THE INFLUENCE OF INTELLIGENCE AND INTERLIST STIMULUS SIMILARITY IN THE VERBAL LEARNING AND RETENTION OF A PAIRED ASSOCIATE LEARNING TASK

JOHN PATRICK McGREGOR

THE INFLUENCE OF INTELLIGENCE AND INTERLIST STIMULUS SIMILARITY IN THE VERBAL LEARNING AND RETENTION OF A PAIRED ASSOCIATE LEARNING TASK

An Abstract

Presented to

the Graduate Council of

Austin Peay State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

by

John Patrick McGregor

May 1972

ABSTRACT

The purpose of this study was to investigate the relationship of intelligence and the ability to discriminate among competing stimuli at various levels of similarity. The null hypotheses were:

1. There is no relationship between intelligence and stimulus similarity as measured by overall learning of verbal material in a paired associate learning task.
2. There is no relationship between intelligence and stimulus similarity as measured by recall and relearning of verbal material in a paired associate learning task.

Sixty-three fourth grade Ss were divided into three IQ groups which had ranges of 114 to 136, 96 to 103, and 72 to 88 and means of 121.9, 99.7, and 81.6, respectively. Each of the IQ groups were randomly distributed across three treatment groups. All Ss learned one list (list A) of five paired associates with the anticipation method in which the stimulus items were nonsense syllables and the response items were high association value words. The treatment consisted of learning one of three interpolated lists (list B) of paired associates in which the stimulus items shared two, one, or zero letters with list A, depending on the similarity group to which the S had been assigned. The response items of all the interpolated lists were identical to each other but they were dissimilar to the response items in list A. All Ss

were then tested for recall and relearning on list A. The criterion for original learning on lists A and B and relearning list B was one perfect trial of five correct anticipations of the response items.

Results indicated that as stimulus similarity increased learning and retention for low IQ Ss improved significantly, and under the high similarity condition there was a tendency for low IQ Ss to learn faster and retain more than high IQ Ss. Learning and retention generally improved for high IQ Ss as stimulus similarity decreased. The results failed to support a theory of inhibition of attention for low IQ learners, and it was suggested that the relationship between learning abilities and intelligence, as measured by the usual IQ test, needs to be seriously reexamined.

THE INFLUENCE OF INTELLIGENCE AND INTERLIST STIMULUS SIMILARITY IN THE VERBAL LEARNING AND RETENTION OF A PAIRED ASSOCIATE LEARNING TASK

A Thesis

Presented to

the Graduate Council of

Austin Peay State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

by

John Patrick McGregor

May 1972

LIST OF TABLES

To the Graduate Council:

I am submitting herewith a Thesis written by John Patrick McGregor entitled "The Influence of Intelligence and Interlist Stimulus Similarity in the Verbal Learning and Retention of a Paired Associate Learning Task." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Psychology.

Garland E. Blair
Major Professor

We have read this thesis and recommend its acceptance:

Beulah B. Murray
Minor Professor
or
Second Committe Member

Elizabeth H. Stokes
Third Committee Member

Accepted for the Council:

Wayne E. Stamper
Dean of the Graduate School

ACKNOWLEDGEMENTS

The author wishes to express appreciation to the members of the graduate committee, Drs. Garland Blair, Elizabeth Stokes, and Beulah Murray. Special appreciation goes to Dr. Blair, whose consultation and suggestions for analysis of data and results were invaluable.

The author would like to thank the personnel in the Clarksville-Montgomery School System without whose total cooperation this study would not have been possible: Mr. O. B. Moorehead, Coordinator of Instruction for Clarksville-Montgomery County Schools; Mr. Albert E. Alcock and Mrs. Grace Cunningham, school principals; Mrs. Saundra Cain, Mrs. Vergie Partain, Mrs. Vernon Shasteen, Mrs. Isobel Grizzard, Mrs. Eleanor Ditmore, and Mrs. Eleanor McGregor, fourth grade teachers; and all the students who served as subjects.

Appreciation goes to Mrs. Lee Geis and Mr. Mike McGregor who helped with the tedious testing procedure, and to Mrs. Marilyn Woodfin who was so generous with her time.

