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A COMPARISON OF THE LEARNING AND FORGETTING RATES OF MENTALLY RETARDED AND NORMAL SCHOOL CHILDREN

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CHAPTER I

INTRODUCTION

Two problems which are of central importance to education are the learning process and the forgetting process. These processes are referred to as problems because they form the core of education, yet little is actually known about the factors involved in learning or those producing forgetting. The many current theories of learning and forgetting attest to this lack of knowledge.

Psychologists have recognized for a long time that the bulk of human behavior is learned. Learning is involved when a baby stops crying when his mother approaches, or when a child is memorizing a poem, or when an adult is undergoing psychotherapy. Experimental and educational psychologists have attacked the core of the learning problem by trying to analyze the learning process, and to learn about the conditions under which learning takes place. Those who teach have also been concerned with the learning process, but from a different point of view. They have

been concerned primarily with providing experiences which result in learning that produce the most desirable changes in behavior. Much research is needed to determine the most effective means of producing these changes.

The forgetting process has received less attention in research than the learning process from both experimental and educational psychologists, even though it would be difficult to say which one is more important to education. If learned material is soon forgotten, then the forgetting process should be of utmost concern to those who teach. In any formal school situation certain standards must be met before a student can progress to a higher grade or level. Whenever certain standards must be met, two problems can immediately be seen. One, the student may not have the intellective ability to learn the material to standard, or two, he may forget a sufficient amount of the material to make his performance below standard. Even in students with superior intellective ability, forgetting is an important factor in the person's later performance. Examples of this are easily seen: a medical doctor retains only a fraction of the physiology, anatomy, and neurology which he once knew as a medical student; a child who memorized the presidents of the United States may soon find that he is unable to recall all of them, or recall them in order; a person is often unable to recall the name of a person he met only a few days before.

Psychologists have attempted to explain the process of forgetting in a number of ways. One explanation is referred to as the principle of disuse and refers to the gradual waning of learned material because of a lack of use. In discussing this principle, Deese writes, "...we can learn from the work on the experimental production of forgetting that the principle of disuse has very little validity."[1] McGeoch raised two fundamental objections to the principle. First, he pointed out that some "forgetting" curves rise instead of fall with the passage of time, and second, McGeoch said that the principle of disuse is ineffectual in explaining forgetting if it implies only the passage of time. Time itself does not cause anything, but it is the events which happen in time.[2]

Another attempt to explain forgetting makes use of the mechanism of repression. Repression refers to the unconscious process whereby material is forced into the unconscious and is relatively inaccessible to recall. One of the fundamental aspects of this concept is that the repressed material is not lost. It is simply at a level where the person cannot recall it under ordinary circumstances.

Today, few psychologists think of forgetting as a

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[1]James Deese, The Psychology of Learning, (New York: McGraw-Hill Book Co., Inc., 1952), p. 186.

[2]J. A. McGeoch, "Forgetting and the law of disuse," Psychological Review, XXXIX (1932), pp. 353-70.

disintegration of learned material, or believe that repression accounts for all forgetting. Rather, forgetting is generally viewed as an inhibitory process; an interference effect of new learning. The trend in experimental and educational psychology has been to study the factors involved in forgetting by experimentally producing forgetting. This is done by two types of experiments known as retroactive and proactive inhibition. Forgetting is produced in the retroactive design by learning intervening between original learning and recall, and in the proactive design by a learning task given prior to the main task.

Less is known about the learning and forgetting processes in mentally retarded children than in normal children because much less research has been done in the area of mental retardation. It has long been thought that mentally retarded individuals are not capable of acquiring information and skills as rapidly as individuals of normal or superior intelligence. Moreover, it is commonly asserted that mentally retarded individuals have shorter memory spans, that is, poorer recall than normal or superior people.

This thinking about the learning and forgetting processes in mentally retarded children has significantly affected instructional procedures in special classes for the mentally retarded, yet data will be given to show that such thinking is based on conflicting and inconclusive evidence.

The major concern of this study was whether or not there were differences between mentally retarded and normal children in the amount of forgetting produced in a proactive inhibition design. However, another concern which came as a secondary aspect of the study, was whether or not there are quantitative differences between mentally retarded and normal children in their learning rates on a paired-associates learning task. As more knowledge is gained about learning and forgetting in mentally retarded children, instructional procedures in special classes for the educable mentally retarded can become more objective and less intuitive.

Review of the Experimental Literature

Studies related to learning in retarded and normal individuals. In 1948, McPherson reviewed the experimental studies of learning in retarded individuals which had been carried out over the period from 1907 to 1945. These studies were on various aspects of learning such as learning simple tasks, learning in problem situations, and conditioning, and involved tasks which were not related to school-type experiences. In summarizing the studies, McPherson states:

> The outstanding impression gained from this review of learning in the subnormal is one of lack of information. The actual experiments have been few, the number of subjects small, the tasks to be learned heterogeneous within a narrow range, and the motivational factors inadequately controlled. The results of this review serve not so much as an aid to the

> technician in meeting clinical problems but as a reminder to the experimentalist.[3]

In 1958, McPherson reviewed the studies on learning in mental defectives covering the period from 1948 to 1957. This review covered fourteen studies, four of which involved verbal learning. The tasks in these four studies consisted of learning nonsense syllables, or learning lists of common words. None of the studies used paired-associate tasks, and again the studies were unrelated to school-type learning. McPherson states in the introduction:

> The first survey indicated that the relationship between these two variables represented an area of limited information and that the learning of mental defectives is not consistently inferior to that of individuals who achieve normal intellectual ratings.

In summary of the studies reviewed, McPherson writes:

> The review reveals a diversity of methodology and of results. Some papers highlight a slow, arduous learning process among mental defectives whereas others point to more skill in acquisition than is ordinarily assumed. There is evidence that intellectual level is not an adequate predictor of the learning of mental defectives and that their learning per se is variable.[4]

Only three studies of paired-associate learning in normal and educable mentally retarded children appear in the literature since McPherson's 1958 review. Eisman used

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[3]Marion White McPherson, "A Survey of Experimental Studies of Learning in Individuals Who Achieve Subnormal Ratings on Standardized Psychometric Measures," American Journal of Mental Deficiency, LII-LIII, (1948), p. 252.

[4]Marion White McPherson, "Learning and Mental Deficiency," American Journal of Mental Deficiency, LXII, (1958), p. 870 and 877.

the paired-associates technique for studying differences in learning, generalization, and retention between retarded, average, and superior groups of children. The learning task consisted of a series of seven pairs of pictures to be learned to a criterion of four consecutive, correct trials. Group I consisted of twenty three educable mentally retarded children, Group II consisted of twenty three intellectively average children, and Group III consisted of twenty three intellectively superior children. Eisman found: "A comparison of Groups I, II, and III on number of trials to learn...revealed no significant differences."[5]

Berkson and Cantor used the paired-associates method for comparing learning ability between normal and retarded children. They used thirty normal children whose IQ's ranged from 86 to 115, and twenty four retarded children ranging between 55 and 85 IQ. These two groups were subdivided into experimental and control groups for the purpose of studying the mediation phenomenon in learning, a theoretical question which is not pertinent to this review. The material to be learned was three lists of paired stimuli consisting of various arrangements or arabic numerals, pictures of common objects, and hexagons varying in color. The lists were learned to a criterion of five successive correct repetitions. Berkson and Cantor report:

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[5]Bernice S. Eisman, "Paired Associate Learning, Generalization, and Retention," American Journal of Mental Deficiency, LXIII (1958), p. 484.

