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AN EXPERIMENTAL STUDY ON THE EFFECTS OF RETROACTIVE INHIBITION ON BRIGHT AND DULL ADOLESCENTS IN A PAIRED ASSOCIATIVE LEARNING TASK

A DISSERTATION

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1962

AN EXPERIMENTAL STUDY ON THE EFFECTS OF RETROACTIVE INHIBITION ON BRIGHT AND DULL ADOLESCENTS IN A PAIRED ASSOCIATIVE LEARNING TASK

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CHAPTER I

INTRODUCTION

It has been recognized for many years that the bulk of human behavior is learned. For example, learning is involved when a baby stops crying as his mother approaches, when a child is acquiring vocabulary, when an adult is undergoing psychotherapy, etc. One of the important aims of the educative process is to provide a specialized learning environment deliberately arranged to produce desirable changes in behavior. Psychologists and educators are interested in discovering more about the learning process and more about the conditions under which effective learning takes place. In spite of the enormous amount of research which has been done in the field of learning, large gaps still exist in our understanding of this phenomenon.

Learning is generally defined as changes or alterations of behavior in an organism as the result of experience. However, not all of these changes in behavior are retained permanently by the organism. Think how quickly dates of events in history are forgotten after they have been learned. The measuring of retention is usually done in one of three ways. The first method is by recall--simply ask the subject to reproduce the learned material. This would be analogous to asking a person the date of the Crimean War. He would have to be able to call from memory this date. Secondly, the method of recognition can be used--the subject selects the correct response from several alternatives. In this case the subject would be given a list of dates from which to choose the correct date of the Crimean War. A third and more sensitive way to measure retention is by relearning. The subject learns the date of the Crimean War again. The saving effect in time and effort in relearning material that has been previously learned would be the index to the amount of retention. The failure to reproduce that which has been learned is called forgetting. Forgetting can be measured by finding the difference between the amount of material originally learned and the amount of that material retained at a later date.[1]

In an attempt to understand the nature of learning, one must deal with the phenomenon of forgetting. The process of forgetting has probably received less attention

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[1]E. T. Prothro and P. T. Teska, Psychology (New York: Ginn and Co., 1950), p. 434.

than has the process of learning, even though it would be difficult to say which one is more important to educators. If material which has been learned in school is soon forgotten, then the phenomenon of forgetting should be of great concern to those who teach. Traditionally, educators have attempted to lessen forgetting by employing such methods as varying the presentation of material, reviewing the material at frequent intervals, encouraging concentrated study and using repetition to the point of "overlearning."

Experimentally, too little is actually known in the fields of education and psychology concerning the factors which produce forgetting. The three theories of forgetting which are accepted by most psychologists are repression, disuse and interference effect of new learning. Most psychologists will accept parts of more than one theory in accounting for all forgetting. These three theories of forgetting will be stated here briefly.

Repression refers to the unconscious process whereby material is automatically forced into the unconscious and is inaccessible for immediate 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. The following statement by Symonds is apropos.

> Freud has likened repression to the process in the body of building up a wall of protective tissue, which will isolate the tumor or diseased part from the rest

> of the organism. Repression has a comparable function of isolating from the conscious part of the mental life that which is not acceptable because it is dangerous or repulsive or bad. Repression takes its place as one of the measures that the ego can adopt in defending itself against unacceptable and dangerous tendencies within . . . a considerable amount of what is usually thought of as forgetting is actually erased by a process of repression, as may be demonstrated by the vast amount of earlier experiences that can be recalled through the process of free association or by means of hypnotism.[2]

The theory of disuse refers to the gradual waning of learned material because of lack of use. Teska and Prothro have described the principle of disuse and questioned its validity in the following manner:

> . . . it is generally believed that forgetting is a sort of decay that occurs with the passage of time. Poets have called learning "writing in the sands of time." Physiologists have referred to "neural pathways" and "neural decay." . . . Is forgetting actually a decay due to the passage of time? What about senile amnesia in which a very old man can recall his twenty-first birthday quite clearly but cannot remember what happened yesterday? What about traumatic amnesia, in which a blow on the head can cause forgetting of the last month's events without affecting other memories?[3]

Deese writes, ". . . we can learn from the work on the experimental production of forgetting that the principle of disuse has very little validity."[4] McGeoch raised two fundamental objections to the principle. First, he pointed out that some "forgetting" curves rise instead of fall with

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[2]P. M. Symonds, Dynamic Psychology (New York: Appleton-Century-Crofts, Inc., 1949), p. 184.

[3]E. T. Prothro and P. T. Teska, Psychology (New York: Ginn and Co., 1950), pp. 434-435.

[4]J. Deese, Psychology of Learning (New York: McGraw-Hill, 1952), p. 186.

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.[5] An experiment by Jenkins and Dallenback illustrates the point that forgetting cannot be explained only by the passage of time. They had groups of subjects learn nonsense syllables to a certain criterion and then tested for recall at periods of 1, 2, 4 and 8 hours after learning. In one condition of the experiment (control group), the subjects learned the material and then went to sleep for a period corresponding to the retention interval. In the second condition (experimental group), the subjects went about their normal waking activities for the same period. Recall after sleep was uniformly better than after a period of wakeful activity. Jenkins and Dallenback concluded that forgetting is not so much a matter of decay of the old as of "interference, inhibition, or obliteration" of the old by the new. Time in itself does nothing. Disuse simply allows "other and more specific factors" to operate, _viz_., interference effect of new learning and altered stimulating conditions.[6]

The third theory of forgetting is the interference

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[5]J. A. McGeoch, "Forgetting and the Law of Disuse," _Psychological Review_, 39 (1932), 352-370.

[6]J. G. Jenkins and K. M. Dallenback, "Obliviscence during sleeping and waking," _American Journal of Psychology_, 35 (1924), 605-612.

effect of new learning. The trend in psychology has been to study the factors involved in forgetting by experimentally producing forgetting. Much knowledge of forgetting has come from a type of experiment known as the "retroactive inhibition" design. Retroactive inhibition is the process by which new learning interpolated between an original learning activity and the later test for retention of that original learning, interferes with the retention of the original learning. In other words retroactive inhibition is the interference effect of new learning on original learning. The following definition for retroactive inhibition was given by Bunch and McTeer. "In those instances where the intervening activity interferes with the reinstatement of the previously acquired activity, the phenomenon has frequently been termed retroactive inhibition."[7] Britt similarly defined retroactive inhibition as "the detrimental influence of subsequent activity upon the retention of previously established activities."[8] Another way of defining retroactive inhibition is by the experimental design of retroactive inhibition which is shown here.

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[7]M. E. Bunch and F. D. McTeer, "The Influence of Punishment During Learning upon Retroactive Inhibition," Journal of Experimental Psychology, 15 (1932), 473-495.

[8]S. H. Britt, "Retroactive Inhibition; a review of the Literature," Psychological Bulletin, 32 (1935), 381-440.

Exper. Group:	Learning Task 1	Learning Task 2	Recall test on Task 1
Control Group:	Learning Task 1	Filler Task	Recall test on Task 1

This paper will attempt to investigate the differences, if any, which exist in the susceptibility to retroactive inhibition between bright and dull adolescents.