The author would like to thank Miss Sharon Swearingen for her help and Mrs. Mary Emma Barnes whose combination of typing and concern for the author's deadlines were invaluable to the completion of this study.

Special appreciation goes to my mother, Mrs. Eleanor McGregor, for her understanding and to a far away friend, Miss Virginia Tate, whose letters were a constant source of inspiration.

TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER I

INTRODUCTION TO THE PROBLEM

In investigating the factors which influence verbal learning and retention, there has been a great deal of research pertaining to the effects of both the nature of the material (such as stimulus similarity) and individual differences (such as intelligence). Gaudreau (1968) found that it is very difficult to discriminate between intelligence and perception when the task is complex, i.e., made up of parts or elements more or less confusingly interrelated. He suggests that differences in perception, as opposed to differences in intelligence, may be assigned cultural antecedents such as socio-economic status. On the other hand, intelligence (or the ability to cope with one's environment) is largely a matter of dealing with complexity, an attribute of the physical world which can be brought about by interference, stimulus similarity, and many other variables.

The demonstrated effects of stimulus similarity have been explained using theories of stimulus discrimination and generalization (Gibson, 1940). Osgood's (1949) transfer model made predictions about all possible interactions of response and stimulus similarity between lists. His prediction of the effects of stimulus similarity with responses remaining dissimilar has been supported by much of the literature (Dallett, 1962; Underwood, 1957; Bugelski and Cadwallader, 1956; Wimer, 1964; Young and Underwood, 1954).

The effects of intelligence upon learning are more enigmatic. This is in part due to our inability to agree upon the exact nature of intelligence. It has been suggested that deficits in retardate learning are due to problems of attention rather than in the area of instrumental learning (Zeaman and House, 1963) and that these learners seem to be deficient in discrimination skills (Spivack, 1963). Kidd (1970) goes so far as to say that discriminative skills are ultimately the basis for all learning. A similar approach to the problem is taken by Heal and Johnson (1970) in which they review and discuss the evidence in favor of an inhibition deficit as a hypothetical construct to explain retardate learning. One of the basic goals of comparing retardate learning with normal learning is to identify basic learning processes that correlate with intellectual development. There is, however, no research which attacks the problem from within the normal range of intelligence. The present study uses three IQ groups. A high IQ group which has a range of 114 to 136 with a mean of 121.9, a medium IQ group which has a range of 96 to 103 with a mean of 99.7, and a low IQ group which has a range of 72 to 88 with a mean of 81.6. This is a 40 point difference between high and low IQ groups, which is suggested by Zeaman and House (1967).

There is a glaring lack of research in which both the nature of the material and individual differences are simultaneously varied in order to investigate the effects upon verbal learning and retention. It seems that more attention to this problem would have practical implications by helping to define individual differences within the normal range of intelligence in terms of the effects of stimulus similarity upon performance in a verbal learning task.

CHAPTER II

REVIEW OF THE LITERATURE

Transfer theory states that when the learning of one task aids in the learning of a second, positive transfer has occurred. When the learning of one task hinders the learning of a second task, negative transfer has occurred (Hall, 1971). Most transfer studies have been conducted from a stimulus-response point of view and they most often employ a paired-associate (PA) paradigm which provides a two-stage experimental situation in which not only must the proper stimulus be associated with the proper response, but the stimuli must be differentiated from each other (Jung, 1968). In this paradigm the variables contributing to complexity can be easily controlled and manipulated. Using the anticipation method in which the stimulus is presented and the response must be recalled, interference is controlled by manipulating both stimulus and response similarity. There is a great deal of research investigating the first stage, i.e., discrimination stage, of PA learning.

