An Analysis of the Role of Reinforcement Magnitude in the Transfer of Stimulus Control in a Receptive Discrimination Task

Beverly S. Adler
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AN ANALYSIS OF THE ROLE OF REINFORCEMENT MAGNITUDE IN THE TRANSFER OF STIMULUS CONTROL IN A RECEPTIVE DISCRIMINATION TASK

by

Beverly S. Adler

A Thesis
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Faculty of the Graduate College
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requirements for the
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AN ANALYSIS OF THE ROLE OF REINFORCEMENT MAGNITUDE IN THE TRANSFER OF STIMULUS CONTROL IN A RECEPTIVE DISCRIMINATION TASK

Beverly S. Adler, M.A.
Western Michigan University, 1980

The role of reinforcement magnitude in the transfer of stimulus control was analyzed using a delayed prompting procedure. A delay was gradually lengthened between the presentations of the relevant discriminative stimulus and an imitative prompt. During one condition, the contingencies of reinforcement were arranged such that the reinforcement available for anticipatory and prompt-controlled responses were equal. During another condition, responses which preceded delivery of the prompt were given more reinforcement than prompt-controlled responses. Two subjects were exposed to these conditions in the context of acquiring a series of receptive discrimination tasks. Results were inconclusive. Mean trials to criterion showed little variability for either subject. Percentages for correct anticipations as well as prompt-controlled responses were inconsistent under both conditions. However, use of the delayed prompting procedure produced high percentages of correct responding.
ACKNOWLEDGEMENTS

I want to acknowledge those individuals with whom it has been my good fortune to work during this study. Words cannot express my sincerest appreciation to Dr. Jack Michael for all his time, help and patience throughout. I would also like to express my gratitude to Dr. Arthur Snapper and Dr. Wayne Fuqua for their feedback and encouragement. I am grateful to Dr. Jane Howard and James Cowart for their highly valued advice. Many thanks go to Susan Corman, Stephan Brewer, and Heidi Wagstaff for their support, as well as their participation as reliability observers. Last, but not least, my deepest appreciation is extended to Dr. Leonore Loeb Adler and Dr. Helmut E. Adler for their "understanding" and reinforcement.

Beverly S. Adler
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WESTERN MICHIGAN UNIVERSITY, M.A., 1980
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INTRODUCTION

The scientific literature reports many studies in education which have investigated contingencies which would be optimal for learning. Skinner (1976) stated in About Behaviorism that the point of education is that "a teacher arranges contingencies under which the student acquires behavior which will be useful to him under other contingencies later on" (p. 202-3). During initial exposure to a standard discrimination-training procedure, the subject responds and obtains reinforcement in the presence of $S+$, and responds but does not obtain reinforcement in the presence of $S-$. Terrace (1963) developed a procedure whereby he developed stimulus control over 14 pigeons by progressively decreasing the difference between a pair of discriminative stimuli in transferring from a simple discrimination of color to a more difficult discrimination of the orientation of a line. His results demonstrated that a pigeon can successfully be trained to learn a red-green discrimination, as well as a discrimination between a vertical and a horizontal line, without making a single error. The crucial aspect of the fading procedure that results in errorless discrimination learning seems to be the slow transition from the easy to the difficult discrimination. Terrace's
experiment demonstrated that extinction was not necessary for the establishment of precise differential responding.

