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The Effects of Stimulus Repetition on Performance of a Discrimination Task

Nancy A. Neef
Western Michigan University

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THE EFFECTS OF STIMULUS REPETITION
ON PERFORMANCE OF A DISCRIMINATION TASK

by

Nancy A. Neef

A Thesis
Submitted to the
Faculty of The Graduate College
in partial fulfillment
of the
Degree of Master of Arts

Western Michigan University
Kalamazoo, Michigan
December 1975

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Nancy A. Neef
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CHAPTER I

The Problem and Its Background

While administering a training procedure for an object discrimination task on an early edition of the Language Acquisition Program (LAP), (Kent, 1972), an unexpected learning difficulty was encountered. The children being trained were able to correctly give the trainer any one of three objects in the presence of the other two when asked to do so, but some had difficulty in selecting combinations of two objects when asked to do so. The children readily gave the trainer two objects, but on only about 50% of the trials in any one session were the two objects given, the two objects requested, even after extensive training. Incorrect responses did not appear to be related to the relative position of the objects nor the order in which they were requested.

Winter (1973) sought to explore the nature of the learning problem in several studies. The results of a preliminary single subject study suggested that accuracy was facilitated when trials involving pairs of objects commonly associated together (e.g., shoe and sock, brush and comb) were alternated with trials involving unrelated object pairs (e.g., shoe and comb). The results of a second larger pilot study suggested that the facilitation effect was a function of alternation of a relatively easy task (related object pairs or one object at a time) with a more difficult task (unrelated object pairs), rather than the alternation with related object pairs per se.
In an attempt to explore possible explanation for the results of the pilot studies, a third study was conducted examining the effect of temporal separation of trials on performance. Test trials, requiring the subjects to select a color pair from a set of three differently colored cubes, were alternated with one of the other of four treatment conditions: (a) a 15 second delay period, (b) a single color cube selection task, (c) an unrelated paper and pencil task, and (d) trials identical to the test trials or a no alternation condition. Tokens were used as reinforcers and density of reinforcement was allowed to vary with correct responses; at the end of the sessions tokens were exchanged for edibles. The results supported those from the previous pilot studies; accuracy of performance appeared to vary as a function of (a) the separation of trials by time, (b) alternation with an unrelated paper and pencil task, and (c) alternation with a related but less difficult task.

Research has shown that although few people can accurately reproduce a conversation just heard, fragments are "remembered" (Bartlett, 1932). Possibly then, performance might be enhanced by continuous repetition by the trainer of the verbal discriminative stimulus or instruction, during the task, until the selection has been made, thereby eliminating the delay between the presentation of the stimulus and the response. Indeed, Skinner (1957) maintains that repetition, a self echoic prompt, is a self strengthening device of verbal behavior, and cites an example when "... in looking for a name in a telephone directory, we keep repeating the name as we run down the list" (1957, p. 406).
According to Estes (1970), there appears to be a relationship between discrimination learning and rehearsal tendencies, which vary widely among individuals of differing intellectual levels; and effective rehearsal strategies should facilitate discrimination learning. "In verbal learning and recall... improvements in learning or retention of various degrees of specificity may result from the acquisition of rehearsal and organizing strategies and by means of verbal rehearsal the human learner can greatly extend the effective short term memory function" (1970, p. 16).

In agreement with Estes, Wickelgren (1974) states, "Rehearsal aids both short term and long term retention by increasing the degree of learning of the material being rehearsed" (1974, p. 101). Various studies support this indicating an increase in "memory" performance as a function of rehearsal (Kingsley and Hagen, 1969; Belmont and Butterfield, 1971). The results of the latter study suggest that retarded children are less likely than normal children to practice rehearsal in a "short term memory" task, but when instructed to engage in a rehearsal strategy similar to that of normal children performed significantly better.

Alternately, Estes presents the possible explanation that the facilitation of "memory storage" is a function of labeling responses. "If a learner, who on a given trial has perceived a relation between a certain stimulus property and the reward of an instrumental response based on it, has available a labeling response corresponding to the stimulus property, he will be in a position to rehearse this relationship following the trial and thus to facilitate recall of this
relationship at the start of a later trial in which the same stimulus pattern occurs. Then, on the later trial, if the labeling response is recalled upon presentation of the stimulus, this response could serve to direct attention to the relevant cue, thus increasing the likelihood that the instrumental response would be based on this cue rather than an irrelevant one."