Gibson's (1940) theory states that a major part of verbal learning is establishing discrimination among the items to be learned and that this is fundamental to the learning process. If no discrimination between the items already exists, then the early part of the learning process will be characterized by an increase in the tendency to confuse the items, followed by the development of discrimination. Learning time in this case should be at a maximum, but if such discrimination already exists, learning time should be at a minimum. Negative transfer occurs when generalization with a previous task is such that discrimination between some aspect of the two tasks themselves is required, as well as learning of the second. Similarly, retroactive inhibition will occur if a second task generalizes with one already learned, and if the situation is such that discrimination between some aspect of the two tasks must be produced before the first can be recalled adequately. Gibson defines generalization within the PA learning method as a process which occurs between the various stimulus items, so that a response to one tends to occur as a response to other stimulus items in the list also. Thus, generalization is the tendency for a response R_a learned to S_a to occur when S_b (with which it has not been previously associated) is presented. Differentiation is a progressive decrease in generalization as a result of reinforced practice with $S_a \longrightarrow R_a$ and unreinforced presentation of S_b. From a list of ten postulates, Gibson (1940) predicts a number of propositions, two of which are significant to the present study. First, inter-list interference as a function of similarity: More repetitions will be required to learn a second list, in proportion to the strength of the tendency for items of a first list to generalize with the items of the second list. Secondly, retroactive inhibition and similarity: A first list will be more poorly recalled as the strength of the tendency for items of a second list to generalize with it increases. Gibson's (1940) theory has received a great deal of support. Gibson (1941) first demonstrated, using geometric forms, that stimulus generalization is a function of similarity between stimulus items with response items remaining dissimilar. She then found that as the degree of generalization increases, retroactive inhibition also increases.

Gibson's (1941) findings influenced Osgood (1949) to propose a third transfer principle which states that the magnitude of negative transfer increases as stimulus similarity increases when both stimulus and response members are simultaneously varied. He defines transfer effects as specifiable prior activity upon the learning of a given test activity and retroaction as the effect of a specifiable interpolated activity upon the retention of a previously learned activity. Osgood's (1949) model predicted transfer and retroaction effects of all possible combinations of interlist response and stimulus similarity. This model has received empirical support from Dallett (1962), and to a lesser extent by Bugelski and Cadwallader (1956), and Wimer (1964). All of these investigators, however, lend strong support to Osgood's proposition that as interlist stimulus similarity increases, the magnitude of negative transfer increases as long as the responses across lists are either unrelated (neutral) or dissimilar.

Gibson (1969) points out that what really matters in discrimination learning is not merely attaching reinforcement to a response link but rather learning to attend selectively to the relevant variables. House and Zeaman (1963), in studying discrimination in retarded children, demonstrated that an increase in the number and kind of stimulus variables resulted in an increase in the rate of acquisition of discrimination. Other investigators have supported this relationship between number of relevant dimensions and learning (Ullman and Routh, 1971; Trabasso and Bower, 1968). Trabasso and Bower (1968) present an excellent review of the literature and discussion of this question in terms of cue salience.

Cue salience within the PA learning paradigm can be seen as contributing to ease of discrimination (House and Zeaman, 1960; Runquist and Blackmore, 1971). Restel (1955) points out that every individual cue is either relevant or irrelevant. A cue is relevant if it can be used by the subject to predict where or how reward is to be obtained. A cue aroused by an object uncorrelated with reward is irrelevant (Restel, 1955). It is obvious then that between stimuli with the same number of total dimensions, the greater the number of cues they have in common, the fewer will be the number of relevant cues by which the stimuli may be discriminated from each other. This is demonstrated by Runquist and Blackmore (1971) who manipulated formal similarity (number of common letters among nonsense syllables within lists) and found decrements in performance as stimulus similarity increased. The implications for transfer are that interlist stimulus similarity would cause a reduction of the number of relevant cues on the second list. Retroactive inhibition can be explained in this respect as a function of the stimulus items on the second list reducing the number of available relevant cues on some performance criterion for the memory of the first list.

Zeaman and House (1963) have published a theory of discrimination learning which postulates a chain of two responses for problem solutions. The first is an attention response to relevant stimulus dimensions and the second is a correct instrumental response to the positive cue of the relevant dimension. They propose that observed individual differences in empirical learning curves are not attributable to individual differences in rate of habit acquisition but rather to some other underlying process such as attention. They found differences between high IQ and lower IQ subjects not in the slopes of the rising part of the learning curve but rather in the length of the initial plateau (at chance level). This finding is in perfect correspondence to Gibson's (1940) prediction that if no discrimination between the items already exists, then the early part of the learning process will be characterized by an increase in the tendency to confuse the items, followed by the development of discrimination. Zeaman and House (1963) found, therefore, differences in performance of IQ groups to be due to differences in the time required to make the initial discrimination between items.

