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HINER, Gladys Webber, 1907-
A COMPARISON OF ASSOCIATIVE LEARNING RATES OF BRIGHT, NORMAL AND RETARDED CHILDREN.

The University of Oklahoma, Ph.D., 1962
Education, psychology

University Microfilms, Inc., Ann Arbor, Michigan

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1962

THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

A COMPARISON OF ASSOCIATIVE LEARNING RATES OF BRIGHT, NORMAL AND RETARDED CHILDREN

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

BY

GLADYS WEBBER HINER

Norman, Oklahoma

1962

A COMPARISON OF ASSOCIATIVE LEARNING RATES
OF BRIGHT, NORMAL AND RETARDED CHILDREN

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ACKNOWLEDGMENTS

The writer feels a deep sense of gratitude to Dr. P. T. Teska, her advisor. His faith in the writer, his encouragement and advice, and his interest in her, are sincerely appreciated.

Sincere appreciation is extended to the other members of the writer's committee who made helpful suggestions and showed a profound interest in her program: Dr. W. B. Ragan, Dr. Arthur W. Heilman, and Dr. Claude Kelly.

The writer expresses thanks to her principal, Mr. L. S. Lanman, and to Dr. R. R. Phillips, Pupil Service Department of Oklahoma City Public Schools for assistance in the arrangements that were made for research to be done in Oklahoma City Public Schools. Also, thanks are extended to the other principals, teachers and pupils who participated in the study.

Thanks is extended to Mr. Francis Bloodgood, Headmaster of Casady Lower School and to his teachers and pupils who participated in the study.

A special recognition is given to Mrs. Donna Witcher and Mrs. Georgia Comegys for their handling of mechanical details in the typing of the manuscript. Their helpfulness is deeply appreciated.

Finally, a special thanks is extended to my husband, Wayman, who has been patient and helpful to me during the performance of this task.

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A COMPARISON OF ASSOCIATIVE LEARNING RATES OF BRIGHT, NORMAL AND RETARDED CHILDREN

CHAPTER I

INTRODUCTION

We have dealt with the whole business of learning in education for so long that we believe that we understand the learning process far better than we actually do. For instance we have had basal spellers, readers and arithmetic books, and we have deceived ourselves into thinking we know how learning takes place. As we stop to analyze the learning process we realize how little we know about the conditions under which learning takes place.

Much of the basic and fundamental research into the learning process has been done by psychologists. Psychologists are interested in human behavior and almost from the outset they have been aware that the bulk of human behavior is learned. Psychologists have attacked the core of the problem and have attempted to analyze the learning process and learn about the conditions under which learning takes place. Educators have been interested in and have sought to provide experiences through which children might learn. In

general one might expect the first preoccupation of educators to be with the nature of the learning process, and it would appear that the bulk of research in education should have been or should be research into learning. Yet this is not the case at all. What learning theory there is in education has grown up almost apart from experimentation with the learning processes.

Psychologists have been concerned with the multiple aspects of the intellectual functioning of retarded children. Research has led them into exhaustive studies seeking evidences of cultural deprivation, hereditary factors, or organicity as a basis for retardation. A recent and initial survey of the field of subnormality brings into focus the divergence of opinion that exists among psychologists concerning subnormality in individuals. At the same time the several authors making the survey were forced to a sharp recognition of the fact that:

> No case of mental subnormality could be fully understood on the basis of biological or of environmental influences alone.[1]

There is agreement among psychologists that mental retardation refers to the overall efficiency of the functioning organism from both quantitative and qualitative points of view. Mental retardation refers to the maturation, learning capacity and social adjustment of the individual. No one knows whether or not the known phenomena of

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[1]Richard L. Masland, Seymour B. Sarason, Thomas Gladwin, Mental Subnormality (New York: Basic Book, Inc., 1958), p. 6.

learning apply to slow learners and mentally retarded subjects in the same way as they apply to normals. Masland, Sarason, and Gladwin state:

> Study of the subnormal individual suggests subclinical organic deficits which contribute to variations in intellect within the normal range. Similarly, studies of learning in retarded children have important implications for understanding the development and structure of intellect in normals, and also focus our attention on almost completely neglected subject, the kinds of intellectual skills which are actually needed to function in our culture, particularly outside of the school situation.[2]

Presumably, associative learning is a function of intelligence. McGeoch conceives learning as the improvement in performance resulting from repetitive practice in response to stimuli held constant throughout the learning period.[3] This involves changes in the rate, amount, and mode of acquisition.

The paucity of research into causal factors of retardation leads to the necessity of investigating learning rate as well as intellectual level. A comparison of associative learning rates of retarded children, and with those of bright children, should prove to be a step nearer to isolating some of the factors operating in individuals whose intelligence scores place them in the range of the mentally retarded group.

Educators are primarily concerned with providing

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[2] Ibid., p. 7.

[3] J. A. McGeoch, The Psychology of Human Learning (New York: Longmans, Green and Co., 1942), p. 228.

learning experiences which will result in desirable changes in behavior. The bulk of the theory and of the methods in providing these experiences for retarded children is based upon what is known about normal children. This practice emphasizes the great need for experimental research to be done with retarded children.

> "In the absence of any detectable pathology there is at present no valid explanation of a child's retardation except a deficit in learning."[4]

Review of the Experimental Literature

In 1948, McPherson reviewed the experimental studies of learning in retarded individuals which had been done during the period of 1907 to 1945. Included in her review were only those studies concerned with subjects who had been demonstrated by psychometric criteria to be subnormal. These studies fell into three general classifications, i.e., formation of conditioned responses, learning simple tasks, and problem solving. None of the learning tasks involved were related to school-type experiences. In summary, 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

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[4]Masland, et al., pp. 290-291.