CHAPTER II

BACKGROUND AND RELATED RESEARCH ON RETROACTIVE INHIBITION

There is much experimental verification on the interference effect of new learning in the retroactive inhibition design. Ebbinghaus in 1885 paved the way for much experimental work in forgetting as affected by retroactive inhibition, even though he did not deal specifically with the phenomenon now known as retroactive inhibition. He worked on the problem of loss of retention of a learned activity caused by increasing the duration and quantity of interpolated activities.[9]

The first to conduct a learning experiment anything like a retroactive paradigm (in which length of time and interpolated activity were varied) was Bigham in 1894. His experiment consisted of having the six subjects involved learn numbers, colors, forms, words and nonsense syllables,

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[9] H. Ebbinghaus, Über das Gedächtnis: Untersuchungen zur experimentellen Psychologie. Leipzig: Duncker & Humblot, 1885. Pp. ix-169. Also, as Memory (trans, by Ruger, H. A., and Bussenius, C. E.). New York: Teachers College, Columbia University, 1913. Pp. viii-123.

each kind of which was presented part of the time visibly and part of the time audibly. Time intervals of 2, 10, 30 and 60 seconds were filled with reading of newspapers, etc., by the subject or by listening to the reading of such by the experimenter. Bigham concluded that for both kinds of filler task and in each of the intervals, interference was least for the numbers and increased for colors, forms, words, and syllables; also that the visual filler task hindered more for the words while the audio filler task hindered more for all others.[10]

Müller and Pilzecker are given credit as the first workers in the actual field of retroactive inhibition. In their study, published in 1900, they termed the phenomenon of interpolated activities interfering with recall of previously learned material, "ruckwiekende Hemmung" ("retroactive inhibition"). They used paired nonsense syllables exposed on a memory drum as original learning material and let a definite time interval elapse before recall was tested. The time interval was one of either "rest" or of some specific mental activity which consisted of the study of a second series of syllables or of the study of landscape pictures and description of the pictures after they were removed from view. The results showed that recall was definitely less after a period of assigned mental

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[10]J. Bigham, "Memory," Psychological Review, 1 (1894), 453-461.

activity than after a period of rest. The forgetting was as great after the syllables had been studied as that after the pictures had been studied. Muller and Pilzecker then concluded that the decrease in retention of original learning, the retroactive inhibition, was caused by any definite intervening activity as compared with rest during the interval between original learning and recall.[11]

In 1910, Meyer was the next to investigate the phenomenon of retroactive inhibition. He used learning of simultaneous complexes of simple colored figures as original learning and following that by giving an interpolated activity of addition problems to the experimental group and no intellectual stimulus to the control group. The results exhibited definite evidence of RI.[12]

The phenomenon of Retroactive inhibition having been empirically established, subsequent studies attempted to discover the determining conditions of this phenomenon and to construct theories based on these findings.

Earlier Muller and Pilzecker had propounded the perseveration theory. They considered the perseveration tendency to be a kind of after-discharge -- a continued

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[11]C. E. Müller and A. Pilzecker, Experimentelle beiträge zur Iehre vom gedächtniss. Zsch. f. Psychol. u. Physiol, d. Sinnes., Ergänzungsband, 1900, 1. Pp. 300, esp. 174-198.

[12]El Meyer, Über die Gesetze der simultanen assoziation and des wiedererkennen. Untersuch. z. Psychol. u. Philos., 1910, 1, No. 3. Pp. 92, esp. 45-53.

activity -- of neural elements following any kind of learning. This after - discharge was thought to be of such importance to the setting-in of the memory pattern, that any interference offered by interpolated activity would inhibit the perseveration of the original activity. Consequently, the sooner interpolated material was introduced after the original learning the greater the retroactive effects. Also the amount of retroactive inhibition was thought to vary with the intensity of the interpolated activity.[13]

Decamp agreed that the primary cause of inhibition was due to disturbance of the setting-in process by another activity, but departed from Muller and Pilzecker in that he felt that inhibition was caused by similarity of interpolated learning to original learning rather than by the difficulty of the interpolated learning. He offered another theory which he called the transfer theory and stated it as follows:

> From the neurological standpoint, in the learning of a series of syllables we may assume that a certain group of synapses, nerve cells, nerve paths, centres, etc., are involved. Immediately after the learning process the after-discharge continues for a short time, tending to set the associations between the just learned syllables. Any mental activity engaged in during this after-discharge, involving or partially involving the same neurological groups, tends, more or less, to block the after-discharge, and gives rise to retroactive inhibition. Engagement in any mental activity involving a new -- so far as it is new --

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[13]Müller and Pilzecker, <u>op. cit</u>.

> group of synapses, neurones, etc., would allow the setting process of the just excited group to proceed unhindered. The effect of retroactive inhibition would vary directly as the relative identity of the neurological groups concerned . . . We should expect retroactive inhibition to appear more readily where material similar to that learned is used for the interpolated work.[14]

The major theoretical positions which are held at this time grew out of extension and elaboration of the transfer theory which was given its greatest exposition by McGeoch and his collaborators in the thirties. In essence the transfer theory stated that the general principles discovered in the study of transfer could explain retroactive inhibition. The loss of retention of an old association could be caused by greater strength of a new association, a mutual blocking of the old and the new associations or of confusion between the two associations.[15] There are two sources of evidence for support of these principles. One is the effect of similarity of materials in original learning and interpolated learning upon retroactive inhibition. Skaggs found that the effects of retroactive inhibition tended to increase as the materials of original learning and interpolated learning were exactly the same, i.e., repetition.[16]

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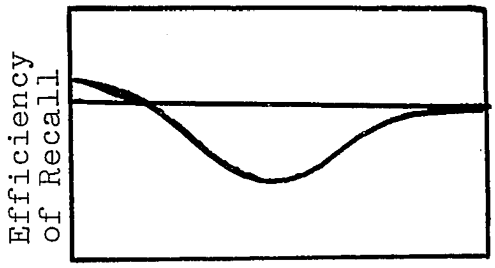
[14] J. E. DeCamp, "A Study of Retroactive Inhibition," Psychological Monograph, 19 (1915), 69.

[15] J. A. McGeoch, "The Influence of Four Different Interpolated Learning upon Retroactive Inhibition." American Journal of Psychology, 44 (1932), 695-708.

[16] E. B. Skaggs, "Further Studies in Retroactive Inhibition," Psychological Monograph, 34 (1925), 60.

Since Robinson made further study to corroborate Skaggs' finding with regard to similarity,[17] the above statement has been referred to as the Skaggs-Robinson hypothesis.



Degree of Similarity Between Interpolated Activity and Original Memorization

The second source of evidence was intrusion errors which are responses from interpolated learning given by subjects when they are asked for responses to original learning. Intrusion errors increase as the degree of interpolated learning increases. When an intermediate level of interpolated learning is reached, intrusion errors decrease; however, correct responses are not forthcoming. In other words the subject has learned the interpolated learning to the degree that he is aware that responses of interpolated learning to original learning is in error but the correct responses to original learning cannot be recalled. The importance of intrusion errors was given its ascendency by Melton and Irwin whose two-factor theory of retroactive inhibition will be discussed below.

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[17]E. S. Robinson, "The Similarity Factor in Retroaction," American Psychology, 39 (1927), 297-312.

The three prevailing theoretical positions of retroactive inhibition which have emerged out of the transfer theory referred to above, will be discussed briefly.

Gibson proposed the two basic postulates of generalization and differentiation. Generalization is the tendency for response R_a, learned to stimulus S_a, to occur when S (with which it has not been previously associated) is presented. The progressive decrease in generalization as a result of reinforced practice with S_a-B_a and reinforced presentation of S_b, Gibson labeled differentiation.[18] Two deductions have been presented and confirmed from these constructs. These are: (1) that retroactive inhibition is a function of various similarity among the items to be learned (Hamilton substantiated this in 1943)[19] and (2) that the curvilinear retroactive inhibition function is obtained as the degree of interpolated learning increases (Melton tested and confirmed this in 1940)[20] Gibson's theory has been given further corroboration by other findings, e.g., Brigg's studies which showed that as original learning

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[18]E. J. Gibson, "A Systematic Application of the Concepts of Generalization and Differentiation to Verbal Learning," Psychological Review, XLVII (1940), 196-229.