If it is the case that rehearsal strategies facilitate task performance, it might be expected that those subjects who are able to verbalize the instruction themselves would be able to remember it for a longer period of time and therefore perform better on a discrimination task than those subjects who cannot verbalize the instruction. Estes (1970) cites a study which indicated that for children in the "imbecile" range, there existed a relationship between the ability to name colors and the rate of learning a color discrimination.

The present set of studies attempts to investigate the effect of training with immediate auditory verbal repetition of the discriminative stimulus \( S^D \), or instruction on accuracy of performing the task of selecting a pair from a set of four different items on verbal command is explored. In addition, labeling and verbal imitative tendencies of all subjects were assessed.
CHAPTER II
Methods and Results

Each of the following related studies was a follow-up of the study preceding it. Therefore, the methods and results of each of the three studies are presented in the order in which the studies were conducted.

STUDY I
Method

Stimulus material
The stimuli consisted of nine one inch cubes, each a different color: red, blue, green, yellow, black, white, orange, brown, and purple.

Subjects
Subjects (Ss) were selected from children diagnosed as mentally retarded from two special education programs in the Kalamazoo Valley Intermediate School District; the Kalamazoo Valley Multihandicap Center and the Day Training Center for the Severely Retarded.

Procedure
Possible candidates were administered a four part evaluation on which they were required to meet two criteria in order to serve as Ss.

The first part of the evaluation involved the child's being able to select a color cube named by the experimenter (E) in the
presence of eight other individually colored cubes. On each trial E arranged all nine cubes on a table and the child was instructed to give E a specified one of the cubes. A correct response was defined as S handing E the cube requested, leaving the remaining eight cubes on the table. All correct responses received reinforcement. Three randomized trials were presented for each of the nine color cubes, comprising 27 trials. To qualify as a subject, the child was required to select the correct color cube on all three trials for each of two colors and on at least one of three trials for two other colors.

In the second part of the evaluation the child was instructed to give E two designated cubes from a set of four differently colored cubes. For each of 27 trials for a given child, the color set consisted of the four color cubes which were selected correctly most often as determined by the first part of the evaluation; thus the color set used was determined individually for each child. For instances in which more than the necessary number of colors qualified equally, the color cubes used were selected randomly from these. For each trial, the color pair requested consisted of the two color cubes which were selected correctly most often, as determined by each child's performance on the first part of the evaluation. The order in which the two colors were requested was randomized. A child was required to respond correctly on no more than 55\% of the color pair trials in order to serve as an S.

In a third part of the evaluation, the labeling tendencies of the children who met the above criteria were assessed. Two trials were presented for each of the two color cubes which were selected
correctly most often in the first part of the evaluation, for each individual S. E placed one of the color cubes on a table in front of the S and said, "Tell me all about this." A correct response was defined as a distinguishable verbal approximation of the color name of the cube presented. Each trial was followed by a five second interval. All correct responses received reinforcement. Ss who named the color correctly on 75% of the trials or more were classified as having a strong expressive labeling tendency. Following each incorrect response, E asked, "What color is this?". All correct responses received reinforcement. Ss who named the color correctly on 75% or more of these trials were classified as having a weak expressive labeling tendency. Ss who named the color correctly on less than 75% of the trials were classified as having no expressive labeling tendency.

Finally, each S who met the criteria for inclusion in the study was assessed with respect to his echoic tendencies. For each of three separate trials, E instructed S, "Say 'coat'", "Say 'tree'", "Say 'dog'". Words imitated correctly were recorded as echoic responses.

Out of twenty-five candidates, only two met the criteria for subjects: (a) able to select the individual color cube requested on all three trials for each of two colors and on at least one of three trials for two other colors, and (b) able to select two designated cubes from a set of four differently colored cubes on no more than 55% of the trials. The two children selected as Ss were Brian, a 12 year old boy, diagnosed as deaf, emotionally disturbed, and mentally retarded, with an IQ of 58, and David, an 8 year old boy,
diagnosed as speech impaired, emotionally disturbed, and mentally retarded, with an IQ of 58.

Procedure

Both Ss participated in each of two different training procedures but in opposite order.

Training Procedure I: Single statement of the verbal stimuli (nonrepetition). On each trial E arranged the four color cubes on a table and instructed S to "Give me ____ (color) and ____ (color). A correct response was defined as S handing E the two specified cubes while leaving the remaining two on the table.

Training Procedure II: Repetition of verbal stimuli: This condition was identical to Training Procedure I, with the exception of the repetition of the verbal stimuli. E instructed S to "Give me ____ (color), and ____ (color), ____ (first color requested, ____ (second color requested)...", repeating the two colors until a response was made, for 30 seconds or 10 repetitions.