> clinical problems but as a reminder to the experimentalist.[5]

In 1958, McPherson reviewed the studies on learning in mental defectives covering the period from 1943 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.[6]

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.[7]

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 the

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[5]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.

[6]Ibid., Introduction, p. 1.

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

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 intellectually average children, and Group III consisted of twenty three intellectually superior children. Eisman found: "A comparison of Groups I, II, and III on number of trials to learn...revealed no significant differences."[8]

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 whose IQ's ranged from 55 to 85. 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 of 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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[8]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."[9]

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 would be expected if mental age is a variable affecting performance on this task."[10]

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[9]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.

[10]Elizabeth M. Ring and David S. Palermo, "Paired

Statement of the Problem

The purpose of this study was to compare the learning rates on a paired-associates learning task of bright, normal, and mentally retarded children. Its purpose, also, was to investigate the differences in the number of errors made by each group in reaching the learning criterion chosen for the learning task. The associative learning task was selected because of its similarity to school type learning situations.

In order to determine the differences, if any, in the learning rates of the three groups, the following null hypotheses were tested:

1. There is no statistically significant difference in the number of trials required to meet the criterion of learning in a paired-associative learning task of bright children whose IQ's fall within the range of 120 to 156 and that of a group of children whose IQ's fall within the range of 52 to 75.

2. There is no statistically significant difference in the number of trials required to meet the criterion of learning in a paired-associative learning task of normal children whose IQ's fall within the range of 90 to 110 and that of a group of children whose IQ's fall within the range of 52 to 75.

3. There is no statistically significant difference in the number of trials required to meet the criterion of

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Associate Learning of Retarded and Normal Children," American Journal of Mental Deficiency, LXVI, (July, 1969), p. 105.

learning in a paired-associative learning task of bright children whose IQ's fall within the range of 120 to 156 and that of a group of normal children whose IQ's fall within the range of 90 to 110.

4. There is no statistically significant difference in the number of errors made in reaching the criterion of learning on a paired-associative learning task by a group of bright children and the number made by a group of retarded children.

5. There is no statistically significant difference in the number of errors made in reaching the criterion of learning on a paired-associative learning task by a group of normal children and the number made by a group of retarded children.

6. There is no statistically significant difference in the number of errors made in reaching the criterion of learning on a paired-associative learning task by a group of bright children and the number made by a group of normal children.

The Pilot Study

An associative learning task was chosen for the pilot study because associative learning is one of the most commonly used types 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. Much of the reading process takes place by means of such association. Examples involving the associative process 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 system; (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 intertrial 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.[11, 12, 13] 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 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

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[11]Eisman, op. cit., p. 485.

[12]Berkson and Cantor, op. cit., p. 85.

[13]Ring and Palermo, op. cit., p. 105.

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 determination of the length of the test, that is, the number of pairs which would differentiate between various 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 task 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.[14] 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 pre-

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[14]Eisman, op. cit.

sentation 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 ninety boys and girls from schools in Oklahoma City, Oklahoma. The subjects were white children whose chronological age fell within the range of one hundred fourteen months to one hundred twenty-six months.

The subjects composing the bright group were enrolled in Casady Lower School. The 1960 Revision of the Stanford-Binet was administered to thirty-eight pupils in this school from which the thirty subjects were chosen. The subjects chosen scored in the range from 120 to 156 IQ. Each subject in this group was considered to be a high academic achiever by the Headmaster of the school.

The subjects in the normal group were chosen from the largest elementary school in the Oklahoma City Public Schools. The 1960 Revision of the Stanford-Binet was administered to forty two children from which the thirty subjects were taken.

The subjects composing the retarded group were chosen from Special Education classes in the Oklahoma City Public Schools. Recent IQ scores had been obtained by administration of the Wechsler Intelligence Scale for Children or the 1960 Revision of the Stanford-Binet. These scores were re-

leased to the writer by Pupil Services Department of the Oklahoma City Public Schools.

The Test Instrument

Test materials 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 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 contained thirteen cards on each of which appeared the first picture of the stimulus pair. 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 this booklet, also.

The construction of the associative learning test, the selection of the pictures, and the arrangement of the pairs in the test series have been discussed under the preceeding heading The Pilot Study. The criteria for selection of the pictures for the test series are again listed: The pictures were simple outline drawings of common objects; the words represented by the pictures were one-syllable nouns; the pictures were immediately recognizable; the pictures were consistently identifiable; and the pictures were not obviously potentially affect arousing.

The examiner used individual record sheets for each subject on which appeared the name of the subject, the record of each response made by the subject, and the total number of trials for reaching the criterion of learning, also, the total number of errors made by the subject in reaching that criterion of mastery.

The examiner had a stop watch available as an aid in the timing of the presentation of the stimuli, the timing of the intertrial period, and the timing of the response period.

The Procedure

Each subject was tested individually in a small, comfortable, quiet, well-ventilated, and well-lighted room. Each subject was brought by an office girl or another pupil as directed to the experimental room. The Subject was asked to sit to the right 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 in the study:

> "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 Examiner recorded each oral 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."

If the Subject questioned the Examiner about the test, she added:

> "We shall keep looking at the pairs of pictures until you remember all of them."

CHAPTER II

THE RESULTS

Ninety boys and girls were used in this study to compare the rate of learning on a paired-associates learning task. Thirty boys and girls whose IQ range is from 120 to 156 compose the Bright Group. Thirty boys and girls whose IQ ranges from 90 to 110 compose the Normal Group, and thirty boys and girls whose IQ ranges from 52 to 75 make up the Retarded Group. The IQ scores for the Bright and the Normal Groups were obtained by administering the 1960 Revision of the Stanford-Binet Intelligence Scale in the early stages of this study. The Retarded Group were members of Special Education classes whose IQ scores had been recently established by either the Stanford-Binet Intelligence Scale or the Wechsler Intelligence Scale for Children.