[19]R. J. Hamilton, "Retroactive Inhibition Facilitation as a Function of Degree of Generalization Between Tasks," Journal of Experimental Psychology, XXXII (1943), 363-376.

[20]A. W. Melton and J. McQ. Irwin, "The Influence of Degree of Interpolated Learning on Retroactive Inhibition and the Overt Transfer of Specific Responses," American Journal of Psychology, LIII (1940), 173-203.

increases so must the interpolated learning level increase for maximal relative retroactive inhibition.[21]

The two-factor theory of Melton and Irwin mentioned above accounts for retroactive inhibition in the following manner. Intrusion of interpolated learning responses to original learning stimulus is one factor. This intrusion accounts for only part of the retroactive inhibition which is computed. Intrusions increased to a maximum when intermediate levels of interpolated learning had been reached, while retroactive inhibition rose sharply and maintained a relatively high level, decreasing only slightly at the highest level of interpolated learning. The rest of the retroactive inhibition not accounted for by overt competition is explained by their second factor. This was identified as the direct "unlearning" of original responses by their unreinforced elicitation or punishment, during interpolated learning. Melton and Irwin feel that unlearning is almost totally responsible for retroactive inhibition at the highest interpolated learning degree, and that retroactive inhibition under that condition most rapidly disintegrated after a few relearning trials. The conclusion followed that effects of such unlearning were quite transitory. The competition of response theory remained, in that the original learning was still seeming

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[21]G. E. Briggs, "Retroactive Inhibition as a Function of Degree of Original and Interpolated Learning," Journal of Experimental Psychology, LIII (1957), 60-67.

to compete with interpolated learning at recall. Yet to this was added the factor of unlearning the original material by a process of weakening response strength of original learning, if not complete extinction.[22]

The third theoretical position of retroactive inhibition has been developed by Underwood. He felt that even though overt intrusions dropped as the degree of interpolated learning increased, there was a more subtle intrusion in the form of implicit interference. Elaborating upon this suggestion, he formulated his differentiation theory. The shift in wrong response ratios was interpreted to be the result of two simultaneous processes. One is that the increasing interpolated learning strength tended to produce more overt intrusions. But at the point of increasing interpolated learning where over intrusions begin to decrease the process of growing differentiation overcomes the incorrect responses. The phenomenon of differentiation is described by Underwood as being "related to the verbally reported experience of 'knowing' on the part of the subject that the responses from the interpolated learning are inappropriate at the attempted recall of original learning. Degree of differentiation in this sense is thus an indication of the degree to which the subject

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[22]Melton and Irwin, op. cit.

identifies the list to which each response belongs."[23] Giving the subject more time for recall of original learning did not decrease the effects of retroactive inhibition and therefore the concept of unlearning was still retained.[24] Even so, since unlearning was shown to take place only in the first few interpolated learning trials, Underwood's revision of the two-factor theory became an important influence on subsequent retroactive inhibition thinking. After carefully surveying the literature, it seems that these major theories of retroactive inhibition have remained relatively unchallenged and unchanged over the past ten years.

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[23]B. J. Underwood, "The Effect of Successive Interpolations on Retroactive and Proactive Inhibition," <u>Psychological Monograph</u>, LIX (1945).

[24]B. J. Underwood, "Retroactive Inhibition with Increased Recall Time," <u>American Journal of Psychology</u>, LXIII (1950), 67-77.

CHAPTER III

STATEMENT OF THE PROBLEM

In spite of the immense amount of research which has been done on retroactive inhibition, there are still wide gaps in our knowledge about this phenomenon. One of the serious limitations of the research that has been carried out is that almost all of the experiments have used intellectively normal subjects. There has been only one reported study involving mentally retarded subjects using the retroactive inhibition paradigm. Cassel using list of words to be learned serially as the task, found no difference in the susceptibility to retroactive inhibition between mentally retarded and normal children.[25] Although many of the research findings on retroactive inhibition could be applied to the school situation, they could not be applied to special education for mentally retarded children since the research has not included these children as subjects.

There are two other studies using mentally retarded

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[25]R. H. Cassel, "Serial Verbal Learning and Retroactive Inhibition in Aments and Normal Children," (unpublished Doctoral dissertation, Northwestern University, 1957).

children which are related to the present study in that one compares mentally retarded children with gifted children and the other compares mentally retarded children with normal and superior children using paired associate pictures as a learning task. The first is a study by Goldstein and Kass (1961) of 21 educable mentally retarded children in special classes and 21 gifted children of the same mental age which was made to discover if educable mentally retarded children acquire learning incidentally in the course of a directed task, and if so, how accurate is the incidental learning. Although rate of learning was not the purpose of the test, the results showed that educable mentally retarded child on learned some of the less complex material as quickly as the gifted children.[26]

Eisman, in 1958, reported a study using 69 public Jr. High School children who were equally divided into three groups designated as superior, average and retarded children. Eisman wanted to compare the performance of mentally retarded children on the paired associate learning of a series of pictures with that of intellectually average and intellectually superior children. She found no significant differences in the measuring of learning, the measuring of retention or the measuring of stimulus

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[26]H. Goldstein and C. Kass, "Incidental Learning of Educable Mentally Retarded and Gifted Children," American Journal of Mental Deficiency, LXVI, (1961), 245-249.

generalization for the three groups.[27] There are several flaws in the construction of this study. I. Q. scores, which formed the basis of the division of the three groups, were not obtained by the same instrument for all of the S_s. Some I. Q. scores were obtained from group tests, while others were obtained from individual tests. Only seven pairs of pictures were used in the learning task with little attempt to make specific controls on the paired associates. The author, herself, states that it is necessary "to consider its (the study's) results as suggestive rather than conclusive."

It is often assumed that bright children learn more material at a faster rate than do dull children, of whom it might be said learn less material more slowly. But this is only an assumption, not an established fact, as the above studies would indicate. However, if this could be empirically confirmed, that bright children learn more material more quickly, it might follow that retroactive inhibition effects the bright children more than the dulls, because the bright children learn more material, in turn creating greater interference with previously learned activities. Or again it could follow that retroactive inhibition has a greater effect upon dull children as

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[27]B. S. Eisman, "Paired Associate Learning, Generalization and Retention as a Function of Intelligence," American Journal of Mental Deficiency, LXIII, (1958), 481-489.

compared with brights because, even though less material is learned, the dull children have less intellective capacity to handle what they do learn.

There has been no empirical evidence to establish the validity or the error of either of the above postulates. If more extensive research were done in this area, the results might confirm that mentally retarded children learn just as quickly as bright children, but within limits of certain types of materials. Because of the meager information in this field, nothing has been established as to what constitutes the most suitable organization of curriculum for educable mentally deficient children. If retroactive inhibition could be demonstrated in mentally retarded children and some of the variables affecting these processes isolated, then the curriculum planning and methods of teaching for classes for the educable mentally retarded could be more objective and less intuitive.

It is the purpose of this study to attempt to discover some of the differences if any, which exist in the suceptibility to retroactive inhibition, as computed in the retroactive inhibition paradigm, of mentally retarded children as compared to bright children, and thus to add to the limited body of knowledge in the field of retroactive inhibition and its implications for the mentally retarded.