Each session consisted of 24 trials, which were constructed from the color set used in the second part of the evaluation with each individual S. Each trial was separated by a 5 second interval.

David was first presented with a single statement of the verbal stimuli, for 10 sessions or until he responded correctly on 22 out of the 24 trials for 3 consecutive sessions, followed by repetition of the verbal stimuli for 10 sessions or until criterion was reached. For the other S, Brian, repetition of the verbal stimuli was presented for 10 sessions, or until the specified criterion was met, followed by a single statement of the verbal stimuli for 10 sessions or until criterion was reached.
The position of the four color cubes for each trial was randomly predetermined before each session and recorded on a chart. Following each trial, E recorded on the chart the position of the color cubes selected by S.

To check reliability, an independent observer observed randomly selected sessions for each subject through closed circuit television in which the sound had been turned off. He was issued a copy of the chart and recorded the position of the color cubes selected by S for each trial, in the same manner as E.

Individual S data were summarized for each S for each session under each treatment condition using percent of triads correct in each session as the dependent variable. The data were evaluated to determine whether the number of correct responses increased for both Ss during the repetition conditions, and whether the Ss' ability to label items or imitate words appeared to be related to the performance of the task. In addition, the color and position of the cubes selected by each S was examined to investigate possible systematic response patterns.

Motivational system

During the pretests and the training sessions, Ss received reinforcement for correct responses on test trials. A trial began with the instruction by E and terminated when S handed E two color cubes, or when 10 repetitions or 30 seconds had elapsed. A 4 X 6 grid was constructed on a sheet of cardboard, containing one square for each of the 24 trials per session. Following each correct response, a token was placed on the appropriate square in view of
the child. A token economy had previously been established with both Ss. Following each session, the Ss were given the tokens on the grid. Each token was exchanged for one M&M candy.

Results

Inter-observer reliability was measured by a comparison, trial by trial, of the observer's data sheet with that of the experimenter. Reliability was calculated by dividing agreements by agreements plus disagreements and multiplying by 100. Inter-observer reliability was 100% for each of the sessions during which observer agreement was assessed.

The percent of correct responses per session across experimental conditions for Brian is presented in Figure 1. The percent of correct responses increased from 0% during baseline (one session consisting of the second part of the screening evaluation), to a mean of 92.6% during the repetition condition (R1). During the nonrepetition condition (NR1), the percent of correct responses immediately decreased to 0% and then steadily increased to 96%, with a mean of 62.5%. A return to the repetition condition (R2) shows the percent of correct responses ranging from 79% to 100%, with a mean of 91.8%. A return to the nonrepetition condition (NR2) resulted in a mean of 94.2%.

Figure 2 represents the percent of correct responses per session across experimental conditions for David. During baseline and the following nonrepetition condition (NR1), the percent of correct responses remained at 0% except for a slight increase to 4% during the ninth session. There was an immediate increase to a mean of 98.6% during the repetition condition (R1), with a range from 96% to
FIGURE LEGEND

Figure 1: The percent of correct trials across repetition and non-repetition experimental conditions for Brian.
FIGURE LEGEND

Figure 2: The percent of correct trials across nonrepetition and repetition experimental conditions for David.
100%. During the following nonrepetition condition (NR2), the percent of correct responses remained stable, with a mean of 99% and a range from 96% to 100%.

Further analysis of the data reveals that Brian and David were no more likely to spontaneously imitate the color names in the repetition condition than in the nonrepetition condition. Across all sessions, both Ss were more likely to emit spontaneous imitation of one color than to emit spontaneous imitation of two colors. Trials on which they spontaneously imitated both color names were more likely to be correct than trials on which they imitated only one color name or none at all.

In addition, the data from the initial screening indicated that both Brian and David had strong expressive labeling tendencies for both colors; and they both consistently imitated two of the three words presented on command.

Discussion

The results of this study suggest that repetition of the verbal discriminative stimulus by the experimenter facilitates performance on a color discrimination task. Both Ss in the present study showed an increase in accuracy of performance immediately after the repetition condition was introduced, both when it was instituted for the first time and when it followed the nonrepetition condition. The continued high level of performance across experimental conditions indicates that once the discrimination was acquired, it was maintained. However, once the subjects learned the correct response and were
able to give the experimenter the two color cubes requested, the
response was often made before the instruction was given. The possi­
bility therefore existed that the subjects were attending to the ver­
bal discriminative stimulus, or instruction, because the two objects
requested were always the same. To control for this possibility, a
second study was conducted in which different permutations of object
pairs were requested, thus varying the verbal discriminative stimulus
from trial to trial. Because additional Ss who qualified for the
color discrimination procedure could not be found at the Multi­
handicap or Day Training Centers, common objects were used instead
of color cubes in Study II.
STUDY II
Method

Stimulus material
The stimuli consisted of nine objects: a toothbrush, key, spoon, car, cup, paper, crayon, comb, and shoe.