> The analysis of variance revealed no significant differences in the learning of List I either for trials to criterion or number of errors.... The results of List II show a slightly different pattern than did those of List I.... While for the trials measure there were again no significant differences between any groups, the normal Ss did make significantly fewer errors in learning List II.... In List III, the experimental Ss learned significantly more quickly and with fewer errors than did the control Ss. It may also be seen that on both measures the normals were more efficient than were the retarded Ss.[6]

Ring and Palermo attempted to investigate further the relationship between intellective level and the ability to learn paired-associates while introducing greater control in the experimental design. Their stimulus materials consisted of eight pairs of Stanford-Binet vocabulary pictures reproduced by a Thermo-Fax process. They matched a group of fourteen mentally retarded adolescents with fourteen normal adolescents according to chronological age, and with a group of normal elementary school children according to mental age. Ring and Palermo write:

> The results of the present study differ from Eisman's finding that retarded Ss were not significantly inferior in performance on this learning task, although her results were in the same direction. The findings of this study supported the hypothesis that retarded Ss would perform less well than normal individuals of the same C. A. The two groups of matched mental age did not differ significantly, and when the two normal groups were compared, the older group was superior to the younger in performance. These results

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[6]Gershon Berkson and Gordon N. Cantor, "A Study of Mediation in Mentally Retarded and Normal School Children," Journal of Educational Psychology, LI (1960), p. 85.

would be expected if mental age is a variable affecting performance on this task.[7]

Studies related to forgetting in retarded and normal individuals. Studies of forgetting in mentally retarded and normal individuals reported in the literature during the past two decades are extremely few. Cassel found no significant difference in the amount of retroactive inhibition produced in normals, familial aments, and non-familial aments;[8] however, his use of serial word tasks, and his use of severely retarded individuals make his study incomparable to the present study.

A study of proactive inhibition in an academic situation is reported only once in the literature. Ausubel and Blake had undergraduate college students learn material dealing with the history, sacred literature, doctrine, and Ethical teachings of Buddhism.[9] However, this study was concerned with theoretical aspects of proactive inhibition which are not relevant to the present study.

Only one study on the comparative ability of mentally retarded and normal children to recall paired-associate material appears in the literature. Eisman attempted to

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[7]Elizabeth M. Ring and David S. Palermo, "Paired Associate Learning of Retarded and Normal Children," American Journal of Mental Deficiency, LXVI (July, 1961), p. 105.

[8]R. H. Cassel, "Serial Verbal Learning and Retroactive Inhibition," Journal of Clinical Psychology, XII (1957).

[9]O. P. Ausubel and E. Blake, Jr., "Proactive Inhibition in the Forgetting of Meaningful School Material," Journal of Educational Research, LII (1958), pp. 145-49.

demonstrate differences in retention between groups of educable mentally retarded, intellectively average, and intellectively superior children. The task consisted of recalling a previously learned series of paired pictures. There were twenty three subjects in each of the three groups. Twelve subjects from each group took the retention test one week after the initial learning, while eleven from each group took the retention test one month after initial learning. Eisman found that a comparison between the three groups "...on number of correct responses recalled, both after a short and after a longer period of time, revealed no significant differences."[10]

The serious lack of experimental data on the learning and forgetting rates in mentally retarded as compared to normal children points to the necessity of further investigation. The evidence on learning rates is conflicting, and differences in methodology, learning tasks, etc., make comparisons difficult. The one study dealing with forgetting failed to show differences between normal and mentally retarded children, but the task may have been too easy to reflect differences in performance.[11] The present study is the first to use paired-associate pictures exclusively for the learning task. This seems important because it is a simple task comparable to many learning situ-

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[10]Eisman, op. cit., p. 484.

[11]Ibid., p. 486.

ations in school, and it is not contaminated by additional tasks such as learning digits which might be unfair to the retarded subjects. Moreover, the present study is the first to study forgetting rates by experimentally producing forgetting. If clarification of the learning rates between normal and mentally retarded children can be obtained, and differences, if any, in forgetting rates can be demonstrated, then instructional procedures for special classes can be based more on fact than belief.

CHAPTER II

STATEMENT OF THE PROBLEM

The purpose of this study was to investigate the differences between mentally retarded and intellectively normal children in the number of trials required and the number of errors made in relearning a previously learned paired-associates learning task. A proactive inhibition design was used in order to experimentally produce forgetting. In using an associative learning task, and the subsequent recall of it, the purpose was to see if there were demonstrable quantitative differences between retarded and normal children in their forgetting rates in a meaningful, common type of learning situation. Since the children first had to learn an unfamiliar task, an additional investigation was made to see if there were any differences between retarded and normal children in the learning rates and number of errors made in reaching the criterion of learning.

In order to determine the differences in the learning and forgetting rates of mentally retarded and normal children, the following null hypotheses were tested. Those

relating to forgetting rates were:

1. There is no statistically significant difference between mentally retarded and normal children in the number of trials required to relearn a series of paired pictures to the criterion when the series was preceded by the learning of a different series.

2. There is no statistically significant difference between mentally retarded and normal children in the errors made in relearning a series of paired pictures to the criterion when the series was preceded by the learning of a different series.

Those relating to learning rates were:

1. There is no statistically significant difference between mentally retarded and normal children in the number of trials required to meet the criterion of learning in a paired-associates learning task.

2. There is no statistically significant difference between mentally retarded and normal children in the number of errors made in reaching the criterion of learning in a paired-associates learning task.

CHAPTER III

PROCEDURE OF THE STUDY

The Pilot Study

An associative learning task was chosen for the pilot study because associative learning is perhaps the most commonly used type of learning in the public schools. Early in their school experiences children learn that certain symbols go together to make a word. They learn to associate these printed symbols, or the verbalization of them, to the object to which the word refers. The entire reading process takes place by means of such association. Examples of associative learning experiences are: (1) associating the positions of musical notes on a staff with certain tones; (2) linking various historical events with specified periods of time; (3) paralleling the numerical and monetary systems; (4) learning that different configurations of the same chemical symbols denote various compounds; and (5) learning the geography of the New England states in connection with the colonial period of history.

The associative learning task for the pilot study was learning pairs of pictures which were paired together

on five-inch by eight-inch cards. The subjects were given these instructions:

> Here are a number of cards. Each card has two pictures on it. Look at both pictures on each card carefully. Then, I will show you a set of cards like this. (The Examiner shows the Subject a sample card with only the first picture of the pair on it.) You are to tell me what was the other picture on each of these cards.

A series of paired pictures was presented to the subjects at the rate of one every three seconds, then, the first picture of each pair was presented singly at the rate of one every five seconds. The longer time interval on the second series was to give the subject time to respond. The inter-trial intervals were ten seconds in length. This procedure was continued until each subject correctly associated the first and second pictures of each of the twelve pairs.

A review of the literature on paired associative studies of verbal learning revealed that all studies but three used either paired nouns, paired adjectives, or nonsense syllables.[12,13,14] The writer rejected the idea of using printed words in the paired associative learning task because of these disadvantages: (1) subject variation in the amount of time needed to recognize words; (2) the variation in reading ability among school children; (3) certain words might arouse sufficient affect so that the learning

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[12]Eisman, op. cit.

[13]Berkson and Cantor, op. cit.

[14]Ring and Palermo, op. cit.

process would be inhibited; and (4) the task might arouse negative feelings if the subject had had unpleasant experiences in reading. In addition, many of the studies reviewed used words of one or more than one syllable in the same list. When more than one syllable was used, this might have presented a variable in the difficulty of learning lists.

For the present study, pictures rather than words were used for the paired-associative task in order to avoid the disadvantages that were just reviewed. In addition, certain other criteria were set up for the selection of the pictures. The criteria were: (1) the pictures must be simple, outline drawings of common objects; (2) the words represented by the pictures must be one-syllable nouns; (3) the pictures must be immediately recognizable; (4) the pictures must be readily and consistently identifiable; that is, if a picture of a horse was sometimes called "pony" and sometimes "horse," the picture was eliminated; and (5) pictures must not be obviously potentially affect arousing, for example, a picture of a gun or of a snake. In order to insure immediate recognition and consistent identification, the pictures were shown to groups of seventy-five kindergarten children and forty fourth-grade children. Pictures which did not meet the above criteria were eliminated.

An important part of the pilot study was the deter-

mination of the length of the test, that is, the number of pairs to be in a series. The length desired was the minimum number of pairs which would differentiate between variour grade levels with respect to learning rate and retention. Lists of eight, twelve, sixteen, twenty, and twenty-four pairs were tested.

A list of twelve pairs was first given to groups of twelve first, twelve fourth, and twelve eighth graders. Using chi-square as the test of significance, the twelve-pair list was found to discriminate between the three groups with respect to learning rate and retention. The differences were significant at the .05 per cent level of significance.