The following hypotheses will be tested:

1. That there is a statistically significant

difference in performance on the relearning task between the Control subjects in the Dull range of intelligence and the Experimental subjects in the Dull range of intelligence (as measured by the total number of trials required for each subject to make a consecutive correct association on all twelve cards).

2. That there is a statistically significant difference in performance on the relearning task between the Control subjects in the Bright range of intelligence and the Experimental subjects in the Bright range of intelligence (as measured by the total number of trials required for each subject to make a consecutive correct association on all twelve cards).

3. That there is a statistically significant difference in performance on the relearning task between the Control subjects in the Dull range of intelligence and the Control subjects in the Bright range of intelligence (as measured by the total number of trials required for each subject to make a consecutive correct association on all twelve cards).

4. That there is a statistically significant difference in performance on the relearning task between the Experimental subjects in the Dull range of intelligence and the Experimental subjects in the Bright range of intelligence (as measured by the total number of trials required for each subject to make a consecutive correct

association on all twelve cards).

5. That there is a statistically significant difference in performance on the original learning task between all subjects in the Dull range of intelligence and all subjects in the Bright range of intelligence (as measured by the total number of trials required for each subject to make a consecutive correct association on all twelve cards).

CHAPTER IV

PROCEDURE OF STUDY

This experimental study took place at Jackson Junior High School in Oklahoma City, Oklahoma. Sixty seventh and eighth grade students were chosen as subjects for this study on a basis of IQ placement as measured by the 1960 revision of the Stanford Binet Intelligence Scale. The time of testing was designated to be carried out during the morning hours of the regular school day to insure against fatigue. The place provided to carry out the experiment was a room approximately fifteen feet by twenty-five feet which was ordinarily used by the special activities class to make school posters, designs, etc. The room was well ventilated and had adequate lighting. Each student was seated to the right of the examiner and both the examiner and student faced in the same direction.

The sixty subjects were first divided into two groups of thirty each. One group of thirty had obtained an IQ score within the range of 120-135 and the other group of thirty had obtained an IQ score within the range of 60-85. These two groups were designated as the Bright and Dull groups respectively. Each of the two groups were then randomly sub-divided into two sub-groups which contained fifteen subjects each. Thus, the original sixty students were divided into sub-groups which contained fifteen students each. One sub-group of fifteen students within the IQ range of 60-85 was designated as Group Number One, the Dull Control Group. The remaining fifteen subjects within the IQ range of 60-85 was designated as Group Number Two, The Dull Experimental Group. One sub-group of fifteen subjects within the IQ range of 120-135 was designated as Group Number Three, the Bright Control Group. The remaining fifteen subjects within the IQ range of 120-135 were designated as Group Number Four, the Bright Experimental Group.

Each of the thirty subjects who was selected by random method to comprise the Bright and Dull experimental sub-groups was treated in the following fashion: They were taken individually to the room described above where they were given the instructions which will be described in the Pilot Study. Then, each subject learned the first set of associated pictures, the original task which will also be described in the Pilot Study, to the criterion of twelve consecutive correct associations to the twelve stimulus pictures. After a one minute break the subject was asked to learn a second set of associated pictures, the interpolated activity, to the same criterion of learning as used in the original task. As soon as this was accomplished there was a one minute break and then the student was asked to relearn the original task, to the same criterion of learning. A separated record sheet for the original task, the interpolated task, and the relearning task was provided to the examiner to record each response made by the subject.

The thirty subjects who comprised the Bright and Dull control sub-groups were treated in the following fashion: They were taken individually to the designated room and after having been given the same instructions as the experimental groups, each learned the original associative task to the criterion of one correct repetition of the twelve correct associations to the stimulus pictures. After each student had met the criterion of learning on the associative task he was sent back into his classroom. Each teacher who had students involved in the study attempted to keep classroom activities as normal as possible, not scheduling tests, intellectual contests, etc. After approximately fifteen minutes of being back in the classroom the student was brought back to the testing room and he then was asked to relearn the original association task to the same criterion of learning. A record was kept of each response made by the subject.

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 the association of two pictures which were paired together on five-inch by eight-inch cards. The subjects were given these instructions: "I am going to show you a set of twelve cards. Each card has two pictures on it, and you are to remember which two pictures go together. After you have looked at these cards, one at a time, we will look at another set of cards, but this second set will have only one picture on each card. You are to name the picture which is missing on each card." A trial with two example cards (one with two pictures, the other with one picture) was given with the above instructions to insure that the subject knew what was expected of him. Twelve cards with paired pictures were presented to the subject at the rate of one every three seconds, then, the second set of twelve cards with only the left hand picture of each pair on each card was presented at the rate of one every five seconds. The longer time interval on the second series was to give the subject time to name the missing picture. The intertrial intervals are ten seconds in length. This procedure was continued until the criterion of learning, which is twelve consecutive correct responses was reached.

A review of the literature on paired associative studies of verbal learning revealed that all studies but one used either paired nouns, paired adjectives, or nonsense syllables. 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 is used, this might have presented a variable in the difficulty of learning the 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 in an obvious manner 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 a group of seventy-five kindergartern 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 to be included in a series. The length desired was the minimum 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 confidence.

The list was then lengthened to sixteen, twenty, and twenty-four pairs in order to see what effect the 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 as discriminative as the twelve-pair list. Apparently, the task of only eight pairs was so easy for all grade levels that it did not discriminate between them. Eisman used seven pairs and criticized her study in that her lists may not have been long enough to be discriminative.[28] The twelve-pair list

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[28] B. S. Eisman, "Paired Associate Learning, Generalization and Retention as a Function of Intelligence," American Journal of Mental Deficiency, LXIII (1958), 487.

proved to be of optimum length for easy administration and discriminability in the pilot study.

During the Pilot Study's 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 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 might 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.

Subjects

There was a total of sixty subjects used for this experiment. The subjects were taken from the seventh and eighth grades in equal numbers and approximately half the subjects were female. All subjects were students of Jackson Junior High School which is located in the South

Western area of Oklahoma City, Oklahoma. All subjects were from very much the same socio-economic level. None of the sixty subjects chosen were functioning academically under or over that which would normally be expected from an individual possessing the IQ score which he had obtained. This is to say that all subjects were operating academically in a fashion which was consistent with their IQ level. There were no individuals included in the study who had been reported by his teachers to have engaged in anti-social behavior to the extent that he was labeled a behavior problem. Thirty of the subjects, fifteen of which were from the seventh grade and fifteen of which were from the eigth grade, obtained an IQ score between 120-135, as measured by the 1960 Revised Version of the Stanford Binet Intelligence Scale. These thirty subjects comprised the "Bright Group" which was used in the experiment. Using the random method of selection fifteen subjects were designated as the Bright Control Group, and the fifteen remaining subjects were designated as the Bright Experimental Group.

The remaining thirty of the total sixty subjects used were also taken in equal numbers from the seventh and eighth grade level. These subjects obtained an IQ score, as measured by the 1960 Revised Version of the Stanford Binet Intelligence Scale, between 60-85. These thirty subjects comprised the "Dull Group" which was used in the experiment. Again using the random method of selection, fifteen subjects were designated as the Dull Control Group, and the remaining fifteen subjects were disignated as the Dull Experimental Group.

Of the sixty subjects used, thirty obtained IQ scores within the range of 120-135 and thirty obtained IQ scores within the range of 60-85, as measured by the 1960 Revision of the Stanford Binet Intelligence Scale.

The subjects were divided into four groups. Group Number One refers to fifteen subjects, scoring within the IQ range of 60-85, who were designated as the Dull Control Group. Each subject in this group learned the original task then after experiencing the filler task, which last approximately fifteen minutes, were brought back individually to relearn the original task.