Studies in several areas of education have utilized this errorless training. Moore and Goldiamond (1964) studied six pre-school children who served as subjects in a task involving form discrimination. Three triangles differing in angle of rotation were used as stimuli. The task was a delayed matching to sample, which required the subject to select the one that matched the withdrawn sample. Fading procedures were involved in transferring stimulus control from brightness to form in an almost errorless sequence. Five pre-school children were the subjects in an experiment conducted by Powers, Cheney, and Agostino (1970). The stimuli to be discriminated in their research consisted of the colors red vs. red-orange. One group received traditional discrimination training, and another Terrace’s errorless training procedure. No child in the traditional group made the discrimination. Both subjects in the errorless condition were successful and made the transition to the final performance with very few errors. In another area of education, Haupt, Van Kirk, and Terraciano (1975) studied a nine year old girl and a ten year old boy in two procedures which gradually reduced the visibility of the answer to number-fact problems, with cellophane or tracing paper. The results yielded fewer errors and better retention over more conventional study and drill procedures.
The topic of reading has also received much attention. Egeland (1975) taught a group of 108 pre-school children to discriminate letters of the alphabet. Children were randomly assigned to one of the three training groups, where the discrimination problem was presented in a match to sample format. In Group 1, a relevant cue of the letter was highlighted, and for Group 2, an irrelevant cue was highlighted. Group 3 was taught to discriminate using a traditional reinforcement-extinction approach. The children in the first errorless-training group made significantly fewer errors on the two post-tests compared to the other two groups. Twelve nursery school children were studied by Corey and Shamow (1972). The subjects were assigned to one of two groups: fading or superimposition. Comparisons were made between reading programs that involved superimposition of correlated pictorial and printed stimuli, fading of the pictorial stimuli, and overt observing responses. The findings indicated that a fading procedure produced fewer errors than a superimposition procedure over a wide range of testing intervals. McDowell, Nunn, and McCutcheon (1969) compared a programmed method of beginning reading instruction utilizing cuing and subsequent fading, with a look-and-say technique where there were no cues to be gradually removed. Fifteen children attending kindergarten served as subjects. The programmed instruction procedure involved four major stages: 1) Echoic training of
the story, 2) Intraverbal training, 3) Fading pictoral stimuli, and 4) Fading intraverbal stimuli. The look-and-say group did not receive programmed reading material. The results showed a consistently low error percentage for the programmed group.

The errorless training procedure has also been utilized with retarded children. Touchette (1968) studied 14 severely retarded boys to determine whether a procedure to maintain stimulus control throughout training would be effective. The data indicated that retarded children who show no signs of learning a discrimination by trial and error can be taught by a program of graduated stimulus changes. Dorry and Zeaman (1973) conducted a study including 18 non-reading retarded children with an IQ range of 23 to 55. The goal of the study was to compare the effectiveness for retarded children of two modes of paired-associate vocabulary acquisition—fading vs. a standard method. The results demonstrated the superiority of the fading procedure over the non-fading method.

Another type of transfer of stimulus control was developed by Touchette (1971). He used a time-delayed prompting procedure that permitted observation of the moment at which each subject began responding on a new basis. His subjects were three severely retarded boys, each having IQ scores below 40. A red vs. white discrimination was used as a stimulus control baseline. Then, black figures were
superimposed on the red and white keys. Each correct response affected the next trial by delaying the onset of the red stimulus by an additional 0.5 seconds. Transfer of stimulus control to the figures was indicated when the subjects responded before the onset of the red stimulus.

The delayed prompting procedure has also been utilized in the area of education. Striefel, Bryan, and Aikins (1974) taught three mentally retarded adolescents a series of specific responses to specific verbal instructions. The function of their procedure was to shift control from motor stimuli (modeling by the trainer) to verbal instructions. Each correct response resulted in an increase of a delay between the instruction and the modeling on the next trial. The results showed a transfer of stimulus control for all three subjects. Functional relations were established between the verbal instructions and the corresponding motor behaviors. Johnson (1977) used errorless techniques to teach a multihandicapped adolescent to correctly identify animal cards, geometric shapes, and arithmetic problems. Stimulus control was transferred from the teacher’s physical prompts (pointing to the correct object) to verbal cues during training. Performance was better than 99 percent during learning. Howard (1978) analyzed the role of reinforcement density in the transfer of stimulus control with multihandicapped children. The subjects were taught a series of receptive discrimination tasks under three
schedules of reinforcement using the delayed prompting procedure. One contingency was arranged such that responses that anticipated the prompt were more frequently reinforced than responses which were prompt-controlled. During a second contingency, responses controlled by the imitative prompt were more frequently reinforced than responses which preceded delivery of the prompt. During a third condition, anticipatory and prompt-controlled responses were reinforced equally. Results showed that the transfer of stimulus control was more rapid under the condition which most frequently favored correct anticipations. Howard concluded that a critical variable in observing transfer of stimulus control, under some conditions, was the reinforcement available for anticipatory versus prompt-controlled responses.