Subjects
The same candidates used in the first study were screened according to a four part evaluation similar to that used in Study I.

Possible subjects were required to select an object named by the E in the presence of eight other objects on three out of three trials for each of two objects and on at least one of three trials for two other objects. In the second part of the evaluation, the child was required to give E two designated objects from a set of four objects, responding correctly on no more than 55% of the trials in order to qualify as a subject. All permutations of the four object pairs were randomly requested rather than just one pair as in Study I.

Labeling tendencies of Ss were assessed by asking them to verbally identify two items, as in Study I. In addition, the ability of the Ss to imitate words that E presented ("coat", "tree", and "dog") was assessed.

Using the above criterion, five candidates qualified as Ss. Paul was a 9 year old boy, diagnosed as trainable mentally retarded, IQ untestable. Bradley was a 13 year old boy, diagnosed as emotionally disturbed, speech impaired, and severely mentally retarded, with an IQ of 35. David, who had served as an S in Study I, was a 6 year
old boy, diagnosed as emotionally disturbed and severely mentally retarded, with an IQ estimated at 58. Lori was a 13 year old girl, diagnosed as severely mentally retarded, with an IQ of 30 on the Stanford-Binet. Laura was a 12 year old girl, diagnosed as speech impaired, Down's Syndrome, and severely retarded, with an IQ below norms (20) on the Stanford-Binet.

Procedure

There were two treatment conditions: (a) single statement of the verbal stimuli (nonrepetition or NR), and (b) repetition of verbal stimuli (R). Following baseline (one 24 trial session consisting of the second part of the screening evaluation), Ss were first presented with the repetition treatment condition for at least five sessions or until a criterion was met, specified individually for each child. The nonrepetition condition followed, for five sessions or until criterion was reached, followed by at least one reversal of each of the treatment conditions. In each session, 24 training trials were followed by 10 consecutive test trials, in which the object pairs were requested once, as in the nonrepetition condition. (For the nonrepetition condition, test and training trials were therefore identical.) The purpose of the test trials was to determine whether any facilitative effects during repetition treatment would be maintained when treatment was discontinued.

Interobserver reliability was measured by a comparison, trial by trial, of the observer's data sheet with that of the experimenter. Reliability was calculated by dividing agreements by disagreements and multiplying by 100.
Motivational system

During pretests, training trials, and test trials, Ss received reinforcement for correct responses. A trial began with the instruction by E and terminated when S handed E two objects, or when 10 repetitions or 30 seconds had elapsed. Following each correct response, a token was placed in the S's token can, in view of the child. A token economy had previously been established with both Ss. Following each session, each token was exchanged for one M&M candy.

Results

Inter-observer reliability was 100% for each of the sessions during which observer agreement was assessed.

The dependent variables across experimental conditions were the percent of correct responses made during each session on the 24 training trials and the percent of correct responses made during each session on the 10 test trials. The mean percent of correct responses on training trials and on test trials across experimental conditions for all Ss is shown in Table 1; the percent of correct responses per session is displayed in Figures 3-7. The initial testing data with respect to expressive labeling tendencies and echolalic responses are presented in Table 1.

With respect to training trials, the data for Paul show increases in accuracy of performance during the repetition conditions. Accuracy of performance either decreased slightly or remained stable during the nonrepetition conditions. On the test trials, the percent of correct responses gradually increased across all successive treatment conditions.
Table 1

Mean Percent of Correct Responses on Training Trials and on Test Trials Across Experimental Conditions and Labeling Tendencies and Echoic Responses

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<td>33.3***</td>
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*Definition of labeling tendencies is presented on page 7.
**Definition of echoic response categories is presented on page 7.
***Special condition described on page 32.
FIGURE LEGEND

Figure 3: The percent of correct training trials and test trials during repetition (R) and nonrepetition (NR) conditions for Paul.
FIGURE LEGEND

Figure 4: The percent of correct training trials and test trials during repetition (R) and nonrepetition (NR) conditions for Brad.
FIGURE LEGEND