Table I reveals the number of trials required by each group to master this task. It will be noted that the Bright Group required 180 trials, the Normal Group, 185 trials, and the Retarded Group, 188 trials to complete the task. The Bright Group made 323 errors, the Normal Group 299 errors, and the Retarded Group 293 errors in reaching

the criterion on the learning task.

It appeared desirable to examine the point on the learning continuum from trial one to trial fourteen, that the completion of the learning task occurred in each group. Table II reveals this information. Fourteen was the maximum number of trials required by any one subject to complete the task. This subject who required fourteen trials fell within the normal group. One subject accomplished the task on the second trial. This subject was a retarded boy who had achieved an IQ score of 63. Incidentally, this subject was considered to be a non-achiever by his classroom teacher.

It will be noted also that there is a larger spread in the number of trials required, in both the Normal and the Retarded groups than exists in the Bright group.

Table III reveals on which trial the errors occurred in reaching the criterion for completion of the learning task. It is noted here that the Bright group made more errors earlier in their attempt at mastering the task than did either the Normal or Retarded groups. The composite error curve shown in Table V reflects a gradual decline in errors for the Bright group, all errors falling within the range of the first and sixth trials. The Normal Group reflected the longest error curve, with errors falling in the range of the first to the twelfth trial. The error curve for the Retarded Group declined gradually from trial one to six with straighter line curve extending to the tenth trial.

TABLE I

RESULTS OF COMPARISON OF ASSOCIATIVE LEARNING RATES OF BRIGHT, NORMAL AND RETARDED CHILDREN

Groups		Total Number of Trials on Learning Task	Total Number of Errors on Learning Task
I	Brights (120-156 IQ) N-30	180	323
II	Normals (90-110 IQ) N-30	185	299
III	Retarded (52-75 IQ) N-30	188	295

TABLE II

THE COMPLETION OF THE LEARNING TASK TO NUMBER OF TRIALS

Number of Trials	Brights (120-156 IQ) N-30	Normals (90-110 IQ) N-30	Retarded (52-75 IQ) N-30
1			
2			1
3		3	2
4	6	6	5
5	9	7	3
6	5	3	6
7	4	4	5
8	3	3	3
9	2		3
10		1	
11	1	1	1
12		1	1
13			
14		1	
15			

TABLE III

ERRORS IN REACHING THE CRITERION FOR COMPLETION OF THE LEARNING TASK

Trial Error Number	Brights (120-156 IQ) N-30	Normals (90-110 IQ) N-30	Retarded (52-75 IQ) N-30
1	122	106	95
2	99	61	75
3	51	44	47
4	27	35	33
5	13	15	20
6	9	13	10
7	2	8	7
8		6	4
9		2	2
10		4	1
11		3	1
12		1	
13		1	
14			

The composite learning curve for the three groups shown in Table IV shows a more erratic curve in the Normal group and the Retarded group than that of the Bright group. The incidence of more trials to completion on the composite learning curve than on the composite error curve is due to the fact that in recording responses to the learning task in the administration of the test instrument, non-responses as well as errors were recorded by the examiner. In other words, non-responses to the stimuli occurred after the cessation of errors.

The statistical technique chosen for treatment of the data was a nonparametric statistic, the Kolmorogorov-Smirnov Two-Sample Test.[15] Using the Kolmorogorov-Smirnov Two-Sample Test a comparison of the results in number of trials required to reach the criterion of learning on the paired-associates learning task of the Bright Group and the Retarded Group is shown in Table IV. For analysis these data were cast into two cumulative frequency distributions.

To apply the Kolmorogorov-Smirnov Two-Sample Test, we make a cumulative frequency distribution for each sample of observations, using the same intervals for both distributions. For each interval, then, we subtract one step function from the other. The test focuses on the largest of these observed deviations.

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[15]Sidney Siegel, Nonparametric Statistics for the Behavioral Sciences, (New York: McGraw Hill Book Co., 1956), p. 127-136.