The present experiment investigated another variable which may be relevant to the delayed prompting procedure's effectiveness in producing transfer. The purpose of this research was to examine the relation between reinforcement magnitude and the transfer of stimulus control.

It has been previously demonstrated by Staats, Staats, Schutz, and Wolf (1962) that reading behavior, when reinforced, is quickly brought under experimental control with enthusiastic participation. In their study, they presented six four year old subjects with a textual program consisting of 26 words arranged so that the word stimuli were
gradually combined into sentences and then short "stories". A large variety of reinforcers were used such as trinkets, edibles, and tokens. The results indicated that without reinforcement the acquisition of textual responses does not commence, or it quickly ceases. Lahey and Drabman (1974) taught 16 second grade students to read 30 words orally. One group of subjects received verbal consequences, while the other group received verbal consequences with token reinforcement. The results indicated that on the average, subjects in the no-token group took twice as many trials to reach criterion as did the token group.

In a pilot study conducted by this investigator using the delayed prompting procedure, magnitude of token reinforcement was varied under three conditions, similar to those used by Howard (1978). During Condition 1, the contingencies of reinforcement were arranged such that responses which preceded delivery of the prompt were reinforced with two tokens, while responses which were controlled by the imitative prompt resulted in one token. During Condition 2, responses which occurred after delivery of the prompt were reinforced with two tokens, while responses which preceded the prompt resulted in one token. During Condition 3, the reinforcement available for anticipatory and prompt-controlled responses was equal (two tokens). After four correct and consecutive responses the delay between the delivery of the verbal instruction and
the imitative prompt increased by 0.5 seconds—up to a maximum of five seconds. Criterion for mastery was nine correct anticipations within ten consecutive trials, for three consecutive sessions.

For the present study, Condition 2 was dropped, as it was considered inappropriate and useless in assessing mastery of the task. The gradual increase in the delay between the prompt and the subject's response was changed, as it was considered too slow, resulting in boredom with the task. The criterion for mastery was changed to a higher value in fewer consecutive trials, in order to accelerate the procedure. One subject was dropped from the pilot study due to behavior problems. The results from the pilot study were discarded due to the procedural difficulties mentioned above.

The current research tested for the presence of a functional relation between reinforcement magnitude, as determined by the number of tokens delivered, and the transfer of stimulus control with the delayed prompting procedure.
METHOD

Subjects

The subjects were two students at the Kalamazoo Valley Multihandicap Center, whose parents gave informed consent for them to participate. S1 was a 14 year old girl, who was diagnosed as mentally retarded (IQ: 3-4\$ standard deviations below the mean), physically impaired (cerebral palsyed and confined to a wheelchair), and speech and language impaired. S2 was a 15 year old boy, who was diagnosed as mentally retarded (MA: 5-3), emotionally impaired—exhibiting "autistic like" behaviors, and speech and language impaired.

S1 was not initially on a token economy, but had been token trained for, and participated in, an earlier research. S2 was on a token economy. These children were selected because they were under good verbal instructional control, did not present major behavioral problems, and the "receptive" discrimination tasks—related to reading—was an appropriate academic task for them.

Setting and Apparatus

The study was conducted at the Kalamazoo Valley Multihandicap Center during school hours in the Elementary
3 and 4 components. The sessions took place twice daily on an individual, or one-to-one basis. Each session was conducted for approximately 25 minutes. The experimenter sat across the desk, facing the subject, with the training stimuli placed in between.

The apparatus consisted of: flashcards of the training stimuli (4 1/2 in. x 2 in.), each with six printed letters one inch in height; tokens (2 in. x 1 in.); a mat, to be placed on top of the subject's desk (approx. 19 in. x 12 in.); data sheets; a stop watch; and a variety of "back up" reinforcements, such as dolls, cars, jig-saw puzzles, crayons, and coloring book, etc.