The list was then lengthened to sixteen, twenty, and twenty-four pairs in order to see what effect test length had on learning and retention. Forty subjects were tested with the sixteen-pair list, forty subjects with the twenty-pair list, and thirty subjects with the twenty-four-pair list. None of the three increased test lengths was found to be more discriminative than the twelve-pair list. An eight-pair list was then tried on thirty subjects to see if a shorter list would be as discriminative as the twelve-pair list. It was found not to be. Apparently, the taks was so easy for all grade levels that it did not discriminate between them. Eisman used eight pairs and criticized her study in that her lists may not have been long

enough to be discriminative.[15] The twelve-pair list proved to be of optimum length for easy administration and discriminability in the pilot study.

During the testing to determine test length, serial effects were noted in the learning curves of some groups. That is, the first and last pairs of the list tended to be learned first, with the middle pairs being learned last. This was evidence of the well-known phenomenon which takes place when items are learned serially. It was known that if the learning curves could be flattened so that the end-pairs of the lists were not learned more quickly than the middle-pairs, the serial effects would be controlled and a random presentation of the lists would be unnecessary. Therefore, one hundred twelve students were then tested using various arrangements of the pairs until the learning curves became flat with certain arrangements. It was desired to keep the arrangement of the pairs constant, since certain random orders might be more difficult to learn than others; and an additional variable would then be introduced. A random presentation of pairs could not be kept constant from subject to subject since the subjects would vary with respect to the number of trials needed to reach the learning criterion.

The Subjects

The subjects used in this study were sixty boys and girls selected from a total school enrollment of about

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[15]Eisman, op. cit.

eighteen hundred students at a Kansas City, Missouri public junior high school. The students attending this school are all white, and their parents are predominately in the middle-middle and lower-middle socio-economic groups. Their occupations range from semi-skilled labor to professions.

The subjects ranged in chronological age from fourteen years, eight months to fifteen years, seven months. Thirty of the subjects were mentally retarded students attending special education classes. The other thirty subjects were intellectively normal children attending regular ninth grade classes. Recent Stanford-Binet Intelligence Test data were available on all subjects. The mentally retarded subjects ranged in I. Q. from 58 to 79 with the mean I. Q. being 77.3. The intellectively normal subjects ranged in I. Q. from 95 to 105 with a mean of 99.6.

The mentally retarded and normal groups were subdivided into experimental and control groups for purposes of the proactive inhibition experimental design. Each child served as a subject in only one of the sub-groups.

The Test Instrument

Test materials consisted of two series of paired pictures. Each series, A and B, consisted of two booklets. Each booklet contained sixteen five-inch by eight-inch cardboard cards bound together by a flexible plastic spiral band. Booklet One of each series contained thirteen cards on each of which there was one pair of outline pictures and three

blank cards serving as front, back, and blank page between sample card and stimuli cards. One pair served as a sample card; the other twelve pairs were the stimuli cards. Booklet Two of each series contained thirteen cards on each of which appeared the first picture of the corresponding stimulus pair of each series. The first picture card served as a sample card for instructional purposes and the other twelve pictures as test cards. Three blank cards were included in these booklets, also.

The selection of the pictures to be used, the arrangements of the pictures into pairs, and the order of the pairs in the test series have been discussed under the preceding heading The Pilot Study.

All responses made by each subject were recorded. The recording was done on individual answer sheets which showed the total number of trials required to reach the criterion of learning, the number of errors made in reaching that criterion, the number of errors made in recalling the previously learned task, and the number of trials needed to relearn the previously learned task to the previous criterion of mastery.

The timing of the presentation of the stimuli, the timing of the intertrial period, and the timing of the response period were determined with the aid of a stopwatch.

The Procedure

Fifteen subjects from the mentally retarded group

and fifteen subjects from the normal group were placed in the Experimental Group. The remaining fifteen subjects in each of these groups were placed in the Control Group. The subjects in the Experimental Group were tested in this manner: Learn Series A to criterion, learn Series B to criterion immediately after Series A, engage in conversation for a five minute interval, recall Series B, and if any mistakes were made in the recall of Series B, relearn it to criterion. The subjects in the Control Group were tested in the following manner: Learn Series B to criterion, engage in conversation for a five minute interval, recall Series B, and if any mistakes were made in the recall of Series B, relearn it to criterion. All subjects in both Experimental and Control Groups engaged in normal classroom activity before their first task. As nearly as could be determined, the only difference between the Experimental and Control Groups was that the Experimental Group learned Series A prior to Series B while the Control Group did not.

Each subject was tested individually in quiet, well-ventilated, and well-lighted rooms. Each subject was called to the testing room by an inter-communications system from the central office. The Subject was asked to sit to the left of the Examiner at a right angle to the Examiner at the end of a small table.

The following instructions were given to each subject for his first series, whether it was Series A for an

Experimental subject or Series B for a Control subject:

> Here are a number of cards. Each card has two pictures on it. Look at both pictures on each card carefully. (The Examiner shows the Subject Booklet Two then, and says:) Then I will show you another set of cards like these. (The Examiner shows the Subject the sample card with only the first picture of the stimulus pair.) You are to tell me what picture was with this first picture. What you are supposed to do is remember which two pictures go together. Now as you see the two pictures together try to remember what two pictures were together.

The twelve paired pictures were presented to each subject visually at the rate of one every three seconds. Then, Booklet Two was opened and the first picture of each pair was presented singly at the rate of one every five seconds. The longer time period for Booklet Two was to give the Subject time to perceive the stimulus and to respond. The Examiner recorded each response made by the Subject. A second trial was then given following the same procedure and additional trials until the Subject was able to make the twelve correct responses. Intertrial intervals were ten seconds in length. Between trials, the Examiner said:

> Now we shall look at the pictures again. Try to remember what two pictures were together.

After each subject in the Experimental Group had learned Series A to criterion, he was given the following instructions:

> Now we are going to look at another set of cards. Again, look at both pictures on each card carefully, because you are to remember what two pictures go together.

The Subject was then presented with Series B. Following the mastery of Series B, each subject was engaged in conversation for a five minute period. The Examiner initiated the conversation, and directed it toward extra-curricular activities, et cetera. Any discussion of the test or of school work was avoided. At the end of the five minute period, the Examiner said:

> Now we are going to see how many of the pictures that go together you remember from the second list you learned.

If the Subject recalled all twelve pairs correctly, the test was finished. If he missed one or more of the pairs, the Examiner said:

> That's fine. Now, let's learn them all.

The Subject then relearned Series B to criterion following the same procedure as when he first learned it.

After each subject in the Control Group learned Series B to criterion, the Examiner initiated conversation centering around the same topics as those for the Experimental Group. This conversation lasted for five minutes, and again discussion of the test or of school work was avoided. At the end of the five minute period, these instructions were given:

> Now we are going to see how many of the pictures that go together you remember.

If the Subject recalled all twelve pairs correctly, the test was finished. If he missed one or more of the pairs, the Examiner said:

That's fine. Now, let's learn them all.

The Subject then relearned Series B to criterion following the same procedure as when he first learned it.

The Obtained Data

The following data were obtained for each of the sixty subjects participating in the study: name of child, chronological age, intelligence quotient, experimental method used, response to each test item, total number of trials required by subject to reach criterion, total number of errors made by each subject in reaching the criterion, number of pairs correctly recalled after an interval, number of trials required to relearn the test to criterion, and the number of errors made in relearning the test to criterion.

CHAPTER IV

THE RESULTS

Thirty mentally retarded children with Stanford-Binet intelligence quotients ranging from 58 I. Q. to 79 I. Q. and thirty normal children whose Stanford-Binet I. Q.'s ranged from 95 to 105 participated in a paired-associates learning test. The purpose of the investigation was to determine if there were statistically significant differences in the learning and forgetting rates between these two groups. Comparisons were made on the number of trials required to meet the criterion of learning, and on the number of errors made in reaching this criterion for determining differences in learning rates, while trials to criterion and errors in reaching criterion on re-learning the task after an interval were used as measure of forgetting. For purposes of the proactive inhibition experimental design, the mentally retarded and normal groups were subdivided into experimental and control groups. In this study the required level of statistical significance was set at 0.05.