TABLE IV

COMPOSITE LEARNING CURVE

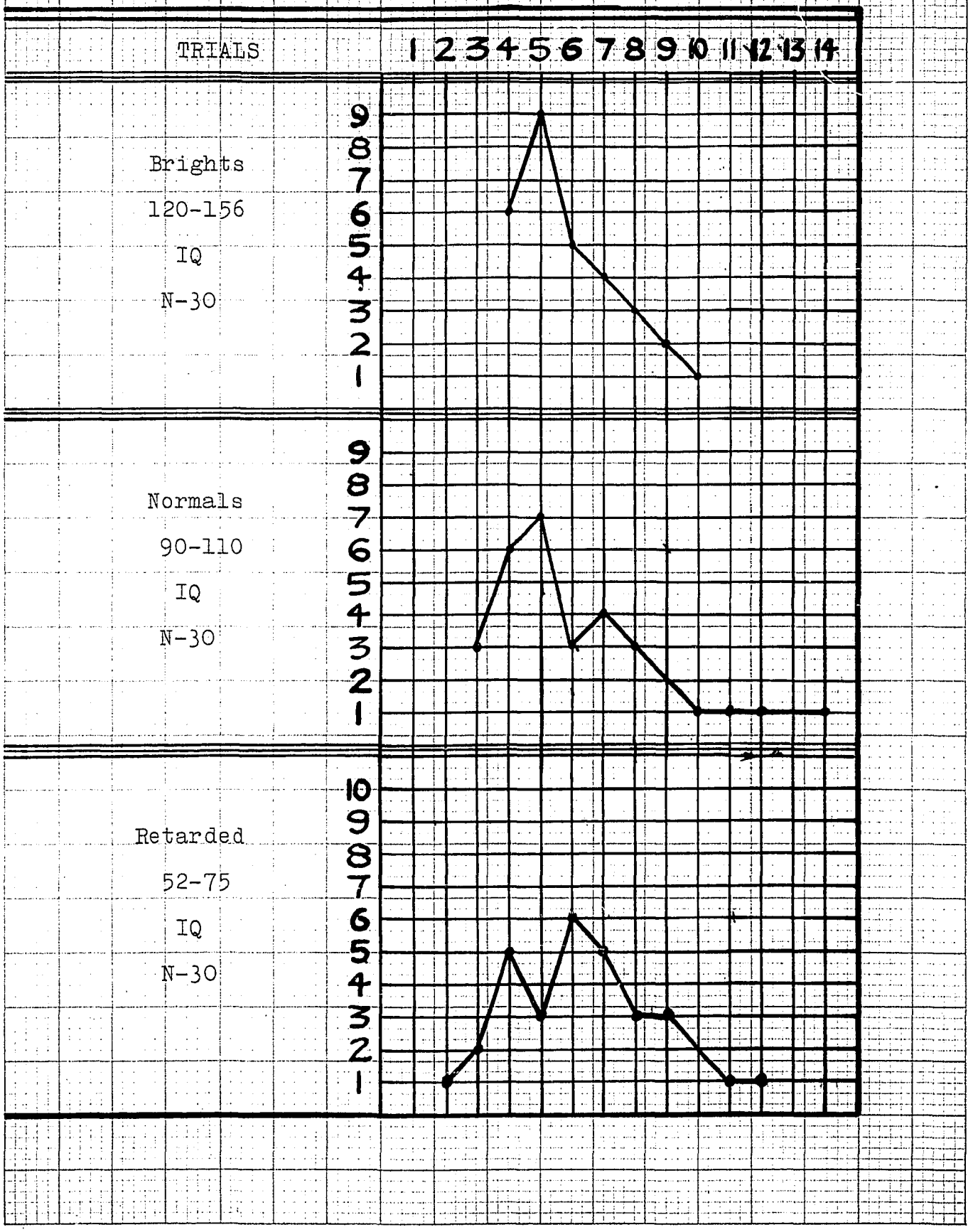
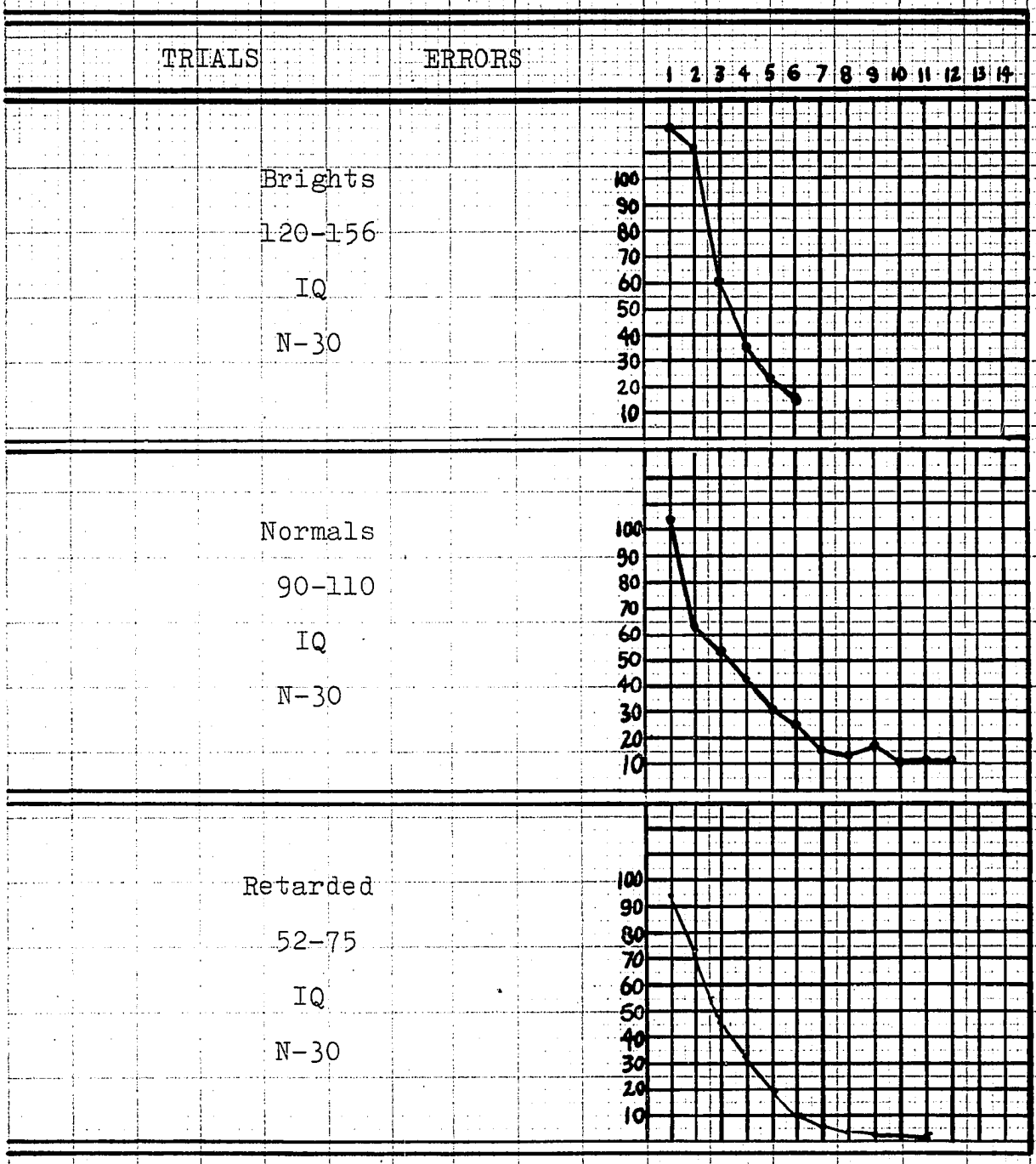


TABLE V

COMPOSITE ERROR CURVE



The sampling distribution of D is known (Smirnov, 1948; Mossey, 1951) and the probabilities associated with the occurrence of values as large as an observed D under the null hypothesis have been tabled.