Procedure

Independent Variable

The independent variable in this experiment was the magnitude of token reinforcement for each of three types of correct responses: R1—correct responses which occurred prior to the delivery of the prompt, R2—correct responses which coincided with the delivery of the prompt, and R3—correct responses which occurred after the delivery of the prompt. There were two values of the independent variable as follows: Condition A: R1, R2, and R3 responses were reinforced on a continuous reinforcement schedule (CRF) with two tokens for each correct response. Condition B: R1 and R2 responses were reinforced on a CRF schedule with two
tokens, R3 responses were reinforced on a CRF schedule with one token.

After twelve words had been trained, the values of the independent variable were changed slightly, as follows: Condition A': remained the same as reported above. Condition B': R1 and R2 responses were reinforced on a CRF schedule with two tokens, R3 responses were reinforced with verbal praise only and no tokens.

**Discrimination Tasks**

The "receptive" discrimination tasks involved sight-words printed on flashcards. The words were selected from a dictionary on the basis of length and level of difficulty. Each word contained six letters, and was used based on the assumption that the word was not in the subject's verbal repertoire. The words were chosen so as to be similar in appearance, in order to ensure attention to the word as a unit, rather than to irrelevant features, such as different initial letters, or different lengths. Each new word was defined for the subject when it was first introduced. There were 12 words each for Conditions A and B, and six words each for Conditions A' and B'.

Training trials consisted of the presentation of four flashcards—the discriminative stimulus (SD) and three SA stimuli. The positions of the words were randomly alternated for each trial, using a table of random numbers. The subjects were trained to use a pointing response to
discriminate the first word within a group, while the other words within that group served as $S^\Delta$ stimuli. After reaching criterion for that discrimination task, that word served as $S^\Delta$ on a random basis during subsequent training within that condition. No word ever served as $S^\Delta$ for training in a different condition. That is, a word assigned to Condition A or A', would never serve as $S^\Delta$ for discrimination training during Condition B or B'. (See Table 1 for ordering and grouping of tasks for both subjects.)

Experimental Design

The experiment utilized the multi-element design, developed by Ulman and Sulzer-Azaroff (1975), which involves the repeated measurement of a behavior under alternating conditions of the independent variable. Subjects were exposed to Conditions A and B, or Conditions A' and B', on an alternating basis within two daily sessions. The condition in effect for the first session was alternated across experimental days. In order to increase the probability of the subjects discriminating the different sets of reinforcement contingencies, different stimuli were associated with each of the two different conditions. Training stimuli were presented on flashcards placed on the desk in front of the subjects. Different colored mats were placed on top of the subjects' desks, with the training stimuli placed on top of these backgrounds. In
### Table 1

Order of Training Stimuli and Contingencies in Effect During Training

<table>
<thead>
<tr>
<th>Task #</th>
<th>Condition A</th>
<th>Condition B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Falcon</td>
<td>Drawer</td>
</tr>
<tr>
<td>2</td>
<td>Falter</td>
<td>Drowsy</td>
</tr>
<tr>
<td>3</td>
<td>Feline</td>
<td>Dragon</td>
</tr>
<tr>
<td>4</td>
<td>Facial</td>
<td>Dredge</td>
</tr>
<tr>
<td>5</td>
<td>Finale</td>
<td>Dreary</td>
</tr>
<tr>
<td>6</td>
<td>Facile</td>
<td>Drudge</td>
</tr>
<tr>
<td>7</td>
<td>Gravel</td>
<td>Badger</td>
</tr>
<tr>
<td>8</td>
<td>Grovel</td>
<td>Bandit</td>
</tr>
<tr>
<td>9</td>
<td>Gopher</td>
<td>Bantam</td>
</tr>
<tr>
<td>10</td>
<td>Ginkgo</td>
<td>Banter</td>
</tr>
<tr>
<td>11</td>
<td>Ginger</td>
<td>Barter</td>
</tr>
<tr>
<td>12</td>
<td>Gimlet</td>
<td>Barium</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Task #</th>
<th>Condition A'</th>
<th>Condition B'</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lariat</td>
<td>Dahlia</td>
</tr>
<tr>
<td>2</td>
<td>Larynx</td>
<td>Dawdle</td>
</tr>
<tr>
<td>3</td>
<td>Lambda</td>
<td>Darnel</td>
</tr>
<tr>
<td>4</td>
<td>Lamina</td>
<td>Damask</td>
</tr>
<tr>
<td>5</td>
<td>Lament</td>
<td>Damsel</td>
</tr>
<tr>
<td>6</td>
<td>Latent</td>
<td>Damson</td>
</tr>
</tbody>
</table>
addition, different colored flashcards and tokens were used during each condition.