Group Number Two refers to fifteen subjects scoring within the IQ range of 60-85, who were designated as the Dull Experimental Group. Each subject in this group learned the original task; then after a one minute break were asked to learn a new task, the interpolated activity. After learning this interpolated task to the same criterion of learning as used in the original task, each subject, following a minute break, was asked to relearn the original task.

Group Number Three refers to fifteen subjects scoring within the IQ range of 120-135, who were designated as the Bright Control Group. Each subject in this group learned the original task; then after experiencing the filler task, lasting approximately fifteen minutes and which was discussed at the beginning of this chapter under Procedure of the Study, were brought back individually to relearn the original task.

Group Number Four refers to fifteen subjects scoring within the IQ range of 120-135, who were designated as the Bright Experimental Group. Each subject in this group learned the original task; then after a one minute break were asked to learn a new task, the interpolated activity. After learning this interpolated task to the same criterion of learning as used in the original task, each subject, following a minute break, was asked to relearn the original task.

The Test Instrument

The test materials consisted of two booklets and an individual recording sheet. Each booklet contained sixteen five-inch by eight-inch #10 wt. cardboard cards bound together by a flexible plastic spiral band. Booklet one contained thirteen cards, on each of which there appeared two outlined drawings of common objects, plus three blank cards. The three blank cards served as a front, back, and a blank page between the sample card and the other twelve stimuli cards. The first card was used for instructional purposes, and it was set off from the other twelve stimuli cards by one blank card. Booklet Two contained thirteen cards on which only the left hand picture of the stimulus pair appeared and the right hand side of the card was blank. As in Booklet One the first card of Booklet Two served as the sample card used for instructional purposes and the other twelve cards contained the pictures for the test proper.

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 heading, The Pilot Study. The criteria for selection of the pictures for the test series are again listed: The pictures were simple out-line drawing in India Ink of common objects; the words represented by the pictures were one-syllable nouns; the pictures were consistently identifiable; and the pictures were not in any obvious manner potentially affect arousing.

The examiner was provided with individual record sheets for each subject on which appeared the name of the subject, his Stanford Binet IQ, age, and grade level.

The Experimental Task

The experimental task began with the following directions. "I am going to show you a set of twelve cards. Each card has two pictures on it and you are to remember which two pictures go together. After you have looked at these cards one at a time, I will show you another set of cards, but this second set will have only one picture on each card. You are to name the picture which is missing on each card." Two example cards were exposed (one having the two pictures on it and the other having only one picture) during the above directions. After it was clear to the examiner that the subject knew what was expected of him the experiment proceeded as follows. Each card on which appeared two pictures was exposed at a rate of one every three seconds until all twelve cards had been shown. This three seconds interval was timed by a stop watch which was observable by the examiner. The booklet was then put aside and the subject told, "Now I will show you the other set of cards and you are to tell me what picture is missing." The other booklet was then opened and each card with only one picture appearing on it was exposed at the rate of one card every five seconds (again this was timed by a stop watch). This rate of presentation was observed even though the subject may not have made the correct association by recalling the picture that was originally paired with the present stimulus picture. The examiner was equipped with check sheet which allowed him to check every response that was made to each stimulus picture. If the subject did not make correct associations on all twelve stimulus cards the examiner would say, "Now look at the cards again and try to remember the pictures that go together." He would then pick up the booklet which has the two pictures on each card and, without exposing the example card, continue the same procedure as described above. This method was observed until the criterion of learning was reached. The criterion of learning was that the subjects made twelve consecutive correct associations. Another way of stating it would be that if the subject missed any one of the twelve correct associations the criterion of learning had not been reached.

CHAPTER V

RESULTS AND DISCUSSION

The results of this study are presented in Table 1. In the first column is listed the name of each of the four groups with its qualifying data, i.e., I. Q. range of the subjects, number, and grade level of subjects in each group. Column two gives the total number of learning trials for each group on original learning, plus a combined total of both groups in each intelligence range. The third column consists in the naming of the interpolated task for each group. And column four shows the total number of trials for each group on relearning and the combined total of both the control and experimental groups in each range of intelligence.

The four groups listed are: Group I, the dull intelligence range (I.Q. 60-85) control group; Group II, the dull intelligence range (IQ 60-85) experimental group; Group III, the bright intelligence range (IQ 120-135) control group; and Group IV, the bright intelligence range (IQ 120-135) experimental group. The total number of trials for Group I on original learning was 80. Group II

TABLE 1

RESULTS OF RETROACTIVE INHIBITION EXPERIMENT - TOTAL NUMBER OF TRIALS ON ORIGINAL LEARNING AND RELEARNING FOR EACH GROUP

Groups	Total Number of Trials on OL	Interpolated Task	Total Number of Trials on RL
I Dull Control IQ 65-80 15 S_s (7th-8th)	80	Filler Task (classroom)	17
II Dull Exper. IQ 65-80 15 S_s (7th-8th)	93	Learned 2nd Set of Pictures	52
Total	173		69
III Bright Control IQ 120-135 15 S (7th-8th)	68	Filler Task (classroom)	20
IV Bright Exper. IQ 120-135 15 S_s (7th-8th)	67	Learned 2nd Set of Pictures	27
Total	135		47

took a total of 93 original learning trials. Groups III and IV had totals of 68 and 67 trials respectively on the original learning task. After having completed original learning, the subjects of Groups I and III went back to their classrooms for fifteen minutes, during which time they experienced the filler task, before returning to the testing room and relearning the original material. The total number of trials on relearning were 17 and 20 for Groups I and III respectively. Groups II and IV were given a break of approximately one minute after original learning before the interpolated task was begun. This interpolated task consisted of learning a new set of twelve paired associative pictures. When the interpolated task had been learned to the same criterion as the original learning, i.e., consecutive correct responses to all twelve stimulus cards, the subjects of Groups II and IV were given another one minute break after which they undertook to relearn the original learning. Group II had a total of 52 trials on relearning, and Group IV had a total of 27 trials on relearning. The criterion of learning for relearning was the same as that of original learning and interpolated learning.

Table 2 classifies each subject in the study according to his respective group and according to the total number of trials he took to reach the criterion of learning on both original learning and relearning. The numbers one through nine across the top of the table indicate the number of trials taken to reach the criterion of learning. No subject took more than nine trials on either the original learning or the relearning task. The headings on the left of the table represent the respective groups on the original or relearning task. For example, Group I_{OL} stands for the Dull Control Group on the original learning task; Group

TABLE 2

CLASSIFICATION OF EACH SUBJECT ACCORDING TO GROUP AND NUMBER OF TRIALS TAKEN TO REACH CRITERION OF LEARNING

Group	Number of Trials								
	1	2	3	4	5	6	7	8	9
I_{OL}			2	4	2	4		2	1
I_{RL}	13	2							
II_{OL}				3	5	1		4	2
II_{RL}	1	5	3	2	1	2	1		
III_{OL}		1	3	5	4			2	
III_{RL}	11	3	1						
IV_{OL}		2	4	2	2	3	1	1	
IV_{RL}	6	6	3						
I and II_{OL}			2	7	7	5		6	3
III and IV_{OL}		3	7	7	6	3	1	3	

IV_{RL} represents the Bright Experimental Group on the relearning task. When a number appears in a cell of the table it represents subjects of the study. To find how many subjects in Group II on the original learning task took five trials before reaching the criterion of learning, one must find Group II_{OL} at the left of the table and read across to column five which is indicated at the top of the table. In this example the table indicates that there were five subjects in Group II who took five trials on the original learning task.