The statistical technique chosen for treatment of

the data was a nonparametric statistic, the Kolmogorov-Smirnov Two-Sample Test. The scores obtained through the testing procedures yielded data for each of the sixty subjects. The data are: (1) number of trials required to reach criterion of learning and number of errors made in reaching the criterion of learning; (2) number of trials required and the number of errors made in re-learning the task to criterion after a five minute time interval. The median number of trials required and the median number of errors made by the various groups are shown in Tables 1 and 2. The raw data from which the statistical calculations were made appears in Appendix A.

Fifteen normal and fifteen mentally retarded children comprised the Experimental Group, which learned Task A, learned Task B immediately following Task A, and after a five minute interval re-learned Task B. The other fifteen children in each of the normal and mentally retarded groups comprise the Control Group which learned Task B, and after a five minute interval re-learned Task B.

In order to test for differences in learning rates between mentally retarded and normal children, comparisons were made: between the two Experimental Groups on the learning of Task A, between the two Control Groups on the initial learning of Task B, and by combining the performances on these two tasks. Thus for the last comparison, performances on the Experimental Task A and on the initial Control Task B

TABLE 1

MEDIAN NUMBER OF TRIALS AND MEDIAN NUMBER OF ERRORS FOR MENTALLY RETARDED EXPERIMENTAL AND CONTROL GROUPS

EXPERIMENTAL:	Task A	Task B	Recall Task B
Trials:	5	3	2
Errors:	25	10	1
CONTROL:		Task B	Recall Task B
Trials:	-	6	1
Errors:	-	23	0

TABLE 2

MEDIAN NUMBER OF TRIALS AND MEDIAN NUMBER OF ERRORS FOR NORMAL EXPERIMENTAL AND CONTROL GROUPS

EXPERIMENTAL:	Task A	Task B	Recall Task B
Trials:	4	3	2
Errors:	13	8	1
CONTROL:		Task B	Recall Task B
Trials:	-	5	1
Errors:	-	19	0

were combined for both mentally retarded and normal groups.

To apply the Kolmogorov-Smirnov Two-Sample Test, a cumulative frequency distribution is made for each sample of observations, using the same intervals for both distributions. For each interval, one step-function is subtracted from the other. The test focuses on the largest of these observed differences.

> Let $S_{n1}(X)$ = the observed cumulative step function of one of the samples, that is, $S_{n1}(X) = K/n_1$, where K = the number of scores equal to or less than X. and Let $S_{n2}(X)$ = the observed cumulative step function of the other sample, that is, $S_{n2}(X) = K/n_2$. Now the Kolmogorov-Smirnov Two-Sample Test focuses on ... D = maximum $|S_{n1}(X) - S_{n2}(X)|$ for a two tailed test.[16]

Table 3 indicates the per cent of total trials required by the mentally retarded Experimental Group and the normal Experimental Group to reach the criterion of learning on Task A. The largest discrepancy between the two series is 5/15. In order to determine if this discrepancy is significant, reference is made to the Table of Critical Values of K_D, where $K_D = 5$, in the Kolmogorov-Smirnov Two-Sample Test.[17] Reference to this table reveals that when N = 15, a value of $K_D = 5$ is not significant at the a = .05 level for a two-tailed test. Thus, the null hypothesis is accepted. There is no statistically significant difference

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[16] Sidney Siegel, Nonparametric Statistics for the Behavioral Sciences, (New York: McGraw Hill Book Co., Inc., 1956), p. 128.

[17] Siegel, op. cit.

TABLE 3

COMPARISON OF MENTALLY RETARDED AND NORMAL SUBJECTS ON TRIALS TO LEARN TASK A

	Per cent of total trials to criterion									
	15-22	23-30	31-38	39-46	47-54	55-62	63-70	71-78	79-86	87-94
S_{15} (X)B_{E1}	3/15	5/15	9/15	12/15	12/15	13/15	15/15	15/15	15/15	15/15
S_{15} (X)D_{E1}	0/15	0/15	4/15	8/15	10/15	12/15	12/15	13/15	14/15	15/15
$S_{15}(B_{E1})$ -S_{15} (D_{E1})	3/15	5/15	5/15	4/15	2/15	1/15	3/15	2/15	1/15	0/15

TABLE 4

COMPARISON OF MENTALLY RETARDED AND NORMAL SUBJECTS ON TRIALS TO LEARN TASK B

	Per cent of total trials to criterion										
	15-22	23-30	31-38	39-46	47-54	55-62	63-70	71-78	79-86	87-94	95-100
S_{15} (X)B_{C1}	1/15	4/15	7/15	8/15	11/15	12/15	13/15	14/15	14/15	14/15	15/15
S_{15} (X)D_{C1}	0/15	0/15	3/15	5/15	10/15	12/15	13/15	13/15	13/15	15/15	15/15
S_{15} (B_{C1}) -S_{15} (D_{C1})	1/15	4/15	4/15	3/15	1/15	0/15	0/15	1/15	1/15	1/15	0/15

between mentally retarded and normal children in the number of trials required to meet the criterion of learning in a paired-associates learning task.

The data in Table 4 indicates the per cent of total trials required by the mentally retarded Control Group and the normal Control Group to learn Task B. The largest discrepancy between the two series is 4/15. Reference to the Table of Critical Values of K_D, where $K_D = 4$, reveals that when $N = 15$, a value of $K_D = 4$ is not significant at the $a = .05$ level for a two-tailed test. Again, the null hypothesis of no difference between mentally retarded and normal children in the number of trials required to learn a paired-associates task is accepted.

Table 5 indicates the per cent of total trials required by the mentally retarded Experimental and Control Groups combined to learn Tasks A and B respectively, and the per cent of total trials required by the normal Experimental and Control groups combined to learn Tasks A and B respectively. The largest discrepancy between the two series is 9/30. Reference to the Table of Critical Values of K_D reveals that when $N = 30$, a value of $K_D = 9$ is not significant at the $a = .05$ level for a two-tailed test. Thus, the null hypothesis is again sustained. There is no statistically significant difference between mentally retarded and normal children in the number of trials required to meet the criterion of learning in a paired-associates learning task.

TABLE 5

COMPARISON OF MENTALLY RETARDED AND NORMAL SUBJECTS ON TRIALS TO LEARN TASKS A AND B

	Per cent of total trials to criterion										
	15-22	23-30	31-38	39-46	47-54	55-62	63-70	71-78	79-86	87-94	95-100
S_{30} (X)B_{E1} and B_{C1}	4/30	9/30	16/30	20/30	23/30	25/30	28/30	29/30	29/30	29/30	30/30
S_{30} (X)D_{E1} and D_{C1}	0/30	0/30	7/30	13/30	20/30	24/30	25/30	26/30	27/30	30/30	30/30
S_{30} (B_{E1} and B_{C1}) -S_{30} (D_{E1} and D_{C1})	4/30	9/30	9/30	7/30	3/30	1/30	3/30	3/30	2/30	1/30	0/30

TABLE 6

COMPARISON OF MENTALLY RETARDED AND NORMAL SUBJECTS ON ERRORS MADE IN LEARNING TASK A

	Per cent of total errors made in reaching criterion										
	5-13	14-22	23-31	32-40	41-49	50-58	59-67	68-76	77-85	86-94	95-100
S_{15} (X) B_{E1}	2/15	5/15	9/15	10/15	13/15	13/15	15/15	15/15	15/15	15/15	15/15
S_{15} (X) D_{E1}	0/15	2/15	3/15	6/15	8/15	11/15	12/15	13/15	14/15	14/15	15/15
S_{15} (B_{E1}) -S_{15} (D_{E1})	2/15	3/15	6/15	4/15	5/15	2/15	3/15	2/15	1/15	1/15	0/15

The data in Table 6 indicates the per cent of total errors made by the mentally retarded Experimental Group and the normal Experimental Group in learning Task A. Because of the large number of errors involved, intervals of five were used rather than one unit intervals. Thus, the per cents in Table 4 represent intervals of five ranging from zero errors to fifty-five errors. The largest discrepancy between the two series is 6/15. Reference to the Table of Critical Values of K_D reveals that when N = 15, a value of $K_D = 6$ is not significant at the a = .05 level for a two-tailed test. Thus, the second null hypothesis is accepted. There is no statistically significant difference between mentally retarded and normal children in the number of errors made in reaching the criterion of learning in a paired-associates learning task.