> Let $S_{n1}(x)$ = the observed cumulative step function of one of the samples, that is, $S_{n1}(x) = K/n$, 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]

Reference to Kolmogorov-Smirnov's Table L reveals that when N = 30, a value of K_D can equal 11 to be significant at the five per cent level of confidence. Observe, in Table VI that the largest discrepancy between the two series is $\frac{4}{30}$. $K_D = 4$, the numerator of this largest discrepancy. This finding reveals that there is no statistical difference in the number of trials required for the Bright Group and the number of trials required for the Retarded Group in reaching the learning criterion for the task. Null hypothesis one, which states there is no significant differences in the number of trials required to meet the criterion of learning in a paired-associative learning task of bright children whose IQ falls within the range of 120 to 156 and that of a group of retarded children whose IQ falls within the range of 52 to 75 is accepted.

Table VII shows the comparison of the Normal group with the Retarded group on number of trials required to reach

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[16] Ibid., p. 128.

The sampling distribution of D is known (Smirnov, 1948; Mossey, 1951) and the probabilities associated with the occurrence of values as large as an observed D under the null hypothesis have been tabled.

> Let $S_{n1}(x)$ = the observed cumulative step function of one of the samples, that is, $S_{n1}(x) = K/n$, 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]

Reference to Kolmogorov-Smirnov's Table L reveals that when N = 30, a value of K_D can equal 11 to be significant at the five per cent level of confidence. Observe, in Table VI that the largest discrepancy between the two series is $\frac{4}{30}$. $K_D = 4$, the numerator of this largest discrepancy. This finding reveals that there is no statistical difference in the number of trials required for the Bright Group and the number of trials required for the Retarded Group in reaching the learning criterion for the task. Null hypothesis one, which states there is no significant differences in the number of trials required to meet the criterion of learning in a paired-associative learning task of bright children whose IQ falls within the range of 120 to 156 and that of a group of retarded children whose IQ falls within the range of 52 to 75 is accepted.

Table VII shows the comparison of the Normal group with the Retarded group on number of trials required to reach

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[16] Ibid., p. 128.

TABLE VI

COMPARISON OF BRIGHT GROUP WITH RETARDED GROUP ON NUMBER OF TRIALS REQUIRED TO REACH CRITERION OF LEARNING USED IN THIS STUDY

Per Cent of Total Trials	$S_{30_1}(x)$ Brights	$S_{30_2}(x)$ Retarded	$S_{N_1}(x)-S_{N_2}(x)$
8-16		1/30	1/30
17-25		3/30	3/30
26-34	6/30	8/30	2/30
35-43	15/30	11/30	4/30
44-52	20/30	17/30	3/30
53-61	24/30	22/30	2/30
62-70	27/30	25/30	2/30
71-79	29/30	28/30	1/30
80-88	29/30	28/30	1/30
89-97	30/30	29/30	1/30
97-99	30/30	30/30	0/30

TABLE VII

COMPARISON OF NORMAL GROUP WITH RETARDED GROUP ON NUMBER OF TRIALS REQUIRED TO REACH CRITERION OF LEARNING USED IN THIS STUDY

Per Cent of Total Trials	$S_{30_1}(x)$ Brights	$S_{30_2}(x)$ Retarded	$S_{N_1}(x)-S_{N_2}(x)$
7-13		1/30	1/30
14-20	3/30	3/30	0/30
21-27	9/30	8/30	1/30
28-34	16/30	11/30	5/30
35-41	19/30	17/30	2/30
42-48	23/30	22/30	1/30
49-55	26/30	25/30	1/30
56-62	26/30	28/30	2/30
63-69	27/30	28/30	1/30
70-76	28/30	29/30	1/30
77-83	29/30	30/30	1/30
84-90	29/30	30/30	1/30
91-97	30/30	30/30	0/30

the learning criterion. Again the Kolmorogorov-Smirnov Two-Sample Test was used. The groups were cast into cumulative frequency distributions. Observe that the largest discrepancy between the two series is $\frac{5}{30}$. $K_D = 5$; the numerator of this largest discrepancy. Reference to Table L reveals that when N = 30, a value of K_D can equal 11 to be significant at the five per cent level. A value of $K_D = 5$ is not significant at the chosen level of confidence, therefore the Null hypothesis number Two is accepted.

Table VIII shows a comparison of the Bright Group with the Normal Group on number of trials required to reach the learning criterion used in this study. The data on these two groups were cast into cumulative frequency distributions and the Kolmogorov-Smirnov Two-Sample test was applied.

Observe that the largest discrepancy between the two series is $\frac{3}{30}$. $K_D = 3$, the numerator of the largest difference. Reference to Table L, table of critical values of K_D, reveals that when N = 30, a value of K_D can equal 11 to be significant at the five per cent level of confidence. A value of $K_D = 3$ is not significant at the chosen level of confidence, five per cent, therefore the Null hypothesis number three, which states that there is no significant difference in the learning rate on a paired-associative learning task, of brights and normals is accepted.