The Kolmogorov-Smirnov Two-Sample Test[29] and the Walsh Test for Related Samples[30] were the statistical techniques used to analyze the data of this study in comparing the four groups on the original learning and the relearning tasks. Using the Kolmogorov-Smirnov Two-Sample Test a comparison of the results in performance of subjects in Groups I and II on the relearning task is shown in Table 3. For analysis these data were cast into two cumulative frequency distributions. Observe that the largest discrepancy between the two series is $\frac{12}{15}$. $K_D = 12$, the numerator of this largest difference. Reference to Kolmogorov-Smirnov's Table L reveals that when N = 15, a value of $K_D = 9$ is significant at the one per cent level of confidence.[31] This finding reveals that there is a statistically significant difference between the performance on relearning between Group I, who did not have an interpolated learning task, and Group II who did have an interpolated learning task. It is therefore demonstrated that the subjects in the dull experimental group were susceptible to retroactive inhibition. Hypothesis one, which states, that there is a statistically significant difference in

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

[30] Ibid., 278.

[31] Ibid., 278.

TABLE 3

COMPARISON OF GROUPS I AND II ON RELEARNING TASK

Groups	Percent of Total Trials								
	6-16	17-27	28-38	39-49	50-60	61-71	72-82	83-93	94-100
I RL S_s15	13/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15
II RL S_s15	1/15	6/15	9/15	11/15	12/15	14/15	15/15	15/15	15/15
I RL S_s15 II RL S_s15	12/15	9/15	6/15	4/15	3/15	1/15			

performance on the relearning task between the Control subjects in the Dull range of intelligence and the Experimental subject in the Dull range of intelligence as measured by the total number of trials required for each subject, is sustained on the basis of these findings.

Table 4 shows the same comparison for Groups III and IV as Table 3 shows for Groups I and II. The Kolmogorov-Smirnov Two-Sample Test was again used to compare the performances of subjects in Groups III and IV on the relearning task. This table shows that the largest discrepancy between the two series is $\frac{5}{15}$. $K_D = 5$, the numerator of this largest difference. Reference to Kolmogorov-Smirnov's Table L reveals that when N = 15, a value of $K_D = 9$ is significant at the one per cent level of confidence or a value of $K_D = 8$ is significant at the five per cent level of confidence. Since a value of $K_D = 5$ was obtained, and a value of $K_D = 9$ or 8 is needed to show significance, we therefore reject hypothesis two, which states that there is a statistically significant difference in performance on the relearning task between the Control subjects in the Bright range of intelligence and the Experimental subjects in the Bright range of intelligence as measured by the total number of trials required for each subject to make a consecutive correct association on all twelve cards.

In Table 5 a comparison of the performances of subjects in Groups I and III on the relearning task is

TABLE 4

COMPARISON OF GROUPS III AND IV ON RELEARNING TASK

Groups	Percent of Total Trials								
	6-16	17-27	28-38	39-49	50-60	61-71	72-82	83-93	94-100
III RL S15	11/15	14/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15
IV RL S15	6/15	12/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15
III RL S15 IV RL S15	5/15	2/15							

TABLE 5

COMPARISON OF GROUPS I AND III ON RELEARNING TASK

Groups	Percent of Total Trials								
	6-16	17-27	28-38	39-49	50-60	61-71	72-82	83-93	94-100
S_s 15 Group I RL			2/15	6/15	8/15	12/15	12/15	14/15	15/15
S_s 15 Group III RL		1/15	4/15	9/15	13/15	13/15	13/15	15/15	15/15
S_s 15 Group I S_s 15 Group III RL		1/15	2/15	3/15	5/15	1/15	1/15	1/15	

shown. The Kolmogorov-Smirnov Two-Sample Test was used to compare the performance of Group I, the dull control group, and Group III, the bright control group, on the relearning task. The largest discrepancy between the two series is 5/15. $K_D = 5$, the numerator of this largest difference. Reference to Kolmogorov-Smirnov's Table L reveals that when N = 15, a value of $K_D = 9$ or 8 is needed to show a statistically significant difference at the one per cent or five per cent level of confidence, respectively. Since a value of $K_D = 5$ was obtained in this comparison, the conclusion is that there is no difference in the performance of Group I as compared to Group III on the relearning task. In view of this finding hypothesis three, that there is a statistically significant difference in performance on the relearning task between the Control subjects in the Dull range of intelligence and the Control subjects in the Bright range of intelligence (as measured by the total number of trials required for each subject), is therefore rejected.

Table 6, shows a comparison of the performances of the subjects in Group II, the dull experimental group, and Group IV, the bright experimental group, on the relearning task, using the Kolmogorov-Smirnov Two-Sample Test. Here the largest discrepancy between the two series in 5/15. $K_D = 5$, the numerator of this largest difference. When N = 15, a value of $K_D = 9$ or 8 is needed to show significance. Since the value of $K_D = 5$ was obtained on this comparison,

TABLE 6

COMPARISON OF GROUPS II AND IV ON RELEARNING TASK

Groups	Percent of Total Trials								
	6-16	17-27	28-38	39-49	50-60	61-71	72-82	83-93	94-100
Subjects 15 Group II RL	1/15	6/15	9/15	11/15	12/15	14/15	15/15	15/15	15/15
Subjects 15 Group IV RL	6/15	11/15	14/15	14/15	14/15	15/15	15/15	15/15	15/15
S 15 Group II RL S 15 Group IV RL	5/15	5/15	5/15	3/15	2/15	1/15			

it is concluded that there is no difference in the performance of Group II and Group IV on the relearning task. On the basis of this finding hypothesis four, that there is statistically significant difference in performance on the relearning task between the Experimental subjects in the Dull range of intelligence and the Experimental subjects in the Bright range of intelligence (as measured by the total number of trials required for each subject to make a consecutive correct association on all twelve cards), is rejected.

Table 7 shows the comparison of all subjects in the dull range of intelligence, i.e., Groups I and II, with all subjects in the bright range of intelligence, i.e., Groups III and IV, on the original learning task. Using the Kolmogorov-Smirnov Two-Sample Test, the results show that the largest discrepancy between the two series is 8/30. Therefore, $K_D = 8$, the numerator of this largest difference. Reference to Kolmogorov-Smirnov's Table L reveals that when $N = 30$, a value of $K_D = 13$ must be obtained to show significance at the one per cent level or a value of 11 to show significance at the five per cent level of confidence. Since a value of $K_D = 8$ was obtained, it is therefore concluded that there is no significant difference between the performance of subjects in the dull range of intelligence and subjects in the bright range of intelligence on the original learning task. In the light of

TABLE 7

COMPARISON OF COMBINED GROUPS I, II AND III, IV ON ORIGINAL LEARNING

Groups	Percent of Total Trials								
	6-16	17-27	28-38	39-49	50-60	61-71	72-82	83-93	94-100
Subjects 30 Groups I & II OL			2/30	9/30	16/30	21/30	21/30	27/30	30/30
Subjects 30 Groups III & IV OL		3/30	10/30	17/30	23/30	26/30	27/30	30/30	30/30
Subjs 30 Group I, II OL – Subjs 30 Group III IV OL		3/30	8/30	8/30	7/30	6/30	6/30	3/30	

these findings hypothesis five is rejected. Hypothesis five states that there is a statistically significant difference in performance on the original learning task between all subjects in the Dull range of intelligence and all subjects in the Bright range of intelligence (as measured by the total number of trials required for each subject to make a consecutive correct association on all twelve cards).