Figure 5: The percent of correct training trials and test trials during repetition (R) and nonrepetition (NR) conditions for David.
FIGURE LEGEND

Figure 6: The percent of correct training trials and test trials during repetition (R) and nonrepetition (NR) conditions for Lori.
FIGURE LEGEND

Figure 7: The percent of correct training trials and test trials during repetition (R) and nonrepetition (NR) conditions for Laura.
Spontaneous imitation of either or both of the objects requested increased during the nonrepetition conditions and decreased during the repetition conditions. Trials on which Paul spontaneously imitated object names were more likely to be correct than trials on which spontaneous imitation did not occur. The percent of trials on which spontaneous imitation occurred and on which the objects were also selected correctly was 100% across all experimental conditions, and there were no incorrect trials on which both object names were spontaneously imitated. For incorrect trials on which only one of the object names was spontaneously imitated, the object which was imitated was usually selected correctly.

With respect to training trials, the data for Brad show increases in accuracy during the repetition conditions and decreases in accuracy during the nonrepetition conditions. With respect to test trials, accuracy of performance increased during the repetition conditions and either decreased or remained stable during the nonrepetition conditions. Brad did not spontaneously imitate the object names on any of the trials.

With respect to the training trials for David, the level of performance increased immediately during the first repetition condition and was maintained at a high level during all successive conditions. The same trend was evidenced in the test trial data. The trials on which David spontaneously imitated one or both object names were more likely to be correct than trials on which he did not imitate the object name(s). The percent of trials on which spontaneous imitation occurred and on which the objects were also selected correctly was
100% across all experimental conditions, and there were no incorrect trials on which both object's names were spontaneously imitated.

For Lori, the percent of correct responses on training trials increased during the repetition conditions and decreased during the (alternate) nonrepetition conditions. With respect to test trials, the data show an increase in accuracy across all experimental conditions with the exception of the final nonrepetition condition during which there was a significant decrease. For Lori, there did not appear to be any relationship between imitation of the verbal discrimination stimulus and the experimental conditions; nor did there appear to be a relationship between imitation of the verbal discrimination stimulus and the percent of correct trials.

For Laura, the level of performance on training trials increased during the first repetition condition and decreased during the single session of the nonrepetition condition. Performance again increased during the second repetition condition, but remained fairly stable at a relatively low level. Because of her poor performance, the procedure was altered during the last three sessions: only one object was requested and this verbal discrimination stimulus was repeated as in the repetition condition. Performance increased slightly.

On the test trials the percent of correct responses was 0% during baseline, the first repetition condition (R1), and during the one session of the nonrepetition condition (NR1). There was an increase during the second repetition condition (R2) which remained fairly stable across the next two conditions, NR2 and R3, respectively. An
increase in accuracy occurred during the special condition described above in which only one object was requested.

For Laura, the percent of trials in which spontaneous imitation of the verbal stimulus occurred varied from 0-8% across all sessions and experimental conditions for both test and training trials. Trials on which Laura spontaneously imitated object name(s) were apparently no more likely to be correct than trials on which spontaneous imitation did not occur.

Discussion

The results of Study II support the finding of Study I that repetition of verbal discriminative stimuli facilitates accuracy of performance on a discrimination task. Four of the five Ss in the present study showed an immediate increase in accuracy of performance on both training and test trials during the R1 condition. For one S, Laura, an increase did not occur until the R2 condition. In general, the greatest increases in accuracy of performance for both training and test trials occurred during the repetition conditions. One exception occurred during NR2 for Lori: accuracy decreased during the training trials, and increased during test trials.

For Laura, after an initial increase during the R2 condition, accuracy of performance remained fairly stable and relatively low across all conditions. One possible explanation for this is that the facilitative effects of repetition may be limited if repetition does not result in a fairly rapid increase in accuracy of performance, thereby providing sufficient density of reinforcement to maintain correct responding.
For two of the Ss, Paul and David, the discrimination, once acquired, was maintained, even across the NR conditions on both training and test trials. For two other Ss, Brad and Lori, accuracy of performance decreased during the NR conditions for both training and test trials (with the exception of NR1 test trials for Lori), suggesting that the facilitative effect of repetition was not yet being completely maintained across the NR conditions.