Table 7 indicates the per cent of total errors made by the mentally retarded Control Group and the normal Control Group in learning Task B. The per cents represent five unit intervals. The largest discrepancy between the two series is 4/15. Reference to the Table of Critical Values of K_D reveals that when N = 15, a value of $K_D = 4$ is not significant at the a = .05 level for a two-tailed test. Again, no difference is demonstrated between mentally retarded and normal children in the number of errors made in learning a paired-associates learning task.

The per cent of total errors made per interval by

TABLE 7

COMPARISON OF MENTALLY RETARDED AND NORMAL SUBJECTS ON ERRORS MADE IN LEARNING TASK B

	Per cent of total errors made in reaching criterion										
	5-13	14-22	23-31	32-40	41-49	50-58	59-67	68-76	77-85	86-94	95-100
S_{15} (X) B_{C_1}	3/15	4/15	6/15	8/15	10/15	12/15	13/15	14/15	15/15	15/15	15/15
S_{15} (X) D_{C_1}	0/15	0/15	2/15	4/15	9/15	11/15	13/15	14/15	14/15	14/15	15/15
S_{15} (B_{C_1}) -S_{15} (D_{C_1})	3/15	4/15	4/15	4/15	1/15	1/15	0/15	0/15	1/15	1/15	0/15

TABLE 8

COMPARISON OF MENTALLY RETARDED AND NORMAL SUBJECTS ON ERRORS MADE IN LEARNING TASKS A AND B

	Per cent of total errors made in reaching criterion										
	5-13	14-22	23-31	32-40	41-49	50-58	59-67	68-76	77-85	86-94	95-100
S_{30} (B_{E_1} and B_{C_1})	5/30	9/30	15/30	18/30	23/30	25/30	28/30	29/30	30/30	30/30	30/30
S_{30} (D_{E_1} and D_{C_1})	0/30	2/30	5/30	10/30	17/30	22/30	25/30	27/30	28/30	28/30	30/30
S_{30} (B_{E_1} and B_{C_1}) -S_{30} (D_{E_1} and D_{C_1})	5/30	7/30	10/30	8/30	6/30	3/30	3/30	2/30	2/30	2/30	0/30

the mentally retarded Experimental and Control Groups combined in learning Tasks A and B respectively, and the per cent of total errors made per interval by the normal Experimental and Control Groups combined in learning Tasks A and B respectively are shown in Table 8. The largest discrepancy between the two combined groups is 10/30. With an N of 30, the Table of Critical Values of K_D shows a K_D value of 10 as not significant at the a = .05 level for a two-tailed test. The null hypothesis of no difference between mentally retarded and normal children in the number of errors made in learning a paired-associates learning task is accepted.

The data in Tables 3 through 8 consistently support the two null hypotheses concerning learning rates in mentally retarded and normal children. These are: 1. There is no statistically significant difference between mentally retarded and normal children in the number of trials required to meet the criterion of learning in a paired-associates learning task. 2. There is no statistically significant difference between mentally retarded and normal children in the number of errors made in reaching the criterion of learning in a paired-associates learning task.

Before comparisons could be made between mentally retarded and normal subjects on the number of trials required and the number of errors made in relearning Task B, it was necessary to demonstrate that differences did occur between initial test and retest performances. The Kolmogorov-

Smirnov Two-Sample Test was not appropriate to test for test-retest differences because this data is related. Therefore, the Walsh Test for testing differences in two related samples was selected to treat this data. In order to use the Walsh Test, difference scores must be obtained for each of the N pairs. These difference scores are then arranged in order of size, with the sign of each score being taken into consideration in this arrangement. d_1 = the lowest difference score, whether negative or positive, and d_n = the highest difference score. For a one-tailed test, H_1 is that $\mu 1 > 0$. After the difference scores are obtained, significance can be determined by the appropriate formula in the Table of Critical Values for the Walsh Test.[18] For the data in this study the appropriate formula is:

$$\min \ [1/2(d_1 + d_{10}),\ 1/2(d_5 + d_6)] > 0$$

The term "min" refers to minimum and means that the smaller of the two values separated by the comma should be used. If this value is greater than zero, then the difference is significant at the a = .01 level for a one-tailed test.

The data in Table 9 produced a value = minimum [1/2(0+2), 1/2 (1+1)] = 1. Since this value is greater than zero, there is a difference in the number of trials between test and retest which is significant at the .01 level for a one-tailed test.

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[18]Siegel, op. cit.

TABLE 9

NUMBER OF TRIALS ON TEST AND RETEST FOR THE MENTALLY RETARDED EXPERIMENTAL GROUP

Subject	Test	Retest	d
a	2	2	0
b	3	3	0
c	3	2	1
d	3	2	1
e	3	2	1
f	3	2	1
g	3	2	1
h	3	2	1
i	3	2	1
j	4	2	2
k	5	3	2
l	4	2	2
m	5	2	3
n	6	2	4
o	11	3	8

TABLE 10

NUMBER OF TRIALS ON TEST AND RETEST FOR THE MENTALLY RETARDED CONTROL GROUP

Subject	Test	Retest	d
a	4	1	3
b	4	1	3
c	4	1	3
d	6	3	3
e	5	1	4
f	5	1	4
g	6	1	5
h	6	1	5
i	7	2	5
j	6	1	5
k	6	1	5
l	7	1	6
m	8	1	7
n	11	1	10
o	11	1	10

The data in Table 10 produced a minimum value = 4 which is significant at the .01 level of significance. Thus, a difference in the number of trials required by the mentally retarded Control Group on test and retest is significant.

Comparison of the normal Experimental Group on the number of trials required to reach criterion on test and retest as shown in Table 11 revealed a minimum value = 1. This value is significant at the .01 level.

TABLE 11

NUMBER OF TRIALS ON TEST AND RETEST FOR THE NORMAL EXPERIMENTAL GROUP

Subject	Test	Retest	d
a	2	2	0
b	3	3	0
c	3	2	1
d	3	2	1
e	3	2	1
f	3	2	1
g	3	2	1
h	3	2	1
i	3	2	1
j	4	2	2
k	5	3	2
l	4	2	2
m	5	2	3
n	6	2	4
o	11	3	8

A minimum value of 2.5 was obtained for the data in Table 12. This value is significant at the .01 level of significance. Thus, the normal Control Group differed significantly on the number of trials required for the initial test as compared to the retest.

TABLE 12

NUMBER OF TRIALS ON TEST AND RETEST FOR THE NORMAL CONTROL GROUP

Subject	Test	Retest	d
a	2	1	1
b	3	2	1
c	3	1	2
d	4	2	2
e	3	1	2
f	4	1	3
g	4	1	3
h	5	1	4
i	6	2	4
j	6	1	5
k	7	2	5
l	6	1	5
m	9	2	7
n	8	1	7
o	12	1	11

The data in Table 13 produced a minimum value = 6 which is significant at the .01 level of significance. Therefore, the mentally retarded Experimental Group differed significantly on the number of errors made on the test as compared to the retest.

Table 14 indicates the number of errors made by the mentally retarded Control Group on test and retest. The minimum value obtained for this data is 20.5. This value is significant at the .01 level of significance. There was a significant difference in the number of errors made between test and retest for this group.

The data in Table 15 produced a minimum value of 4.5. Since this value is above zero, it is significant at

TABLE 13

NUMBER OF ERRORS ON TEST AND RETEST FOR THE MENTALLY RETARDED EXPERIMENTAL GROUP

Subject	Test	Retest	d
a	1	1	0
b	5	5	0
c	5	1	4
d	6	1	5
e	7	1	6
f	7	1	6
g	9	1	8
h	10	1	9
i	12	1	11
j	14	1	13
k	15	1	14
l	15	1	14
m	22	5	17
n	26	1	25
o	52	2	50

TABLE 14

NUMBER OF ERRORS ON TEST AND RETEST FOR THE MENTALLY RETARDED CONTROL GROUP

Subject	Test	Retest	d
a	14	0	14
b	15	0	15
c	17	0	17
d	19	0	19
e	21	0	21
f	23	2	21
g	23	0	23
h	23	0	23
i	25	0	25
j	28	1	27
k	29	0	29
l	31	0	31
m	35	0	35
n	39	0	39
o	53	0	53

TABLE 15

NUMBER OF ERRORS ON TEST AND RETEST FOR THE NORMAL EXPERIMENTAL GROUP

Subject	Test	Retest	d
a	2	1	1
b	5	1	4
c	6	2	4
d	6	1	5
e	5	0	5
f	7	1	6
g	7	0	7
h	9	1	8
i	8	0	8
j	9	1	8
k	9	0	9
l	12	2	10
m	15	0	15
n	15	0	15
o	25	1	24

the .01 level and demonstrates a significant difference between test and retest on the number of errors made by the normal Experimental Group.