The Walsh Test for Related Samples[32] was used to analyze the data on the performance on original learning compared with relearning in each of the groups. Although the performance on original learning compared with relearning within the same group was not among the hypotheses which were tested, the writer feels it is necessary to demonstrate statistically the differences which exist. Tables 8 through 11 show a comparison within Groups I through IV, respectively, of number of trials made by each subject to reach the criterion of learning on the original learning and the relearning tasks. The differences between these two tasks in number of trials made by each subject are ranked in numerical order from the smallest difference to the largest difference. The numerical value of these differences is then substituted in the appropriate formula found in the Table of Critical Values for the Walsh Test.[33] Note that for each of the four groups

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[32] Ibid., 83-87.

[33] Ibid., 255.

TABLE 8

COMPARISON OF DULL CONTROL GROUP ON ORIGINAL LEARNING AND RELEARNING

Subject	Number of trials to reach criterion of Learning on OL.	Number of Trials to reach criterion of Learning on RL.	d
a	3	1	2
b	3	1	2
c	4	1	3
d	4	1	3
e	4	1	3
f	4	1	3
g	5	1	4
h	5	1	4
i	6	1	5
j	6	1	5
k	6	1	5
l	6	1	5
m	8	2	6
n	8	1	7
o	9	2	7
	Minimum Value Obtained = 3*		

*Significant at .01 level.

TABLE 9

COMPARISON OF DULL EXPERIMENTAL GROUP ON ORIGINAL LEARNING AND RELEARNING

Subject	Number of trials to reach criterion of Learning on OL.	Number of Trials to reach criterion of Learning on RL.	d
a	4	2	2
b	4	2	2
c	5	3	2
d	5	3	2
e	8	6	2
f	9	7	2
g	4	1	3
h	4	2	3
i	5	2	3
j	5	2	3
k	6	3	3
l	8	5	3
m	9	6	3
n	8	4	4
o	8	4	4
	Minimum Value Obtained = 2*		

*Significant at .01 level.

TABLE 10

COMPARISON OF BRIGHT CONTROL GROUP ON ORIGINAL LEARNING AND RELEARNING

Subject	Number of Trials to reach Criterion of Learning on OL.	Number of Trials to reach Criterion of Learning on RL.	d
a	2	1	1
b	3	1	2
c	3	1	2
d	3	1	2
e	4	1	3
f	4	1	3
g	4	1	3
h	4	1	3
i	4	1	3
j	5	2	3
k	5	2	3
l	5	1	4
m	5	1	4
n	8	3	5
o	8	2	6
	Minimum Value Obtained = 2*		

*Significant at .01 level.

TABLE 11

COMPARISON OF BRIGHT EXPERIMENTAL GROUP ON ORIGINAL LEARNING AND RELEARNING

Subject	Number of Trials to reach Criterion of Learning on OL.	Number of Trials to reach Criterion of Learning on RL.	d
a	2	1	1
b	2	1	1
c	3	1	1
d	3	1	2
e	3	1	2
f	3	1	2
g	4	2	2
h	4	2	2
i	8	6	2
j	5	2	3
k	5	2	3
l	6	3	3
m	6	3	3
n	6	2	4
o	7	3	4
Minimum Value Obtained = 2*			

*Significant at .01 level.

the values obtained by using the Walsh technique are significant at the one per cent level of confidence. In each instance subjects took significantly less trials to reach the criterion of learning on the relearning task than they did on the original learning task.

Summary of Results

A summary of the results of this study reveals that there is a statistically significant difference in performance on the relearning task between subjects in the dull control group and subjects in the dull experimental group. The interference effect of the new learning in the interpolated task was such that the subjects in the dull experimental group took significantly more trials to reach the criterion of learning on the relearning task than did the subjects in the dull control group, who had no interpolated task. This significant difference in performance between subjects in the dull control group and subjects of the dull experimental group on the relearning task demonstrates the phenomenon of retroactive inhibition.

A statistically significant difference was not found in performance on the relearning task between subjects in the bright control group and subjects in the bright experimental group. The interference of the new learning in the interpolated task did not significantly effect the performance of the subjects in the bright experimental group on the relearning task when compared to the performance of subjects in the bright control group who had no interpolated task. The phenomenon of retroactive inhibition was not demonstrated here.

When the performance on the relearning task of subjects in the dull control group were compared with the performance on the relearning task of subjects in the bright control group, no statistically significant difference was observed.

A statistically significant difference was not observed when comparing the performance on the relearning task for subjects in the dull experimental group with the performance on the relearning task for subjects in the bright experimental group, although the difference in this comparison approaches significance.

The subjects of the dull control and experimental groups were compared with the subjects of the bright control and experimental groups. This comparison was made on the number of trials it took each subject to reach the criterion of learning in the original learning task. A statistically significant difference was not found in the performance of the dull subjects when compared to the performance of the bright subjects on the original learning task. Therefore, in this study, the bright subjects did not learn the original task significantly quicker than did the dull subjects.

A comparison within each group was made between its performances on the original learning task and the relearning task. Although the differences in performance of the subjects between these task seemed obvious, it was necessary to demonstrate these differences statistically. In each of the four groups there was a statistically significant difference obtained at the one per cent level of confidence between the performance of the subjects on original learning and relearning.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The whole educative process is directed toward the goal of providing experiences which will result in desirable changes of behavior. Learning is involved in these behavioral changes. The more that is understood concerning the learning process, the more effective will be these experiences which are provided in the education curriculum.

In an attempt to understand the learning process, it is necessary to deal with forgetting. Retroactive Inhibition, has been most fruitful in understanding the process of forgetting. If by using the Retroactive Inhibition paradigm, forgetting can be experimentally produced, then our understanding of the conditions that cause forgetting can be enhanced. It is necessary to know how forgetting operates at the different levels of mentality. Do the same experiences cause the same amount of forgetting in the intellectively dull person as in the intellectively bright person or is there a difference?

The purpose of this study was to examine the effects of retroactive inhibition on intellectively bright adolescents as compared to the effects of retroactive inhibition on intellectively dull adolescents. There is sufficient evidence in the literature to show that a great deal of energy has been invested in the study of retroactive inhibition. However, in all of the literature reviewed, the only study found which involved mentally retarded subjects using the Retroactive Inhibition paradigm was Cassell's.[34] There were two other studies using mentally retarded subjects which are related to the present study. Goldstein and Kass[35] compared mentally retarded children with gifted children of the same mental age in an attempt to discover if educable mentally retarded children acquire learning incidentally in the course of a directed task. Eisman[36] used three groups designated as intellectively superior, average, and retarded children. Her purpose was to compare the performance of mentally retarded on the paired associate learning of a series of pictures with that of intellectively average and intellectively superior

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[34]R. H. Cassel, "Serial Verbal Learning and Retroactive Inhibition in Aments and Normal Children" (unpublished Doctoral dissertation, Northwestern University, 1957).

[35]H. Goldstein and C. Kass, "Incidental Learning of Educable Mentally Retarded and Gifted Children," American Journal of Mental Deficiency, LXVI (1961), 245-249.

[36]B. S. Eisman, "Paired Associate Learning, Generalization and Retention as a Function of Intelligence," American Journal of Mental Deficiency, LXIII (1958), 481-489.

children. Neither Goldstein and Kass nor Eisman were interested in the effect of retroactive inhibition, but their studies are related to the present one in that mentally retarded children were used as subjects.

Sixty subjects were used in this study. All subjects were chosen from the seventh and eighth grades in equal numbers and approximately half were female. The subjects were from very much the same socio-economic level and all attended Jackson Junior High School in Oklahoma City, Oklahoma. None of the subjects chosen for the study were functioning academically under or over that which would normally be expected from an individual possessing the I. Q. score which he had received according to the Stanford Binet Scale. Thirty of the subjects, fifteen of which were from the seventh grade and fifteen of which were from the eighth grade, obtained an I. Q. score between 120-135, as measured by the 1960 Revised Version of the Stanford Binet Intelligence Scale. The remaining thirty of the total sixty subjects used had obtained I. Q. scores between 60-85, as measured by the 1960 Revised Version of the Stanford Binet Scale.