Table IX shows a comparison of the Bright Group and the Normal Group on number of errors made in reaching the

TABLE VIII

COMPARISON OF BRIGHT GROUP WITH NORMAL GROUP ON NUMBER OF TRIALS REQUIRED TO REACH CRITERION OF LEARNING USED IN THIS STUDY

Per cent of Total Trials	$S_{30_1}(x)$ Brights	$S_{30_2}(x)$ Normals	$S_{N_1}(x)-S_{N_2}(x)$
14-20		3/30	3/30
21-27	6/30	9/30	3/30
28-34	15/30	16/30	1/30
35-41	20/30	19/30	1/30
42-48	24/30	23/30	1/30
49-55	27/30	26/30	1/30
56-62	29/30	26/30	3/30
63-39	29/30	27/30	2/30
70-76	30/30	28/30	2/30
77-83	30/30	29/30	1/30
84-90	30/30	29/30	1/30
91-97	30/30	30/30	0/30

TABLE IX

COMPARISON OF BRIGHT GROUP WITH NORMAL GROUP ON NUMBER OF ERRORS MADE IN REACHING CRITERION ON THE LEARNING TASK SET FOR THIS STUDY

Interval Per Cent of Errors	$S_{N_1}(x)$ Brights	$S_{N_2}(x)$ Normals	$S_{N_1}(x)-S_{N_2}(x)$
5-11	1/30	4/30	3/30
12-18	6/30	10/30	4/30
19-25	12/30	18/30	6/30
26-32	19/30	21/30	2/30
33-39	23/30	23/30	0/30
40-46	28/30	26/30	2/30
47-53	28/30	28/30	0/30
54-60	28/30	28/30	0/30
61-67	29/30	28/30	1/30
68-72	29/30	28/30	1/30
73-79	29/30	28/30	1/30
80-86	30/30	29/30	1/30
87-93	30/30	29/30	0/30
94-100	30/30	30/30	0/30

learning criterion. The data on these two groups were cast into cumulative frequency distributions and the Kolmogorov-Smirnov Two-Sample Test was applied. Observe that the largest discrepancy between the two series is $\frac{6}{30}$. $K_D = 6$, the numerator of this largest difference. Reference to Table L, table of critical values of K_D, reveals that when N = 30, a value of K_D can equal 11 to be significant at the chosen level of confidence, five per cent. The Null hypothesis number four, which states that there is no significant difference in the number of errors to reach criterion on a paired-associates learning task between bright children and normal children is accepted.

Table X shows a comparison of the Bright Group and Retarded Group on number of errors to reach the learning criteria set for this study. The data on these two groups were cast into cumulative frequency distributions and the Kolmogorov-Smirnov Two-Sample Test was applied. Observe that the largest discrepancy between the two series is $\frac{4}{30}$. $K_D = 4$, the numerator of this largest difference. Reference to Table L, table of critical values of K_D, reveals that when N = 30, a value of K_D can equal 11 to be significant at the chosen level of confidence, five per cent. The Null hypothesis number five, which states that there is no significant difference in the number of errors to reach the learning criterion on a paired-associates learning task, between Bright children and Retarded children is accepted.

TABLE X

COMPARISON OF BRIGHT GROUP AND RETARDED GROUP ON NUMBER OF ERRORS MADE IN REACHING CRITERION OF LEARNING SET FOR THIS STUDY

Interval Per cent of Errors	$S_{N_1}(x)$ Brights	$S_{N_2}(x)$ Retarded	$S_{N_1}(x)-S_{N_2}(x)$
5-12	1/30	5/30	4/30
13-20	6/30	9/30	3/30
21-28	12/30	15/30	3/30
29-36	19/30	20/30	1/30
37-44	23/30	24/30	1/30
45-52	28/30	25/30	3/30
53-60	28/30	27/30	1/30
61-68	28/30	29/30	1/30
69-76	29/30	29/30	0/30
77-84	29/30	29/30	0/30
85-92	29/30	30/30	1/30
93-100	30/30	30/30	0/30

Table XI shows a comparison of the Normal Group with the Retarded Group on the number of errors made in reaching the criterion of learning on the paired-associates learning task used in this study. The data on these two groups were cast into cumulative frequency distributions and the Kolmogorov-Smirnov Two-Sample Test was applied. Observe that the largest discrepancy between the two series is $\frac{3}{30}$. $K_D = 3$, the numerator of this largest difference. Reference to Table L, table of critical values, of K_D, reveals that when $N = 30$, a value of K_D can equal 11 to be significant at the five per cent level of confidence. The Null hypothesis number six, stating that there is no significant difference in the number of errors to reach the learning criterion on a paired-associates learning task, between the Normal Group and the Retarded Group, is sustained.

In the use of Kolmogorov-Smirnov test, for which the size and number of the intervals is arbitrary, the writer used as many intervals as were feasible in order to conserve information. It is known that when too few intervals are used, information may be wasted. The maximum vertical deviation D of the two cumulative step functions may be obscured by casting the data into too few intervals.

TABLE XI

COMPARISON OF NORMAL GROUP AND RETARDED GROUP ON NUMBER OF ERRORS MADE IN REACHING CRITERION OF LEARNING SET FOR THIS STUDY

Interval Per Cent of Errors	$S_{N_1}(x)$ Normals	$S_{N_2}(x)$ Retarded	$S_{N_1}(x)-S_{N_2}(x)$
5-11	4/30	5/30	1/30
12-18	10/30	9/30	1/30
19-25	18/30	15/30	3/30
26-32	21/30	20/30	1/30
33-39	23/30	24/30	1/30
40-46	26/30	25/30	1/30
47-53	28/30	27/30	1/30
54-60	28/30	29/30	1/30
61-67	28/30	29/30	1/30
68-72	28/30	29/30	1/30
73-79	28/30	30/30	2/30
80-86	29/30	30/30	1/30
87-93	29/30	30/30	1/30
94-100	30/30	30/30	0/30

CHAPTER III

SUMMARY AND CONCLUSIONS

The concept of learning includes in its scope every change in behavior which occurs as a result of experience or practice. Learning applies whenever there is a change in behavior. Educators are primarily concerned with providing learning experiences for children that will result in desirable changes in behavior. Educators who are involved in the education of the retarded child have been at a loss to find valid concepts of learning as it occurs in the retarded child. Very little is known about how learning takes place in the normal child. Far less is known about how learning takes place in the retarded child. The literature on learning in retarded children, scant as it is, was reviewed in Chapter One. McPherson in two separate reviews, reviewed the experimental studies of learning in retarded individuals from the period 1907 to 1957. She reports a serious lack of information concerning learning in mentally retarded individuals, but no evidence to reveal that they are consistently inferior to normal individuals in their learning ability.