**Training Sessions**

Each trial began with the experimenter pointing to each of the four stimulus cards, saying "Look here", and then pointing towards the experimenter's eye. When the subject made eye contact, the experimenter provided the verbal instruction "Point to ____". All correct responses, regardless of whether an R1, R2, or R3, or what condition was in effect, were followed by verbal praise. Depending upon which condition was in effect, zero, one, or two tokens were delivered. Before the start of each session, the contingencies in effect for earning tokens under the particular condition were explained. Tokens were exchanged at the end of the session for a variety of "back up" reinforcements selected by each subject.

Initially, the delivery of the imitative prompt and the verbal instruction occurred simultaneously. After two correct and consecutive responses at this zero second delay, the delay between the delivery of the verbal instruction and the prompt increased by two seconds. Four correct responses were required to increase the next delay by one second (up to a maximum of five seconds). If the subject did not make a response before the delay was reached, the experimenter pointed to the correct stimulus.
card. If the subject made a response before the delay value was reached, the prompt was not delivered for that trial. All incorrect responses, regardless of which value of the independent variable was in effect, were followed by the experimenter saying "No", explaining the error, and removing the training stimuli from the desk and looking away from the subject and ignoring his or her behavior for five to ten seconds. Two consecutive, incorrect anticipations resulted in the value of the delay being decreased by one second. Four consecutive correct responses at the reduced delay value were again required to increase the delay by one second. Criterion for mastery was five out of five consecutive correct anticipations. If criterion was not reached by the end of the maximum five second delay value, that training stimulus was discontinued.

Data Collection and Reliability

For each trial during a session, data were collected on the type of response emitted: whether the response was (a) a correct anticipation (R1), (b) an incorrect anticipation, (c) correct and occurred simultaneously with the delivery of the prompt (R2), (d) an incorrect response which occurred simultaneously with the prompt, (e) a correct response which occurred after the prompt was delivered (R3), or (f) an incorrect response which occurred after the delivery of the prompt.

Reliability checks were made during 45% of all the
sessions. Reliability was calculated using the formula:

\[
\frac{\text{Agreements}}{\text{Agreements} + \text{Disagreements}} \times 100 = \% \text{ reliability}
\]

Inter-observer agreement during sessions with S1 ranged from 95% to 100%, averaging 99.4%. Reliability checks made during sessions with S2 ranged from 95% to 100%, averaging 99.5%. In order to ensure independence of observation, the experimenter did not consequate the subjects' responses (deliver tokens, praise, or remove the stimulus cards) on these trials, until the second observer signalled that he or she had recorded the response as one of the six types described above.
RESULTS

Trials to Criterion

Figures 1 and 2 show the total number of trials to criterion for each discrimination task for S1 and S2. Table 2A presents the ranges, means, and medians of trials to criterion for both subjects.

The results showed that S2 never mastered two words under Condition A and one word under Condition B. S2 consistently responded to all three words by waiting for the delivery of the prompt after he made one incorrect anticipation. Therefore, these words were discontinued after the fourth consecutive prompt-controlled response at the five second (maximum) delay.

The high amount of mean trials to criterion for S1 during Condition B' was due to one task which was mastered after 33 trials.