Zeaman and House (1967) provide an excellent review of the literature concerned with the relationship of discrimination learning and IQ, and the preponderance is in favor of a positive relationship between the two variables. Contradictory results are explained as a function of the task either being too difficult or too easy or due to the difference between IQ groups being too small. The Zeaman-House (1967) model, then, says that discrimination learning is better for high IQ subjects than for low IQ subjects because of a low probability of the high IQ subjects attending to irrelevant dimensions. Other studies have supported this position (Evans, 1968; Iscoe and Semler, 1964). However, Ullman and Routh (1971) found no significant interaction between IQ and number of relevant dimensions in discriminations learning tasks.

Many studies have shown retardate discrimination learning to be inferior to that of normals (Iscoe and Semler, 1964; Zeaman and House, 1960; Stevenson, 1963). However, if the number of relevant variables remains constant, what causes a high IQ group to perform better than a low IQ group? One explanation is that the differences between groups are due to inhibition which is defined as withholding a response or suppressing stimulus input when such action is adaptive (Heal and Johnson, 1970). Inhibition theory states that retardates have a deficit in inhibition of attention to stimuli that are extraneous to the task before him. These extraneous cues could be either embedded in the task or could arise from distracting stimuli (such as noise) external to the learning task (Heal and Johnson, 1970). Zeaman and House (1960) and Stevenson (1963) have both extensively reviewed retardate discrimination learning, and both support the inhibition hypothesis.

In transfer studies with retarded and normal subjects the evidence supports the inhibition hypothesis of greater proactive interference (negative transfer) for retarded subjects (Borkowski, 1965; Isco and Semler, 1964). Johnson and Blake (1960) found some evidence suggesting that retardates show less proactive inhibition than normal subjects. The evidence in respect to retroactive interference is less clear. Studies by Johnson and Sowles (1970), Johnson and Blake (1960), Baumeister et al.(1967), McManis (1967) and Pryer (1960) have all failed to establish a relationship between IQ and retroactive inhibition.

The present study investigates differences between low and high IQ subjects within the normal range of intelligence. The purpose of the study is to simultaneously vary both intelligence and interlist stimulus similarity in a PA learning task to investigate the effects upon transfer of training and retroactive inhibition. The results of such a study should suggest implications concerning individual differences and interference in verbal learning and retention.

CHAPTER III

RESEARCH DESIGN

The present design is a three by three factorial design (Campbell and Stanley, 1963) in which the two independent variables, intelligence and stimulus similarity, are simultaneously manipulated in order to investigate the effects upon four dependent variables used to measure the learning and retention of verbal material: recall, relearning, overall learning, and proactive transfer as shown.

SUBJECT GROUPS (Intelligence)	TREATMENT GROUPS (Similarity) HIGH	MEDIUM	LOW
HIGH	Group I N=7	Group II N=7	Group III N=7
MEDIUM	Group IV N=7	Group V N=7	Group VI N=7
LOW	Group VII N=7	Group VIII N=7	Group IX N=7

To investigate how intelligence and similarity effect the retention of task A after learning an interpolated task B the following hypotheses were tested for significance at the .05 alpha level.

H_o1 There is no statistically significant difference among groups in relearning which is accounted for by intelligence.

H_o2 There is no statistically significant difference among groups in relearning which is accounted for by similarity.

H_o3 There is no statistically significant difference among groups in relearning which is accounted for by the interaction of similarity and intelligence.

H_o4 There is no statistically significant difference in recall which is accounted for by intelligence.

H_o5 There is no statistically significant difference among groups in recall which is accounted for by similarity.

H_o6 There is no statistically significant difference among groups in relearning which is accounted for by the interaction of similarity and intelligence.