It is interesting to note that for the two Ss with whom the discrimination was maintained, 100% of the trials in which the verbal discriminative stimulus was imitated were correct. In addition, both Ss emitted echoic responses for most of the words presented and had strong labeling tendencies for most of the objects used. This is consistent with the data for the Ss in Study I. Of the two Ss, Brad and Lori, for whom accuracy of performance was not maintained during the NR conditions, neither emitted echoic responses for any of the words presented. In addition, Lori showed no labeling responses; and Brad showed strong labeling tendencies for only two of the four objects. The percent of trials in which both the verbal discriminative stimulus was imitated and the objects requested were selected correctly, was relatively low: 0% for Brad and 65% for Lori. Laura, the one S for whom accuracy of performance did not increase significantly, inconsistently emitted echoic responses for only one of the three words presented. The percent of trials in which both the verbal discriminative stimulus was imitated and the objects requested were selected correctly, was a relatively low 34%. For three of the
four Ss who emitted spontaneous imitative responses, imitation appeared to facilitate performance.

For David, a high level of performance occurred relatively quickly and was maintained. This may have been due to possible generalization effects from Study I since he served as a S in both studies.

The findings of the present study are consistent with the contention of Estes and others that difficulty in learning a discrimination may be due to a "short term memory" deficit and that rehearsal facilitates discrimination learning. The results of this study demonstrate that when the delay between the presentation of the verbal stimulus and the response is reduced through repetition or rehearsal of the verbal discriminative stimulus by the experimenter, accuracy of performance is increased. Furthermore, the results of the present study suggest that maintenance of accuracy of performance occurs more quickly for Ss who emit imitative and labeling responses. Presumably, these Ss would be more likely to engage in rehearsal strategies without prompting through repetition of the verbal discriminative stimulus by E.

It is possible that accuracy of performance might be further enhanced by alternating the repetition and nonrepetition conditions on a trial by trial basis, thereby increasing the density of reinforcement. Another possibility would be to alternate repetition training trials with trials on an even simpler task, in which only one item is requested. The efficacy of this is supported both by the previously mentioned study by Winter (1973) in which accuracy of performance
appeared to be facilitated by interspersion of a related but less
difficult task, and by the results of the present studies which indi-
cate that performance is enhanced through repetition of the verbal
discriminative stimulus by E. Possibly, this procedure would be
particularly effective with Ss such as Laura in Study II, Ss
who are less likely to benefit from the rehearsal procedure quickly
even enough to produce sufficient reinforcement to establish the dis-
crimination. These possibilities were explored in a third study
in which repetition and nonrepetition conditions were followed by
one of the other of two conditions: (a) a series of trials on which
NR trials were alternated with R trials or (b) a series of trials
on which R trials were alternated with trials on which a single
item was requested.

STUDY III

Method

Stimulus material

The stimuli consisted of nine, one inch cubes each a different
color: red, blue, green, yellow, black, white, orange, brown, and
purple.

Subjects

Subjects (Ss) were selected from children diagnosed as mentally
retarded from Coldwater State Home and Training School, Coldwater,
Michigan.

Possible Ss were screened according to a four part evaluation,
similar to that used in Study I. In the first part of the
evaluation, possible Ss were asked to select a color cube named by E in the presence of eight other differently colored cubes on the first three trials for each of two colors and on at least one of three trials for two other colors. In the second part of the evaluation, the child was asked to give E two designated cubes from a set of four differently colored cubes, responding correctly on no more than 55% of the trials in order to serve as a subject. All permutations of color pairs were randomly requested.

As in the first two studies, labeling tendencies of Ss were assessed by asking Ss to verbally identify two items, ("Tell me all about this." "What color is this?") and the ability of the Ss to imitate words that E presented ("coat", "tree", and "dog") was evaluated. Using these criteria, five candidates qualified as Ss.

Doug was a 20 year old male who had been a resident of the institution for four years. He was diagnosed as profoundly mentally retarded, with an IQ of 17. He was functioning adaptively at the severe level of retardation.

Jim was a 19 year old male who had been a resident of the institution for fifteen years. He was diagnosed with Down's Syndrome and profound mental retardation, with an IQ of 14. He was functioning adaptively at the severe level of retardation. He was described by his trainer as a slow worker with a poor attention span and easily distractible. Frequently observed behaviors reported were staring out of the window, closing his eyes and refusing to open them, and echolalia.
Randy was a 19 year old male, who had been a resident of the institution for almost seven years. He was diagnosed as severely mentally retarded, secondary to an endocrine disorder (thyroid dysfunction, hypothyroidism), and as visually impaired. He was functioning adaptively at the profound level of retardation, and his IQ was 23.