When the median number of trials are examined for both subjects, the data indicate that when reinforcement magnitude in Condition B' was made more different (two tokens vs. zero tokens), the discrimination tasks were learned in an almost equal number of trials compared to Condition A' (two tokens vs. two tokens). Since the median number of trials during Condition B' was slightly less
Figure 1. Total number of trials to criterion for each discrimination task.
Figure 2. Total number of trials to criterion for each discrimination task.
<table>
<thead>
<tr>
<th>Condition</th>
<th>S1</th>
<th>S2</th>
<th>Condition</th>
<th>S1</th>
<th>S2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>5-21</td>
<td>5-20</td>
<td><strong>Range</strong></td>
<td>5-24</td>
<td>5-23</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>8</td>
<td>13</td>
<td><strong>Mean</strong></td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>5</td>
<td>13.5</td>
<td><strong>Median</strong></td>
<td>5</td>
<td>16.5</td>
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<table>
<thead>
<tr>
<th>Condition</th>
<th>S1</th>
<th>S2</th>
<th>Condition</th>
<th>S1</th>
<th>S2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A'</td>
<td></td>
<td></td>
<td>B'</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>5-12</td>
<td>5-14</td>
<td><strong>Range</strong></td>
<td>5-33</td>
<td>5-13</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>9</td>
<td>9</td>
<td><strong>Mean</strong></td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>8.5</td>
<td>8</td>
<td><strong>Median</strong></td>
<td>7.5</td>
<td>7</td>
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<thead>
<tr>
<th>Condition</th>
<th>S1</th>
<th>S2</th>
<th>Condition</th>
<th>S1</th>
<th>S2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>83-100%</td>
<td>89-100%</td>
<td><strong>Range</strong></td>
<td>83-100%</td>
<td>79-100%</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>95.2%</td>
<td>96.9%</td>
<td><strong>Mean</strong></td>
<td>97.4%</td>
<td>95.5%</td>
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<table>
<thead>
<tr>
<th>Condition</th>
<th>S1</th>
<th>S2</th>
<th>Condition</th>
<th>S1</th>
<th>S2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A'</td>
<td></td>
<td></td>
<td>B'</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>83-100%</td>
<td>86-100%</td>
<td><strong>Range</strong></td>
<td>73-100%</td>
<td>92-100%</td>
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<tr>
<td><strong>Mean</strong></td>
<td>95.8%</td>
<td>96.1%</td>
<td><strong>Mean</strong></td>
<td>95.5%</td>
<td>98.6%</td>
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Table 2 Continued

C. Correct Anticipatory Responses

<table>
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<tr>
<th>Condition A</th>
<th>Condition B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>Mean</td>
</tr>
<tr>
<td>S1 63-100%</td>
<td>89.1%</td>
</tr>
<tr>
<td>S2 0-100%</td>
<td>54.1%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Condition A'</th>
<th>Condition B'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>Mean</td>
</tr>
<tr>
<td>S1 56-100%</td>
<td>77.8%</td>
</tr>
<tr>
<td>S2 64-100%</td>
<td>77.6%</td>
</tr>
</tbody>
</table>

D. Percent Prompt-Controlled Responses

<table>
<thead>
<tr>
<th>Condition A</th>
<th>Condition B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>Mean</td>
</tr>
<tr>
<td>S1 0-20%</td>
<td>6%</td>
</tr>
<tr>
<td>S2 0-89%</td>
<td>42.7%</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Condition A'</th>
<th>Condition B'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>Mean</td>
</tr>
<tr>
<td>S1 0-44%</td>
<td>18%</td>
</tr>
<tr>
<td>S2 0-33%</td>
<td>18.3%</td>
</tr>
</tbody>
</table>
than during Condition A', a trend toward slightly faster learning is possibly suggested.

**Percent Correct**

Table 2B presents, in percentages, the ranges and means of the total correct responses. The following formula was used to calculate the percentage of total correct responses:

\[
\frac{\text{Correct anticipations} + \text{Prompt-controlled responses}}{\text{Total responses} - 0 \text{ second delays}} \times 100 = \% \text{ total correct responses}
\]

The data indicate that the percentage of correct responses was quite high for both subjects across both conditions, leaving little opportunity for improvement under either reinforcement contingency.