To investigate how stimulus similarity and intelligence effect overall learning and proactive transfer, the following hypotheses were tested for significance at the .05 alpha level.

H_o7 There is no statistically significant difference among groups in overall learning which is accounted for by intelligence.

H_o8 There is no statistically significant difference among groups in overall learning which is accounted for by similarity.

H_o9 There is no statistically significant difference among groups in overall learning which is accounted for by the interaction of intelligence and similarity.

$H_o 10$ There is no statistically significant differences between the learning of list A and learning of list B as measured by trials to criterion.

$H_o 11$ There is no statistically significant difference between the learning of task A and the learning of task B as measured by trials to criterion which is accounted for by intelligence.

$H_o 12$ There is no statistically significant difference between the learning of task A and learning task B as measured by trials to criterion which is accounted for by similarity.

$H_o 13$ There is no statistically significant difference between the learning of task A and learning of task B as measured by trials to criterion which is accounted for by the interaction of intelligence and similarity.

CHAPTER IV

METHOD

Subjects

The population sample consisted of sixty-three fourth grade students chosen from the Clarksville-Montgomery County School System. The three intelligence groups were formed by obtaining Otis-Lennon IQ scores for 189 students which were administered in the third grade. The high and low intelligence groups consisted of the highest and lowest twenty-one scores, respectively. The medium intelligence group was obtained by choosing the twenty-one scores which were closest to 100. The mean IQ scores were 121.9, 99.7, and 81.6 for the high, medium, and low intelligence group was then randomly distributed among three treatment groups and the IQ scores were analyzed with an analysis of variance, random design, to insure that the scores across treatment groups were not significantly different from each other. None of the three F ratios were significant. A total of five subjects were eliminated from the experiment and replaced with a subject of similar IQ. Two of those were unable to complete the testing because of a school activity: lunch and catching the afternoon bus. Two subjects were replaced because they failed to learn either list A or list B within a predetermined cutoff point of sixty trials and one subject was replaced because he refused to be tested.

Materials

The treatment groups consisted of three similarity conditions. All subjects learned two lists of five paired associate items using the anticipation method: The stimulus item was presented and the subject anticipated the correct response. The first list (A) was identical for all subjects and the second list (B) varied in similarity with list A according to the treatment group to which the subject was assigned (Table I). The stimulus items for all lists were consonant vowel consonant (CVC) nonsense syllables matched for meaningfulness across

TABLE I

PAIRED ASSOCIATE LISTS

All Subjects		High Similarity Groups		Medium Similarity Groups		Low Similarity Groups	
List A		List B_1		List B_2		List B_3	
XOM	BANK	XOS	PERSON	XAV	PERSON	GAQ	PERSON
ZAH	NEXT	ZUH	MIND	ZIQ	MIND	FOJ	MIND
YUB	KIND	YUQ	READ	YEC	READ	CEH	READ
QEF	TABLE	QEP	STEP	QUC	STEP	RIW	STEP
GIW	CALL	GIX	WORLD	GOJ	WORLD	KUH	WORLD

lists according to Noble's (1961) rating scale, but low in within list similarity in order to facilitate initial learning. In the high similarity condition, the stimulus items in list B shared two letters with the CVC's in list A. In the medium similarity condition, the CVC's in list B shared only the first letter with the stimulus items in list A. In the low similarity condition, the stimulus items shared no letters with those in list A.

There were two groups of response items (Table I): One group of five for list A and one for list B on all stimulus conditions. Thus all learned the same response items regardless of the similarity condition to which they were assigned. The response items consisted of words which were matched for meaningfulness across lists according to all four of the rating scales presented by Thorndike and Lorge (1944) so that for each scale, the total association value of list A was equivalent to that of list B.