Eisman found no significant difference in the number of trials required to learn a paired-associate learning task in intellectively superior, intellectively average, and retarded group. Berkson and Cantor found significant differences in the number of trials required and in number of errors made on learning some lists of paired stimuli, and no significant differences in the number of errors made and in the number of trials required to learn other lists. Ring and Palermo conducted a study which supported the hypothesis that retarded individuals performed less well on a paired-associates learning task than did a group of normal individuals of the same chronological age. We observe that the studies on mentally retarded children and normal children on a paired-associates learning task does not demonstrate that the normal children are consistently superior in ability. The author found no studies comparing the learning rates of bright and retarded children other than the Eisman study.

The Bright Group used in this study were thirty boys and girls whose ages were nine and one-half to ten and one-half years. They were given the 1960 Revision of the Stanford-Binet Scale and their IQ's were found to range from 120 to 156. These children were all bright, academically achieving boys and girls. Their approach to the test was one of eagerness and anticipation. They appeared to use their best efforts in accomplishing the task in as few

trials as possible. There was a moderate amount of rivalry among the members of the group during the few days in which the testing procedure was occurring.

The Normal Group consisted of thirty boys and girls nine and one-half to ten and one-half years who were enrolled in Coolidge Elementary School in Oklahoma City. They approached the task of learning the material with less eagerness than the bright children but with marked determination. Each subject appeared to put forth his best effort to master the task but little rivalry among the group was noted.

The Retarded Group consisted of thirty boys and girls nine and one-half to ten and one-half years of age who were in Special Education classes. For the most part, there was little eagerness or anticipation for the task as these subjects were being tested.

Findings

1. The findings in this study reveal no significant difference in the rate of learning on a paired-associates learning task between retarded children and normal or bright children.

2. They reveal no significant difference in the number of errors made by the retarded children and the number made by normal or bright children, in reaching the learning criteria for the paired-associates learning task employed in this study.

Discussion

Educators have based their teaching procedures with retarded children on learning concepts held to be valid concerning normal children. It has long since been assumed that retarded children learn at a much slower rate than normal children. For this reason the practice of presenting many repetitions of the same material to a retarded child has been employed, simply on the assumption that the repetition of the material would be of assistance in the learning of it. Educators and teachers have held to the practice of presenting far less material to the retarded child than to the normal child. A greater amount of attention has been given to the amount of material presented and to the rate at which it has been presented than to any examination of the existing concepts within the child. In so doing, it is entirely possible that the learning abilities of the retarded child have been grossly underestimated. It is not too presumptious to say that the learning abilities of the retarded child have been insulted many times by the repetitious presentation of meager material to them. This writer has observed children ten to twelve years of age struggling to read pre-primer material. Reading material had been presented to them over a period of three or four years. They were struggling with it. They were also continuing to have failure experiences with it. These same children could tell which faculty member on a staff of eighteen people drove

which car at the end of the second week of school. Something other than ability to learn was involved in the reading failures being suffered by the children observed in this particular situation.

Conclusions

Since these findings reveal no significant differences in learning rates and number of errors to reach the learning criterion, a more exploratory type of approach to the values and processes governing the learning situation should be observed by psychologists and educators.

Further investigation into the learning processes of retarded children is recommended.

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APPENDIX

INDIVIDUAL RECORD SHEET

Achiever:
Non-achiever:

Name _____

Age _____ I.Q. _____

Pairs	Trials
1 2 3 4 5 6 7 8 9 10 11 12	

RAW SCORES

BRIGHT GROUP

Age 9-1/2 - 10-1/2	IQ	Ach.	Non Ach.	Trials	Errors
	120	x		5	15
	123	x		4	4
	121	x		4	3
	120	x		4	5
	120	x		4	8
	121	x		4	9
	137	x		5	12
	129	x		5	8
	126	x		5	9
	145	x		5	4
	122	x		5	11
	134	x		5	6
	124	x		5	7
	132	x		5	9
	120	x		6	9
	120	x		6	16
	134	x		6	7
	130	x		6	11
	127	x		6	10
	120	x		7	16
	121	x		7	25
	156	x		8	34
	138	x		9	16
	125	x		11	3
	130	x		8	8
	133	x		8	16
	124	x		7	12
	136	x		4	2
	121	x		9	14
	125	x		7	14
				180	323

Mean Number Trials = 6.0
Mean Number Errors = 10.76

RAW SCORES

NORMAL GROUP

Age 9-1/2 - 10-1/2	IQ	Ach.	Non Ach.	Trials	Errors
	100	x		6	8
	100	x		4	5
	109	x		3	6
	101	x		3	2
	110	x		3	5
	96	x		4	5
	90	x		4	1
	110	x		4	8
	97	x		4	0
	94	x		5	2
	104	x		5	15
	105	x		5	8
	107	x		5	3
	107	x		5	9
	97		x	5	10
	100	x		6	6
	95	x		5	4
	94	x		6	17
	99	x		7	13
	100	x		7	6
	105	x		7	15
	110	x		7	19
	110		x	8	8
	103		x	8	12
	110	x		8	11
	106	x		10	3
	105	x		11	19
	103	x		12	39
	100	x		14	34
	100	x		4	6
				185	299