However, when the percent of errorfree trials for each discrimination task is examined (although not presented), there appears to be a difference. S1 reached 100 percent for 67% of the tasks in both Condition A and A', respectively, while she performed with no errors in 83% of the tasks in both Condition B and Condition B', respectively. S2 performed without error in 58% of the tasks in both Conditions A and B respectively, but increased his error-free performance from 67% during Condition A' up to 83% during Condition B'. These data suggest that there may have been a functional relation between the reinforcement contingencies in effect and mastery without error,
although it could have been a general trend related to
time in the experiment.

Response Types

Given the high percentage of correct responses, only
data from two correct types of responses are presented
below. Neither subject emitted any simultaneous re­
sponses.

Correct Anticipations

Table 2C presents, in percentages, the ranges and
means of the correct anticipations. The following formula
was used to calculate the percentage of correct anticipa­
tions:

\[
\text{Correct anticipations} \times 100 = \% \text{ correct anticipations}
\]

\[
\text{Total responses} - \text{0 second delays}
\]

Though these data are inconsistent, it should be
noted that S2 showed a slight increase in average percent
of correct anticipations from 77.6% under Condition A'
when compared to 82.8% under Condition B'.

Figures 3 and 4 show the percent of anticipations,
correct and incorrect, for each discrimination task for
both subjects. The percentage of correct anticipations
for S2 increased with repeated exposure during Conditions
A and A', from 54.1% to 77.6%, as well as during Condi­
tions B and B', from 51.8% to 82.8%, suggesting a "learn­
ing to learn" phenomenon. This was not the case for S1
and may have been due to her previous exposure to the
Figure 3. Percent of correct and incorrect anticipations for each discrimination task.
Figure 4. Percent of correct and incorrect anticipations for each discrimination task.
delayed prompting procedure.

**Prompt-Controlled Responses**

Table 2D presents, in percentages, the ranges and means of the prompt-controlled responses. The following formula was used to calculate the percentage of prompt-controlled responses.

\[
\frac{\text{Prompt-controlled responses}}{\text{Total responses} - 0 \text{ second delays}} \times 100 = \% \text{ prompt-controlled responses}
\]

Though these data are inconsistent, it should be noted that S2 showed a slight decrease in average percent of prompt-controlled responses under Condition A' to Condition B'. In addition, the percentage of prompt-controlled responses decreased with repeated exposure during Condition A and A', as well as during Conditions B and B'.

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DISCUSSION

The term transfer as defined by Touchette (1971) refers to "the acquisition of stimulus control by a set of stimuli that have been paired with an unrelated set of stimuli already having control over the response being measured". The purpose of this research was to attempt an assessment of the role of reinforcement magnitude in the transfer of stimulus control with the delayed prompting procedure. Unfortunately, the results of the present study are inconclusive. The data for percentage of correct anticipations, as well as percentage of prompt-controlled responses were inconsistent under both conditions. In addition, there was little variability in mean trials to criterion for either subject from Condition A' to Condition B'. However, median trials to criterion were slightly less during the latter condition, suggesting a possible trend toward slightly faster learning.

Theoretically, the contingencies under which Conditions A or A' operate (two tokens vs. two tokens) should produce conservative responding, since there is no advantage to anticipate the prompt. An error in anticipation would result in the withholding of reinforcement, whereas reinforcement is a "sure thing" for the conservative

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(prompt-controlled) response, at an equal "pay off". It might be expected, therefore, that non-learning is being rewarded, since prompt-controlled responses do not demonstrate a mastery of the task. Following in this manner, the contingency operating under Condition B (two tokens vs. one token) would be expected to produce less conservative responding since the "pay off" for anticipatory responses has increased. It would also be expected that learning will now be rewarded, demonstrated by an increase in correct anticipatory responses. When the reinforcement magnitude is increased one step further as in Condition B' (two tokens vs. zero tokens), it would be expected to produce the least conservative responses and the fastest learning, compared to the contingencies mentioned above.