Procedure

Each S was individually tested using a Lafayette model 303-B memory drum set at a four second interval. The items were typed in upper case using an IBM Selectric Model Number 721. Instructions were given to the Ss in the classroom and then repeated in the testing room until E was certain that the S understood what he was expected to do. First the S was presented with all of the paired-associates in list A together in the order shown in Table I. Then the S began trial one by seeing first the stimulus item for four seconds and then the stimulus item paired with the correct response for four seconds. One trial consisted of the presentation of each of the five stimuli followed by the correct stimulus response pair. The order of presentation was random for within each trial for thirty trials, after which the memory drum was turned back to trial one if the subject had not yet learned the list to criterion. Trials thirty-one through sixty were identical to trials one through thirty. Each S learned list A to a criterion of one trial with all responses correctly anticipated. Each S was then immediately administered list B according to the treatment group to which he was assigned and the procedure for list B was identical to that of list A. After learning list B to criterion of one perfect trial, each S was immediately tested for recall by presenting him with each of the CVC's in list A. During this portion of the testing, the memory drum was turned manually and the S was allowed as much time as he wanted to recall the response. The S was not told or shown whether or not his anticipation was correct. After the recall test, the memory drum was immediately turned back to trial one of list A and each S was required to relearn list A to a criterion of one perfect trial.

Analysis of Data

In order to investigate the effects of similarity and intelligence upon the two dependent variables used to measure retention, recall and relearning, a double analysis of variance was used to test hypotheses H_o1, H_o2, H_o3, H_o4, H_o5, and H_o6. To test the remaining hypotheses a three factor mixed design with repeated measures on one factor (Bruning, 1968) was used. This design was chosen in order to separate the effects of intelligence and similarity on overall learning performance from the differences among groups which could be accounted for lists, intelligence, and similarity alone or in interactions with each other.

CHAPTER V

RESULTS

Tables II and III summarize the results of each double analysis of variance used to determine the effect of intelligence and similarity upon retention. Table II indicates the findings of no significant differences for the main effects or interaction effect of intelligence and similarity upon relearning as a measure of retention. Therefore, $H_o 1$, $H_o 2$, and $H_o 3$ were not rejected; but there is a tendency, as demonstrated in Figure 1, for the high intelligence groups to take fewer trials for relearning as a function of lower similarity. This trend was as expected, but the low intelligence groups took more trials for relearning as a function of lower similarity with a group mean of 6.1 for the high similarity condition versus 16.7 for the low similarity condition. This tendency indicates that the low intelligence groups relearned A more easily if the interpolated task B was more rather than less similar to A. This difference was in the opposite of the expected direction.

Table III indicates the results of the analysis of variance of recall of A as a measure of verbal retention after learning interpolated task B. The main effects of either intelligence or similarity alone were not significant but the interaction of these independent variables yield an F

TABLE II

ANALYSIS OF VARIANCE: RELEARNING

Source	df	MS	F
Total	62		
Intelligence	2	91.5	.527
Similarity	2	86.0	.496
Intelligence x Similarity	4	99.75	.575
error	54	173.53	

TABLE III

ANALYSIS OF VARIANCE: RECALL

Source	df	MS	F
Total	62		
Intelligence	2	.20	.17
Similarity	2	.20	.17
Intelligence x Similarity	4	3.80	3.20*
error	54	1.2	