Roxanne was an 11 year old girl, who had been a resident of the institution for five years. She was diagnosed with Down's Syndrome and severe mental retardation, with an IQ of 31. She was functioning adaptively at the moderate level of retardation. She was described by her trainer as very distractible, with frequently reported behaviors of staring in a mirror, staring at spots on clothing, and asking for water.

Mark was a 13 year old boy who had been a resident of the institution for over 12 years. He was diagnosed with Down's Syndrome and profound mental retardation, functioning adaptively at the severe level of retardation, with an IQ of 12. His trainer frequently reported behaviors such as placing color cubes (stimulus material) in his mouth, laying his head on the table and refusing to look up, and allowing ice cream to run out of his mouth instead of swallowing it.

Procedure

There were four treatment conditions: (a) the previously described NR condition, (b) the R condition, (c) alternation of R and NR trials, and (d) alternation of NR trials on which one color
is requested with R trials on which two colors are requested. The order of the presentation of treatment conditions for each S is shown in Table 2.

In each session, $2^4$ training trials were followed by 10 consecutive test trials, in which the color pairs were requested once, as in the nonrepetition condition.

Reliability was not assessed in this study since the results of the previous studies did not indicate that it was necessary.

**Motivational system**

Initially, each correct response was reinforced with a token; and at the end of each session each token was exchanged for an edible. On the ninth training session, all Ss, with the exception of Jim, were changed from continuous token reinforcement to continuous food reinforcement. Jim was changed on the sixth training session. It was felt that tokens were not sufficiently reinforcing for these Ss. At no time did the change in reinforcement occur during the same session as a change in treatment conditions.

**Results**

The dependent variables across conditions were the percent of correct responses made during each session on the $2^4$ training trials and the percent of correct responses made during each session on the 10 test trials. The mean percent of correct responses across conditions for all Ss is shown in Table 2. The percent of correct responses on training trials and on test trials per session across
conditions for individual Ss are presented in Figures 8-12. The
initial testing data with respect to expressive labeling tendencies
and echoic responses for all Ss are presented in Table 2.

For Doug, the percent of correct responses in the training
trials decreased during the NR condition, increased during the R
condition, and increased further during the alternation of repetition
of two colors with NR of one color. In the test trials, the percent
of correct responses increased successively across all conditions,
although the percent of correct responses on test trials was always
less than on training trials.

Spontaneous imitation of either of the colors requested gradually
decreased across NR, R, and alternation conditions. Trials on which
Doug spontaneously imitated color names appeared more likely to be
correct than trials on which spontaneous imitation did not occur.
For trials on which one of the color names was spontaneously imitated,
the color name which was imitated was selected correctly 100% of
the time. The percent of trials on which both color cubes were
selected correctly and on which spontaneous imitation did not occur,
decreased during the NR condition with a mean of 31.6%, and
immediately increased during the repetition condition, with a mean
of 79.3%.

In the training trials for Jim, there was an increase in percent
of correct responses across all successive conditions: nonrepetition,
repetition, and alternation of repetition and single color, respec-
tively. The percent of correct responses on test trials decreased
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* Mean Percent Correct Responses on NR Trials
FIGURE LEGEND

Figure 8: The percent of correct training trials and test trials across nonrepetition, repetition and alternation experimental conditions for Doug.
FIGURE LEGEND

Figure 9: The percent of correct training trials and test trials across nonrepetition, repetition and alternation experimental conditions for Jim.
Percent Trials Correct

Training Trials

Test Trials

Sessions

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FIGURE LEGEND

Figure 10: The percent of correct training trials and test trials across repetition, nonrepetition and alternation experimental conditions for Randy.
FIGURE LEGEND

Figure 11: The percent of correct training trials and test trials across repetition and alternation experimental conditions for Roxanne.
Percent Trials Correct

R1 A

Training Trials ••
Test Trials ○--○
NR Training Trials ▲▲

Sessions

Roxanne

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Figure 12: The percent of correct training trials and test trials across nonrepetition, repetition and alternation experimental conditions for Mark.
Percent Trials Correct

Training Trials
Test Trials
NR Training Trials

Sessions

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across NR and R conditions, and increased rapidly during the alternation of repetition and single color condition.

Trials on which Jim spontaneously imitated either or both color names appeared more likely to be correct than trials on which spontaneous imitation did not occur. For incorrect trials on which only one of the color names was spontaneously imitated, the color name which was imitated was usually selected correctly.

In the training trials for Randy, there was an increase in percent of correct responses during the R condition, a decrease during the NR condition, and a sharp increase during the alternation of the R and NR condition. In the test trials, there was an increase in accuracy during the R condition, a decrease in accuracy during the NR condition, and an increase in accuracy during the alternation of the R and NR condition.