The sixty subjects used, thirty of which had obtained I. Q. scores within the range of 120-135 and thirty of which had obtained I. Q. scores within the range of 60-85, were divided into four groups as follows:

Group I refers to fifteen subjects randomly chosen from the thirty subjects who had scored within the 60-85 I. Q. range. This group was designated as the Dull Control Group.

Group II refers to the remaining fifteen subjects who obtained I. Q. scores within the I. Q. range of 60-85. This group was designated as the Dull Experimental Group.

Group III refers to fifteen subjects, randomly selected from the thirty subjects who obtained I. Q. scores within the I. Q. range of 120-135. This group was designated as the Bright Control Group.

Group IV refers to the remaining fifteen subjects who obtained I. Q. scores within the I. Q. range of 120-135. This group was designated as the Bright Experimental Group.

Each subject in the Bright and Dull control groups (Groups I and III) individually learned task one. Task one consisted of learning the association of two pictures of common objects which were paired together on a five by eight card. There were twelve such pairs appearing on separate cards. When the criterion of learning, which was twelve consecutive correct associations, was reached, task one was completed. The subjects in Groups I and III were then sent back to their respective classrooms for a fifteen minute interval. After this interval, each subject was brought back to the testing room to relearn task one to the same criterion that was previously used.

Each subject in the Bright and Dull experimental groups (Groups II and IV) individually learned task one to the same criterion of learning as Groups I and III. Following a one minute interval, task two, which consisted of twelve different paired pictures to be learned with the same instructions and to the same criterion of learning as task one, was introduced. Then following a one minute interval, the relearning of task one to the same criterion as was previously used, was attempted by each subject in Groups II and IV.

Five hypotheses were tested. The hypothesis that there is a statistically significant difference in performance on the relearning task between the Control subjects in the Dull range of intelligence and the Experimental subjects in the Dull range of intelligence (as measured by the total number of trials required for each subject to make a consecutive correct association on all twelve cards), was sustained at the one per cent level of confidence. In this study, the phenomenon of retroactive inhibition was, therefore, demonstrated by the subjects in the dull range of intelligence. The interpolated task was such for the dull experimental subjects that it interfered with their relearning of the original material. The amount of inhibition experienced by the dull experimental group becomes important only when compared to the amount of inhibition which the dull control group experienced. When this comparison of performance is made and a statistically significant difference found, herein lies the phenomenon of retroactive inhibition.

Hypothesis two, that there is a statistically significant difference in performance on the relearning task between the Control subjects in the bright range of intelligence and the Experimental subjects in the Bright range of intelligence (as measured by the total number of trials required for each subject to make a consecutive correct association on all twelve cards) was not sustained. The subjects in the bright range of intelligence were not found to be susceptible to the phenomenon of retroactive inhibition in this learning situation. The results of hypothesis one and hypothesis two do not confirm the findings of Cassel[37] who found no differential retroactive inhibition susceptibility between his normal and mentally defective subjects. One of the differences between the present study and Cassel's study is that he compared mentally dull subjects with mentally normal subjects while this present study compared mentally dull subjects with mentally bright subjects. However, one might speculate that one reason why a differential retroactive inhibition susceptibility was found here is that the interpolated learning task was not complex enough to tax the mentality of the bright subjects. Consequently, they were able to learn the interpolated task with such ease that no inhibitory effect

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[37]Cassel, op. cit.

was set up. Whereas, in the case of the dull subjects the interpolated learning task was of such complexity to significantly interfere with their relearning of the original material.

Hypothesis three, that there is a statistically significant difference in performance on the relearning task between the Control subjects in the Dull range of intelligence and the Control subjects in the Bright range of intelligence (as measured by the total number of trials required for each subject to make a consecutive correct association on all twelve cards) was rejected. This finding reveals that when there is no interference effect of new learning there is no significant difference in the rate of forgetting between both the dull and bright ranges of intelligence. Another way to state this finding is that subjects in both the dull and bright ranges of intelligence can remember equally well that which has once been learned when there has been no interference effect of new learning.

Hypothesis four, that there is a statistically significant difference in performance on the relearning task between the Experimental subjects in the Dull range of intelligence and the Experimental subjects in the Bright range of intelligence (as measured by the total number of trials required for each subject to make a consecutive correct association on all twelve cards), was also rejected.

Even though a significant difference was not found between the dull experimental group and the bright experimental group, this difference was approaching significance.

Hypothesis five, which states that there is a statistically significant difference in performance on the original learning task between all subjects in the Dull range of intelligence and all subjects in the Bright range of intelligence (as measured by the total number of trials required for each subject to make a consecutive correct association on all twelve cards), was rejected. This finding indicates that the subjects in the bright intelligence range did not learn the original material significantly more quickly than did the subjects in the dull intelligence range. Although it cannot be concluded from this that dull subjects can learn all material as quickly as bright subjects, the writer feels it is a valuable finding to substantiate that dull subjects can learn material up to a certain level of complexity at the same rate as bright subjects. These results do support the findings by Eisman,[38] who also found no significant difference in rate of learning between mentally retarded, normal, and mentally superior subjects. Yet, Eisman, herself, stated that her study included enough confounding variables to make her results suggestive rather than

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[38]Eisman, op. cit.

conclusive.

One conclusion drawn from this present study is that when dull and bright subjects have a learning experience, the dull subjects will be less able to remember what has been learned than will the bright subjects if there has been new learning interpolated between the original material and the later recall of that material. Further, when the bright and dull subjects have a learning experience and there is no interference of new learning, there will be no difference between the performances of dull and bright subjects in the recall of this learned material. Further research wherein the degree of complexity of the interpolated task is varied is suggested.

Another conclusion drawn from this study is that the rate of learning of material up to a certain level of complexity is the same for both bright and dull subjects. It is suggested that further investigation be done by varying the degree of complexity of the original task in order to pin down the point at which complexity of material begins to discriminate between dull and bright subjects in rate of learning.

If further investigation does confirm the conclusions drawn from the present study, i.e., that individuals in the dull range of intelligence are more susceptible to the interference effect of new learning (retroactive inhibition) than are individuals in the bright range of intelligence, and that rate of learning for both bright and dull ranges of intelligence is the same up to a certain point of complexity, then a substantial step in the understanding of the learning process at these two levels of mentality will have been made.

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APPENDIX

INDIVIDUAL RECORD SHEET
ORIGINAL LEARNING TASK

Name____________________________Age________

I. Q.____________________Teacher__________________

Pairs		Number of Trials															
Stimulus	Response	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
bread	(clock)																
tree	(shoe)																
kite	(fish)																
coat	(sun)																
duck	(saw)																
bird	(lamp)																
hat	(cup)																
comb	(drum)																
leaf	(house)																
chair	(dress)																
box	(pig)																
car	(fork)																

INDIVIDUAL RECORD SHEET
INTERPOLATED LEARNING TASK

Name____ Age__________

I. Q.__________________________________ Teacher__________________

Pairs		Number of Trials															
Stimulus	Response	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
tent	(brush)																
bus	(cow)																
horn	(boat)																
glass	(dog)																
feet	(key)																
frog	(broom)																
cat	(bed)																
star	(train)																
moon	(door)																
ball	(rake)																
sled	(bone)																
spoon	(slide)																