Mean Number Trials = 6.16
Mean Number Errors = 9.96

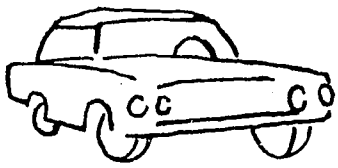
RAW SCORES

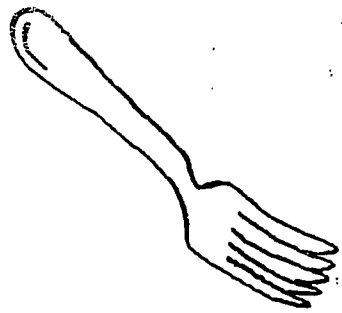
RETARDED GROUP

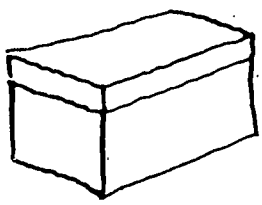
Age 9-1/2 - 10-1/2	IQ	Ach.	Non Ach.	Trials	Errors
	63		x	2	1
	75	x		3	4
	72	x		3	2
	74	x		4	2
	66	x		4	11
	69	x		4	12
	75	x		4	5
	70		x	4	3
	70	x		5	6
	68		x	5	6
	74		x	5	6
	72	x		6	1
	74		x	6	1
	75		x	6	16
	70		x	6	20
	74		x	6	10
	70		x	6	10
	75		x	7	14
	70	x		7	8
	71		x	7	10
	74	x		7	9
	71		x	7	23
	72	x		8	12
	75		x	8	14
	75	x		8	7
	70	x		9	7
	72		x	9	3
	52		x	9	31
	73	x		11	21
	66		x	12	20
				188	295

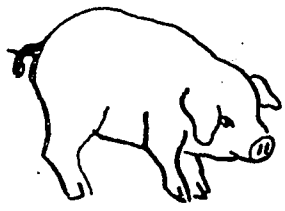
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Mean Number Errors = 9.83

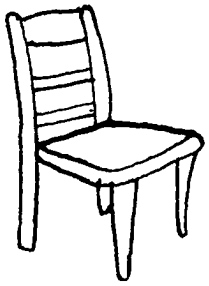
THE TEST INSTRUMENT







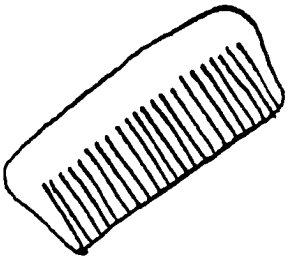


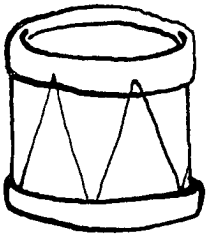




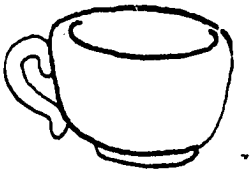


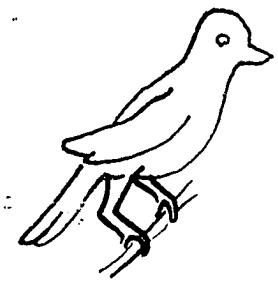


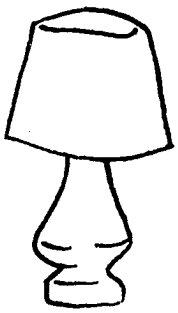




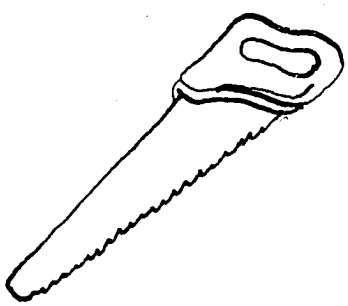




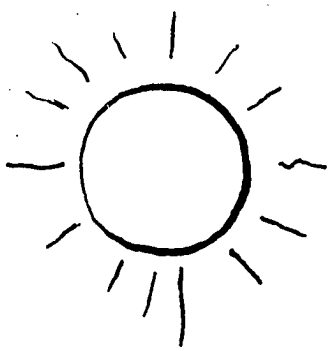


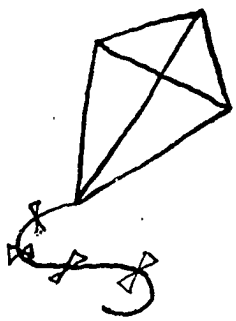


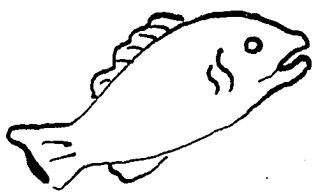


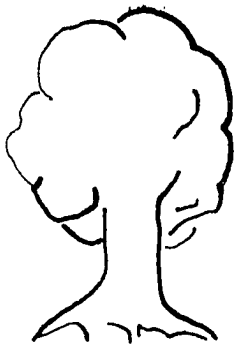




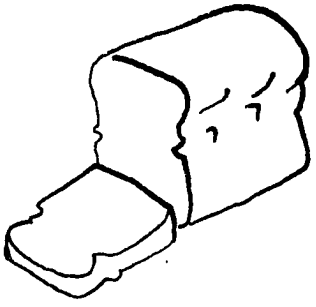


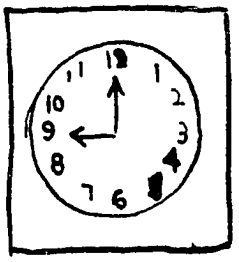











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