Table 16 indicates the same data for the normal Control Group. The minimum value for this data is 12.5, which is significant at the .01 level. Thus, the normal Control Group differed significantly on test-retest errors.

Tables 9 through 16 indicate the differences for all groups between test and retest performances on both trials required and errors made in reaching the criterion of learning. These groups are: mentally retarded Experimental Group; mentally retarded Control Group; normal Experimental Group; and normal Control Group. Using the Walsh Test for

TABLE 16

NUMBER OF ERRORS ON TEST AND RETEST FOR THE NORMAL CONTROL GROUP

Subject	Test	Retest	d
a	2	1	1
b	5	0	5
c	6	0	6
d	8	0	8
e	12	0	12
f	15	1	14
g	18	0	18
h	21	2	19
i	19	0	19
j	27	3	24
k	25	0	25
l	27	0	27
m	33	0	33
n	36	2	34
o	45	0	45

related samples, test-re-test differences significant at the 0.01 level were obtained for the four groups for both trials and errors.

No statistically significant differences were found between the mentally retarded and the normal subjects on the number of trials required or the number of errors made in learning the tasks to criterion. However, statistically significant differences were found between test and retest performances for both of these groups. Thus, it is necessary to determine if there are differences between these two groups on their retest performances. The proactive inhibition design was used in an attempt to experimentally produce forgetting. Forgetting is defined as a superior per-

formance by the control group as compared to the experimental group on retest performance. Thus, if the control group relearns Task B in fewer trials or with fewer errors than the experimental group, then the learning of Task A by the experimental group is assumed to have made the relearning of Task B more difficult. The discrepancy between the experimantal group's and the control group's performances on relearning Task B can be taken as a measure of the forgetting produced.

Table 17 indicates the per cent of total trials required by the mentally retarded Experimental and Control Groups to reach the criterion on relearning Task B after a five minute interval. The Kolmogorov-Smirnov Two-Sample Test was used in making the comparison. The largest discrepancy between the two groups is 13/15. Reference to the Table of Critical Values of K_D reveals that when N = 15, a value of K_D = 13 is significant at the .01 level for a two-tailed test. Thus, a difference between these two groups is demonstrated which meets our previously set criterion of a .05 level of significance.

The per cent of total trials required by the normal Experimental and Control Groups to relearn Task B is shown in Table 18. The largest discrepancy between the two groups, K_D, is 4/15 or 4. The Table of Critical Values of K_D shows that when N = 15, a value of K_D = 4 is not significant at the .05 level for a two-tailed test. Since no difference

TABLE 17

COMPARISON OF MENTALLY RETARDED EXPERIMENTAL AND CONTROL GROUPS ON TRIALS TO RELEARN TASK B

	Per cent of total trials to criterion		
	7-14	15-22	23-30
S_{15} (X)D_{C_2}	13/15	14/15	15/15
S_{15} (X)D_{E_3}	0/15	12/15	15/15
S_{15} (D_{C_2}-D_{E_3}	13/15	2/15	0/15

TABLE 18

COMPARISON OF NORMAL EXPERIMENTAL AND CONTROL GROUPS ON TRIALS TO RELEARN TASK B

	Per cent of total trials to criterion	
	7-14	15-22
S_{15} (X) B_{C_2}	10/15	15/15
S_{15} (X) B_{E_3}	6/15	15/15
S_{15} (B_{C_2}) -S_{15} (B_{E_3})	4/15	0/15

between these two groups is demonstrated, proactive inhibition did not obtain and it must be assumed that the learning of Task A by the Experimental Group did not significantly interfere with the relearning of Task B.

Since the Task B retest of the Experimental Groups would reflect the forgetting, if any, produced by the pro-

active inhibition design, a comparison of the mentally retarded Experimental Group and the normal Experimental Group on the relearning of Task B should reflect the difference, if any, in the amount of forgetting produced. Table 19 shows the data for this comparison.

TABLE 19

COMPARISON OF MENTALLY RETARDED EXPERIMENTAL GROUP AND NORMAL EXPERIMENTAL GROUP ON TRIALS TO RELEARN TASK B

	Per cent of total trials to criterion		
	7-14	15-22	23-30
S_{15} (X) B_{E_3}	6/15	15/15	15/15
S_{15} (X) D_{E_3}	0/15	12/15	15/15
S_{15} (B_{E_3}) $-S_{15}$ (D_{E_3})	6/15	3/15	0/15

The largest discrepancy between the two groups shown in Table 19 is 6/15. Thus, K_D equals 6, and with an N = 15 this value is not significant at the .05 level according to the Table of Critical Values of K_D.

A significant difference was found between the mentally retarded Experimental and Control Groups on the number of trials required to relearn Task B. Thus, it may be assumed that the learning of Task A by the Experimental Group significantly affected the relearning of Task B. A significant difference was not found between the normal Experimental

and Control Groups on the number of trials required to relearn Task B. Thus, the interference effect produced in the mentally retarded subjects was not produced in the normal subjects. However, there was no significant difference demonstrated between the mentally retarded Experimental Group and the normal Experimental Group on the number of trials required to relearn Task B. Therefore, the first null hypothesis concerning forgetting is accepted. There is no statistically significant difference between mentally retarded and normal children in the number of trials required to relearn to criterion a series of paired pictures when the series was preceded by the learning of a different series.

Table 20 indicates the data for the comparison of the mentally retarded Experimental and Control Groups on the number of errors made in relearning Task B. Since the number of errors made dropped considerably on relearning, the data could be presented in one unit intervals rather than five unit intervals. Therefore, the per cent of total errors represents one unit categories.

The largest difference between the mentally retarded Experimental and Control Groups on errors made in relearning Task B is 13/15. Reference to the Table of Critical Values of K_D shows that when N = 15 a value of K_D = 13 is significant at the .01 level of significance. Thus, proactive inhibition did obtain in the mentally retarded group with respect to errors made.

TABLE 20

COMPARISON OF MENTALLY RETARDED EXPERIMENTAL AND CONTROL GROUPS ON ERRORS IN RELEARNING TASK B

	Per cent of total errors on relearning				
	1-2	3-4	5-6	7-8	9-10
$S_{15}(X)\ D_{C_2}$	13/15	14/15	15/15	15/15	15/15
$S_{15}(X)\ D_{E_3}$	0/15	12/15	13/15	13/15	15/15
$S_{15}(D_{C_2}) - S_{15}(D_{E_3})$	13/15	2/15	2/15	2/15	0/15

The comparison of the normal Experimental and Control Groups on errors made in relearning Task B shows a maximum difference of 4/15 between these two groups. This data appears in Table 21. Reference to the Table of Critical Values of K_D shows a value of $K_D = 4$ to be not significant at the .05 level. Thus, proactive inhibition on errors was not produced in the normal subjects.

A comparison was made between the mentally retarded Experimental Group and the normal Experimental Group on errors made in relearning Task B. Since proactive inhibition, if any, is reflected in the performance on this retest, a comparison between the mentally retarded and the normal subjects would show a difference, if any, in the amount of forgetting produced. Table 22 contains the data for this comparison. The largest discrepancy between these two groups is 6/15. The Table of Critical Values of K_D shows a value of 6 to be not significant at the .05 level when N = 15.

