responses to non-matching stimuli per session are plotted. There were fifty possible inhibited responses in each session. As can be seen, matching performance was acquired by both subjects on or before the twenty-fifth session.

The total number of correct inhibited responses, for discrete non-matching stimuli, as a function of sessions are presented in Fig. 3. An analysis of these data showed that performance to non-matching stimuli was acquired first to one stimulus complex and then to the other. In bird 1, the first non-matching stimulus complex to which performance was acquired was red-green (R-G); then second to develop was green-red (G-R). Bird 2 acquired performance just the opposite of bird 1. First to be acquired by bird 2 was G-R and then R-G.
Figure 2. The total number of correct inhibited responses to non-matching stimuli per session for subjects B-1 and B-2.
Figure 3. Acquisition to discrete non-matching stimuli for subjects B-1 and B-2.
Another important fact noted was the role played by superstitious behavior in acquisition of stimulus control. Throughout the experiment superstitious responding was noted to occur in ITI. The superstitious topography was usually characterized by pecking motions just above the key. Experimental observations along with the above indicate that superstitious behavior also played a role in the performance of response inhibition to non-matching stimuli.

Observations showed that no inhibitory behavior was exhibited by the subject to the non-matching stimuli until an emission of some response had occurred which allowed the subject to avoid the aversive stimulation received in the time-out (TO). Once the first response had occurred and the contingency for responding to the non-matching stimulus was avoided, the subject tended to make a similar response shortly thereafter. In bird 1, to R-G, the first topography noted was a movement straight back from the key, a pecking motion, and the head stretched out to about 2 inches above the key. This topography gradually developed into pecking motions in the air near the key. The final superstitious component developed by bird 1 to mediate responding to R-G was a short movement to the
left and pecking behavior just beyond the edge of the key. For acquisition to G-R (also the second matching performance to develop), there was a short movement to the right by bird 1. In the initial development of this superstitious topography it was noted to have intermixed sequences of the R-G topography. That is, at the presentation of the stimulus G-R, the bird would sometimes move to the left following the same superstitious topography as R-G. Along with this a movement to the right was noted which gradually increased in the percentage of type of response made to G-R until it was the only topography used to mediate non-response to G-R. The final superstitious topography to G-R was a short movement to the right of the key with an eating like topography near the key's surround.

Mistakes to R-G were noted to be due to "runoff" of the superstitious chains. The subject, on some of the positive trials, would remain positioned to the right of the key in front of the magazine. At the presentation of R-G the subject would emit the superstitious response chain which was a movement to the left with a pecking component. This would cause the subject to pass on to the key emitting pecking behavior.

Similar patterns of superstitious behavior were
noted in performance of bird 2. For bird 2 no acquisition was noted, to G-R; (the first matching performance acquired) until a small movement to the left was observed. This superstitious turning left pattern to the stimulus G-R was gradually noted to increase until a final component of a 360° turn to the left was made by bird 2. In acquisition to R-G (the second matching performance to develop) bird 2, as had bird 1, developed initially an intermixed sequence of topographies which included the superstitious topography of performance maintained to presentations of the first non-matching stimulus acquired (in this case G-R). That is, at the presentation of R-G the bird was noted to emit the G-R topography and sometimes emit a movement to the right. The final superstitious behavior noted to R-G was a 360° turn to the right.
DISCUSSION

The results of this study clearly indicated that stimulus matching can be gained with a one key procedure. Results in the area of acquisition of non-matching stimuli showed that performance was acquired first to one stimulus complex before acquisition of the other. This differential acquisition indicates that the subject must isolate one piece of stimulus information from the total experimental stimulus environment before being able to acquire or isolate the information needed to develop performance on the second stimulus complex. It would seem as if the above was rather clearly shown in the results with the inverted order of acquisition to non-matching stimuli shown by both subjects (i.e. bird 1, R-G then G-R; bird 2, G-R then R-G). This inverted order makes it fairly safe to say that acquisitional behavior was not due to peculiarities within the apparatus or order of stimulus presentation.

Further results clearly indicated that superstitious behavior not only has transitional stages, but develops in specific patterns to particular stimulus complexes. This finding very strongly supports
the research on complex conditional discriminations reported by Blough, (1959). It would seem that superstitious behavior is extremely important to the development of matching behavior. If this is true one might conclude that we as researchers have missed the controlled development at a very crucial part of our research. That is we wait until some accident occurs within our design which allows the subject to acquire the performance we desire to study. Possibly we should program, as some pre-training procedure, controlled development of behavior which would be compatible with the acquisition of performance.

An attempt was made to advance the knowledge of acquisition of stimulus matching. The data revealed some rather interesting findings, but must be examined with caution when attempting to generalize from these data to data obtained from three key procedures.
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