Spontaneous imitation of one of the colors requested occurred on only five trials, all within the first ten sessions. Of these five trials, four were correct. On the one incorrect trial, the color name which was imitated was selected correctly. On no trials were both color names spontaneously imitated.

With respect to training trials for Roxanne, there was an increase in accuracy across successive experimental conditions; repetition, and repetition and nonrepetition alternation, respectively. In the test trials, the percent of correct responses remained fairly stable across all experimental conditions. Roxanne did not spontaneously imitate any of the color names.
In the training trials for Mark, there was a successive increase in accuracy across all successive experimental conditions: baseline and nonrepetition, repetition, and repetition and non-repetition alternation, respectively. In the test trials, there was also an increase across all successive experimental conditions. Mark did not spontaneously imitate any of the color names.

Discussion

The results of this study support those of the previous two studies in that repetition of the verbal discriminative stimulus by the E facilitates performance on a discrimination task. Although time did not permit a reversal, the immediacy of the increase in accuracy of performance on training trials during the repetition condition for all three of the Ss for whom the NR condition was followed by the R condition suggests that the increase was a function of repetition of the verbal stimulus, as in the preceding two studies. This is further supported by the immediacy of the decrease in accuracy of performance on training trials during the NR condition for the one S for whom the R condition was followed by the NR condition.

With the exception of one S, Jim, accuracy of performance on test trials also increased during the R condition and decreased during the NR condition. Furthermore, for the two Ss who emitted spontaneous imitative responses, imitation appeared to correlate with successful task performance. The results of this study also indicate that performance is further facilitated by the alternation
of an easier task; alternation of either repetition with nonrepetition trials or alternation of trials on single items with repetition trials.

The sharp and immediate increases in accuracy of performance for all five Ss following the introduction of the alternation condition suggests that the increase was due to the effects of the alternation condition rather than a function of time or practice. Indeed, the mean percent of correct responses on both training and test trials was highest during the alternation condition. For all three Ss for whom R trials were alternated with NR trials, the mean percent of correct responses on NR training trials was higher than the mean percent of correct responses on NR test trials, adding further support to the efficacy of the procedure.

The effectiveness of the alternation condition seems to be a result of the high density of reinforcement that it affords. Possibly, attending to the relatively easier alternated tasks serves as a discriminative stimulus for attending on test trials, thereby increasing the probability of responding correctly on these trials. Once the two item discrimination has been acquired, it is likely that the easier, alternated task could be faded, since the level of performance would continue to produce a high density of reinforcement.
General Discussion

The present set of studies demonstrates that repetition of the verbal discriminative stimulus by the experimenter facilitates performance on a discrimination task. The results also suggest that performance is further facilitated by the alternation of trials on an easier task.

In addition, the data seem to indicate that prior to training on a two-item discrimination task, some form of echoic behavior and/or expressive labeling should be established, either vocally or with sign language.

Based on the results, an effective training procedure for the acquisition of a two-item discrimination would be to first alternate trials on which one item is requested with trials on which the verbal discriminative stimulus for two items is repeated and/or then alternate trials on which the experimenter repeats the verbal stimulus with trials on which the verbal stimulus is not repeated, gradually fading out the repetition trials.

Another research possibility would be to explore the effects of training on attending to the stimulus objects prior to discrimination training. In the last two studies discussed, several of the Ss frequently did not attend consistently to the task. In fact, it was necessary to discontinue the training on several sessions as a result of this problem. This would suggest that pretraining and reinforcement of such visual discrimination and attending tasks as color sorting and matching to sample might further facilitate the
learning of a color discrimination since attending to the aspects of
the stimuli relevant to making the discrimination to be learned
would seem to be a prerequisite to the effectiveness of any further
training.

Further research is also recommended to determine the effects
of alternation of an easier task on the acquisition of other
academic skills. Perhaps this procedure would prove to be an
effective means of helping to teach more advanced skills, such as
math or spelling. Anecdotal reports suggest that this is the case.

Conclusion
1. Repetition of instructions tends to increase the accuracy
   of performance of the discrimination response under considera-
   tion.

2. Alternation of trials on the learning task with trials on
   an easier but related task tends to increase the accuracy
   of performance on the learning task.

3. Ss who initially imitate the instructions and/or label the
   objects referred to in the instructions tend to perform the
   learning task at a higher level of accuracy than Ss who do
   not imitate or label.
BIBLIOGRAPHY