TABLE 21

COMPARISON OF NORMAL EXPERIMENTAL AND CONTROL GROUPS ON ERRORS TO RELEARN TASK B

	Per cent of total errors on relearning			
	1-2	3-4	5-6	7-8
$S_{15}(X)\ B_{C_2}$	10/15	12/15	14/15	15/15
$S_{15}(X)\ B_{E_3}$	6/15	13/15	15/15	15/15
$S_{15}(B_{C_2}) - S_{15}(B_{E_3})$	4/15	1/15	1/15	0/15

TABLE 22

COMPARISON OF MENTALLY RETARDED EXPERIMENTAL GROUP AND NORMAL EXPERIMENTAL GROUP ON ERRORS TO RELEARN TASK B

	Per cent of total errors on relearning Task B				
	1-2	3-4	5-6	7-8	9-10
$S_{15}(X)\ B_{E_3}$	6/15	13/15	15/15	15/15	15/15
$S_{15}(X)\ D_{E_3}$	0/15	12/15	13/15	13/15	15/15
$S_{15}(B_{E_3}) - S_{15}(D_{E_3})$	6/15	1/15	2/15	2/15	0/15

Although proactive inhibition was produced in the mentally retarded subjects and not in the normal subjects, these two groups did not differ significantly on the number of errors made in relearning Task B. Thus, the second null hypothesis concerning forgetting was accepted. It was: There is no statistically significant difference between mentally re-

tarded and normal children in the errors made in relearning to criterion a series of paired pictures when the series was preceded by the learning of a different series.

Discussion of Results

In summary, there were no statistically significant differences in the number of trials required to meet the criterion of learning, or in the number of errors made in reaching the criterion of learning: between the mentally retarded Experimental Group and the normal Experimental Group on the learning of Task A; between the mentally retarded Control Group and the normal Control Group on the learning of Task B; or between the mentally retarded subjects and the normal subjects when Tasks A and B were combined for comparison.

There were statistically significant differences in all groups between test and retest for both trials and errors.

There was a statistically significant difference in the number of trials required to relearn Task B between the mentally retarded Experimental and Control Groups; however, no such difference was demonstrated between the normal Experimental and Control Groups. A comparison of the number of trials required to relearn Task B by the mentally retarded Experimental Group and the normal Experimental Group yielded no significant difference.

A comparison between the mentally retarded Experi-

mental and Control Groups on the number of errors made in relearning Task B yielded a statistically significant difference. The same comparison for the normal Experimental and Control Groups failed to yield a significant difference. A comparison on the number of errors made in relearning Task B between the mentally retarded Experimental Group and the normal Experimental Group yielded no statistically significant difference.

CHAPTER V

CONCLUSIONS AND SUMMARY

Learning and forgetting are two processes which are of prime importance to the field of education. Yet, little is actually known about how learning takes place or what factors are involved in forgetting. Less is known about these processes in mentally retarded children than in normal children because much less research has been done in the area of mental retardation. It has long been thought that mentally retarded individuals are not capable of acquiring information and skills as rapidly as individuals of normal or superior intelligence. Moreover, it is commonly asserted that mentally retarded individuals have shorter memory spans or poorer recall than normal or superior people. The literature on learning and forgetting in mentally retarded children as compared to normal children which was presented in Chapter One presented no conclusive evidence for these assertions. McPherson, in two separate reviews, reviewed the experimental studies of learning in retarded individuals which had been carried out during the period from 1907 to 1957. Her reviews revealed that information concerning

learning in mentally retarded individuals was seriously lacking, but they failed to demonstrate that mental defectives are consistently inferior to normal individuals in learning ability. Eisman found no significant difference between groups of mentally retarded, intellectively average, and intellectively superior children in the number of trials required to learn a paired-associates learning task. Berkson and Cantor found significant differences between mentally retarded and normal subjects in the number of errors made and the number of trials required to learn certain lists of paired stimuli, while no differences were found in the number of errors made or in the number of trials required to learn other lists. A study by Ring and Palermo supported the hypothesis that retarded subjects would perform less well than normal subjects of the same chronological age on the learning of paired-associates material. Thus, it can be seen that the studies of paired-associates learning on mentally retarded and normal subjects fail to demonstrate that the normal subjects are consistently superior in learning ability.

Only one study on the comparative ability of mentally retarded and normal children to recall paired-associate material appears in the literature. Eisman found no difference between mentally retarded, normal, and superior children in the ability to recall paired-associate pictures after one week or after one month. Thus, in the area of forgetting,

the lack of evidence makes it impossible to adequately establish the comparative ability of mentally retarded and normal children to recall previously learned material.

This study was designed to investigate the differences, if any, in the rate of learning and in the number of errors made in learning by mentally retarded and normal children. Also, the purpose was to investigate the differences, if any, in the number of trials required and the number of errors made in relearning a task after a time interval. The proactive inhibition experimental design was used in an effort to experimentally produce forgetting.

The subjects used in this study were sixty boys and girls selected from a total school enrollment of about eighteen hundred students. The subjects ranged in chronological age from fourteen years, eight months, to fifteen years, seven months. Thirty of the subjects were mentally retarded children who ranged in Stanford-Binet I. Q. from 58 to 79, and the remaining thirty subjects were normal children ranging in Stanford-Binet I. Q. from 95 to 105.

The mentally retarded subjects and the normal subjects were sub-divided into experimental and control groups for purposes of the experimental design. The experimental subjects learned Task A, learned Task B, and after a five minute interval, relearned Task B. The control subjects learned Task B, and after a five minute interval, relearned Task B. The tasks consisted of learning series of twelve

paired pictures to a criterion of one correct repetition.

Results of the study sustained these null hypotheses concerning learning: 1. There is no statistically significant difference between mentally retarded and normal children in the number of trials required to meet the criterion of learning in a paired-associates learning task; and 2. There is no statistically significant difference between mentally retarded and normal children in the number of errors made in reaching the criterion of learning in a paired-associates learning task.

The two null hypotheses concerning forgetting were also sustained. They were: 1. There is no statistically significant difference between mentally retarded and normal children in the number of trials required to relearn to criterion a series of paired pictures when the series was preceded by the learning of a different series, 2. There is no statistically significant difference between mentally retarded and normal children in the errors made in relearning to criterion a series of paired pictures when the series was preceded by the learning of a different series.

Proactive inhibition was produced in the mentally retarded group, but was not produced in the normal group. The mentally retarded Experimental Group required a mean of 1.20 trials and made a mean of .20 errors in relearning Task B. The Experimental Group required a mean of 6.13

trials to learn Task A and a mean of 4.07 trials to learn Task B. This difference was significant. Thus, for the mentally retarded group the learning of Task A enhanced the learning of Task B, but made the relearning of Task B more difficult.

The normal Experimental Group required a mean of 1.60 trials and made a mean of .73 errors in relearning Task B, while the normal Control Group required a mean of 1.33 trials and made a mean of .60 errors in relearning Task B. The differences between these two groups were not significant, therefore, proactive inhibition did not occur. The Experimental Group required a mean of 4.40 trials to learn Task A and a mean of 3.07 trials to learn Task B. This difference was significant. For the normal subjects, the learning of Task A enhanced the learning of Task B but did not significantly interfere with the relearning of Task B.

These findings have some important implications for instructional methods in school. Forgetting of most learned material occurs to some degree with all children, therefore for functional purposes the material must be relearned. It is a common practice among teachers to present similar materials or similar approaches in an effort to make learning easier. The present finding with the retarded subjects suggests that such a practice is defeated since it makes relearning harder. Apparently with normal children at this level of difficulty the interference effect does not occur.

These findings suggest that in classes for mentally retarded children the materials, methods of presentation, and order of presentation should be planned to avoid the interference effect. Apparently, with normal children at this level of difficulty such planning is unnecessary.

The results of this study support the finding of Eisman in that no difference was found in the number of trials required to learn a paired-associates task by mentally retarded and normal children. Eisman did not use number of errors as a measure, therefore no comparison of the two studies can be made on this factor. Although different methodologies were used to induce forgetting, the present study does support Eisman's finding that mentally retarded children recall paired-associates pictures as well as normal children.

The findings of this study do not agree with the findings of Berkson and Cantor who found a significant difference between mentally retarded and normal children in the number of trials required and the number of errors made in learning certain paired-associate stimuli. Berkson and Cantor did not test for retention, thus no comparison can be made on forgetting. The present results are also in disagreement with the results of Ring and Palermo who found that retarded subjects performed less well than normal subjects. They did not test for retention.

In considering the findings of the present study, certain factors seem important.