Another issue relating to the production of conservative responding is the production of errors. When an error is made, it leads to non-reinforcement (as well as mild punishing consequences in this study). The conflict becomes an important issue as the "pay off" increases in magnitude for anticipatory responding. If there are no errors in anticipation, the probability of conservative responses is low. However, if errors increase in frequency, then conservatism can also be expected to increase. Likewise, if errors decrease in frequency, then conservatism can also be expected to decrease.

This correlation can be used to help explain the mean

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percent of prompt-controlled responses emitted by S2. (See Table 2D). Under Condition A, an equal "pay off" contingency, his mean prompt-controlled responses were 42.7%, while under Condition B', a high "pay off" contingency, his mean conservatism decreased to 16.0%. In between, Condition B, his performance should have been higher than Condition B', but lower than Condition A responses. This was not the case, probably due to the higher percentage of errors made during Condition B. Under Condition A, S2 made 4.4% total incorrect anticipations. However, he made 6.3% total incorrect anticipations under Condition B, which he reduced to 2.2% under Condition B'. This corresponds to his conservative performance: as his errors increased under Condition B, his prompt-controlled responses increased, despite the higher "pay off" for anticipatory responses.

There was another factor which may have influenced the variable performance of S1. S1 was not initially on a token economy and only received tokens during the experimental session. This leads to the question of her motivation. Was she really motivated to earn as many tokens as possible for a "better" reinforcement, or was her primary interest in earning tokens, regardless of amount? She appeared to be just as excited whether she earned one or two tokens, as evidenced by her shrieks of joy. The contingencies were explained to her, but informal observations of her behavior suggested that she did not behave
under their control. The task rather became a game: whether she could respond before the experimenter, regardless of which condition was in effect. If this was the case, then her data must be viewed somewhat critically. For example, this information might help to explain why S1's results did not show an increase in mean percent correct anticipations from Condition A (89.1%) to Condition B (89.8%), and from Condition A' (77.8%) to Condition B' (74.5%). S1 made only 6% and 7.8%, respectively, prompt-controlled responses though she emitted 7.5% and 3.9%, respectively, total incorrect anticipations under Conditions A and B, respectively.

As she came under the control of the token economy, her conservatism increased. S1 emitted 5.6% and 13.0%, respectively, total incorrect anticipations, while at the same time, she increased her mean prompt-controlled responses to 18.0% and 20.8%, respectively, under Conditions A' and B', respectively. That is, as her errors increased, so did her conservatism. It may be the case, that her motivation was also changing.

An important issue to determine the effectiveness of reinforcement magnitude in future research with subjects not initially on a token economy, might be to establish stronger control in the beginning of the experiment. There might have been a larger effect with S1 if she had traded her tokens in more frequently for her reward, rather
than at the end of the 25 minute session.

It is also possible that the multi-element design might not have been the best suited for this study. Although the stimuli associated with each condition were in a different color and the different amount of tokens available were explained to the subjects, it is quite likely that they did not come under control of the different contingencies. Rather than alternating the conditions, it is possible that if one condition was presented for a period of time, discontinued and then the next condition was put into effect for an equal length of time, that the children might have responded differently. The data indicated that the use of the delayed prompting procedure was suitable in this case since it produced high percentages of correct responding.

It is left to additional investigations into the effectiveness of reinforcement magnitude, to determine whether increasing the tokens available to three, four, or five vs. one token will produce more dramatic results.

In summary, this study does not settle the issue whether there is a functional relation between the role of reinforcement magnitude in the transfer of stimulus control. Several factors may have contributed to the present results: a subject not under the control of a token economy, a subject avoiding punishing consequences due to incorrect anticipations, and/or a poor experimental design. The
variable of reinforcement magnitude for anticipatory vs. prompt-controlled responses is a worthwhile topic to pursue and is deserving of further experimental attention.
BIBLIOGRAPHY