After each individual completed the task, the Examiner asked him how he had gone about learning to associate the two pictures. The answers given by the mentally retarded subjects and those given by the normal subjects were essentially the same, that is, they tried to associate the two pictures by finding a common property, for example, "kite" and (flying) "fish," or by connecting the two objects through use, for example, "rake" (ing) a "ball" through the yard. Thus, the mentally retarded subjects not only failed to differ from the normal subjects in learning rate, but their approach to learning appeared to be the same, at least on empirical observation.

Proactive inhibition, or forgetting, was produced in the mentally retarded Experimental Group, but was not produced in the normal Experimental Group. Comparison of these two groups is legitimate on the grounds that they were given the same procedure, although the mentally retarded group was affected adversely while the normal group was not. The results would be more clear-cut if proactive inhibition had been produced in both groups, and then the difference, if any, in the amount of proactive inhibition could have been determined.

It might prove fruitful to repeat this study as designed, but with a younger group of children. The age of the children in this study may have been a factor in the failure of proactive inhibition to obtain in the normal

group. Also, proactive inhibition might be increased by having the subjects perform a simple task during the test-retest interval.

In conclusion, the finding of the present study supports some of the earlier studies on a comparison of learning rates between mentally retarded and normal children, while it fails to support others. The results of this study give evidence that mentally retarded and normal children do not differ significantly with respect to learning rate on a paired-associates learning task. The results agree with the only previous study of retention of paired stimuli in mentally retarded and normal children, that is, that a significant difference in recall does not exist between these two groups.

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APPENDIX

Mentally Retarded Control Group Task B - First Test

Subjects	Trials	Per cent of Total Trials	Errors	Per cent of Total Errors
1.	5	41.6	19	34.5
2.	4	33.3	17	30.9
3.	6	50.0	21	38.2
4.	6	50.0	25	45.5
5.	11	91.6	39	70.9
6.	7	58.3	28	50.9
7.	7	58.3	23	41.8
8.	6	50.0	23	41.8
9.	4	33.3	15	27.3
10.	6	50.0	29	52.7
11.	8	66.6	35	63.6
12.	5	41.6	31	56.4
13.	4	33.3	14	25.5
14.	6	50.0	23	41.8
15.	11	91.6	53	96.4

Mentally Retarded Control Group Task B - Retest

Subjects	Trials	Per cent of Total Trials	Errors	Per cent of Total Errors
1.	1	8.3	0	0.0
2.	1	8.3	0	0.0
3.	1	8.3	0	0.0
4.	1	8.3	0	0.0
5.	1	8.3	0	0.0
6.	2	16.6	1	1.8
7.	1	8.3	0	0.0
8.	1	8.3	0	0.0
9.	1	8.3	0	0.0
10.	1	8.3	0	0.0
11.	1	8.3	0	0.0
12.	1	8.3	0	0.0
13.	1	8.3	0	0.0
14.	3	25.0	2	3.6
15.	1	8.3	0	0.0

Mentally Retarded Experimental Group - Task A

Subjects	Trials	Per cent of Total Trials	Errors	Per cent of Total Errors
1.	6	50.0	28	50.9
2.	5	41.6	23	41.8
3.	5	41.6	27	49.1
4.	7	58.3	34	61.8
5.	4	33.3	8	14.5
6.	4	33.3	15	27.3
7.	10	83.3	42	76.4
8.	7	58.3	28	50.9
9.	4	33.3	10	18.2
10.	5	41.6	25	45.5
11.	5	41.6	17	30.9
12.	4	33.3	18	32.7
13.	9	75.0	36	65.5
14.	6	50.0	19	34.5
15.	11	91.6	55	100.0

Mentally Retarded Experimental Group Task B - First Test

Subjects	Trials	Per cent of Total Trials	Errors	Per cent of Total Errors
1.	2	16.6	1	1.8
2.	3	25.0	9	16.2
3.	3	25.0	5	9.1
4.	3	25.0	12	21.8
5.	3	25.0	5	9.1
6.	3	25.0	7	12.7
7.	11	91.6	52	94.5
8.	6	50.0	26	47.2
9.	3	25.0	7	12.7
10.	4	33.3	10	18.2
11.	5	41.6	14	25.5
12.	3	25.0	15	27.3
13.	5	41.6	22	40.0
14.	3	25.0	6	10.9
15.	4	33.3	15	27.3

Mentally Retarded Experimental Group Task B - Retest

Subjects	Trials	Per cent of Total Trials	Errors	Per cent of Total Errors
1.	2	16.6	1	1.8
2.	2	16.6	1	1.8
3.	3	25.0	5	9.1
4.	2	16.6	1	1.8
5.	2	16.6	1	1.8
6.	2	16.6	1	1.8
7.	3	25.0	2	3.6
8.	2	16.6	1	1.8
9.	2	16.6	1	1.8
10.	2	16.6	1	1.8
11.	2	16.6	1	1.8
12.	2	16.6	1	1.8
13.	3	25.0	5	9.1
14.	2	16.6	1	1.8
15.	2	16.6	1	1.8

Normal Control Group Task B - First Test

Subjects	Trials	Per cent of Total Trials	Errors	Per cent of Total Errors
1.	4	33.3	12	21.8
2.	2	16.6	5	9.1
3.	5	41.6	19	34.5
4.	6	50.0	27	49.1
5.	7	58.3	27	49.1
6.	3	25.0	8	14.5
7.	4	33.3	15	27.3
8.	9	75.0	36	65.5
9.	6	50.0	25	45.5
10.	12	100.0	45	81.8
11.	8	66.6	33	60.0
12.	3	25.0	2	3.6
13.	4	33.3	18	32.7
14.	6	50.0	21	38.2
15.	3	25.0	6	10.9

Normal Control Group Task B - Retest

Subjects	Trials	Per cent of Total Trials	Errors	Per cent of Total Errors
1.	1	8.3	0	0.0
2.	1	8.3	0	0.0
3.	1	8.3	0	0.0
4.	1	8.3	0	0.0
5.	2	16.6	3	5.5
6.	1	8.3	0	0.0
7.	2	16.6	1	1.8
8.	2	16.6	2	3.6
9.	1	8.3	0	0.0
10.	1	8.3	0	0.0
11.	1	8.3	0	0.0
12.	2	16.6	1	1.8
13.	1	8.3	0	0.0
14.	2	16.6	2	3.6
15.	1	8.3	0	0.0

Normal Experimental Group Task A

Subjects	Trials	Per cent of Total Trials	Errors	Per cent of Total Errors
1.	7	58.3	31	56.4
2.	8	66.6	25	45.5
3.	4	33.3	16	29.1
4.	2	16.6	5	9.1
5.	4	33.3	12	21.8
6.	5	41.6	13	23.6
7.	2	16.6	7	12.7
8.	5	41.6	23	41.8
9.	2	16.6	2	3.6
10.	8	66.6	31	56.4
11.	3	25.0	13	23.6
12.	4	33.3	10	18.2
13.	5	41.6	25	45.5
14.	3	25.0	9	16.2
15.	4	33.3	12	21.8

Normal Experimental Group Task B - First Test

Subjects	Trials	Per cent of Total Trials	Errors	Per cent of Total Errors
1.	3	25.0	6	10.9
2.	4	33.3	15	27.3
3.	2	16.6	5	9.1
4.	2	16.6	8	14.5
5.	2	16.6	5	9.1
6.	7	58.3	25	45.5
7.	2	16.6	2	3.6
8.	3	25.0	9	16.2
9.	3	25.0	7	12.7
10.	3	25.0	7	12.7
11.	3	25.0	9	16.2
12.	2	16.6	6	10.9
13.	3	25.0	9	16.2
14.	3	25.0	12	21.2
15.	4	33.3	15	27.3

Normal Experimental Group Task B - Retest

Subjects	Trials	Per cent of Total Trials	Errors	Per cent of Total Errors
1.	2	16.6	1	1.8
2.	1	8.3	0	0.0
3.	2	16.6	1	1.8
4.	1	8.3	0	0.0
5.	1	8.3	0	0.0
6.	2	16.6	1	1.8
7.	2	16.6	1	1.8
8.	2	16.6	1	1.8
9.	1	8.3	0	0.0
10.	2	16.6	1	1.8
11.	1	8.3	0	0.0
12.	2	16.6	2	3.6
13.	2	16.6	1	1.8
14.	2	16.6	2	3.6
15.	1	8.3	0	0.0