*$p < .05$

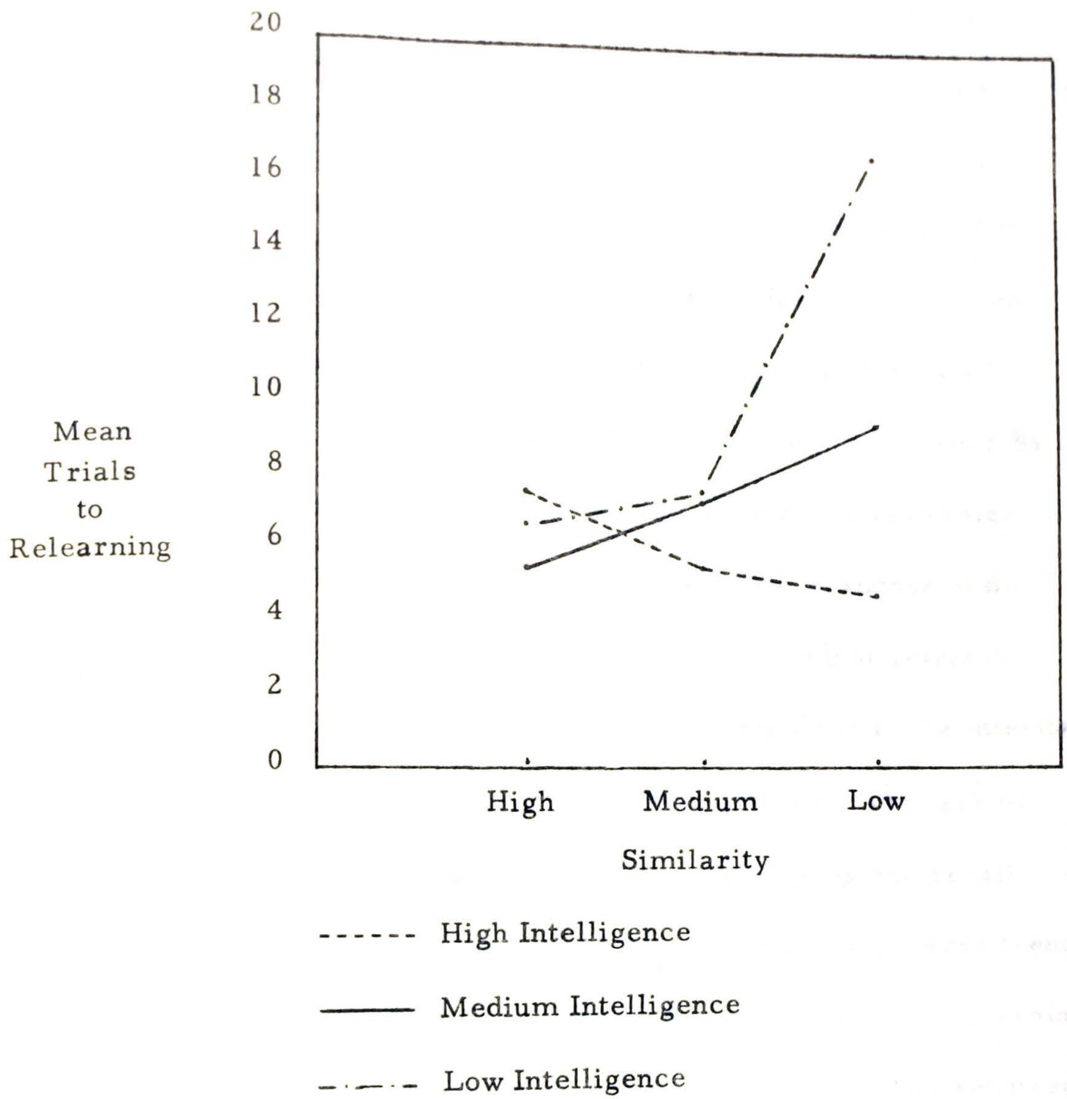

Figure 1

Interaction of Similarity and Intelligence on Relearning ratio of 3.2 which is significant at the .05 level. Thus, H_o4 and H_o5 have failed to be rejected and H_o6 was rejected ($p < .05$) which indicates that there are differences among groups in relearning which are accounted for by the interaction in intelligence and similarity. The nature of this interaction effect is illustrated in Figure 2. The tendency is for the high intelligence Ss to improve in retention as a function of lowered similarity of task B and the lower intelligence Ss' performance decreases as a function of lowered similarity of interpolated task B. In a PA learning task with interlist response similarity low, Osgood's (1949) transfer model predicted that retention of verbal material will decrease (retroactive inhibition) as the interlist similarity of the interpolated task B becomes greater. The lack of significance of similarity as a main effect in relearning and recall failed to support this prediction. Table IV indicates the reverse trend for relearning to be true as a comparison of mean trials for relearning in the mean of rows column shows a greater number of trials required for relearning as similarity decreases.

Table V summarizes the analysis of the effect of similarity and intelligence upon overall learning of lists A and B and the proactive transfer from list A to list B. The effect of intelligence on overall learning yields an F ratio of 8.74 which was significant at the .001 level. The effect of similarity on overall learning yields an F ratio of 1.17 which was not statistically significant. Thus, H_o7 was

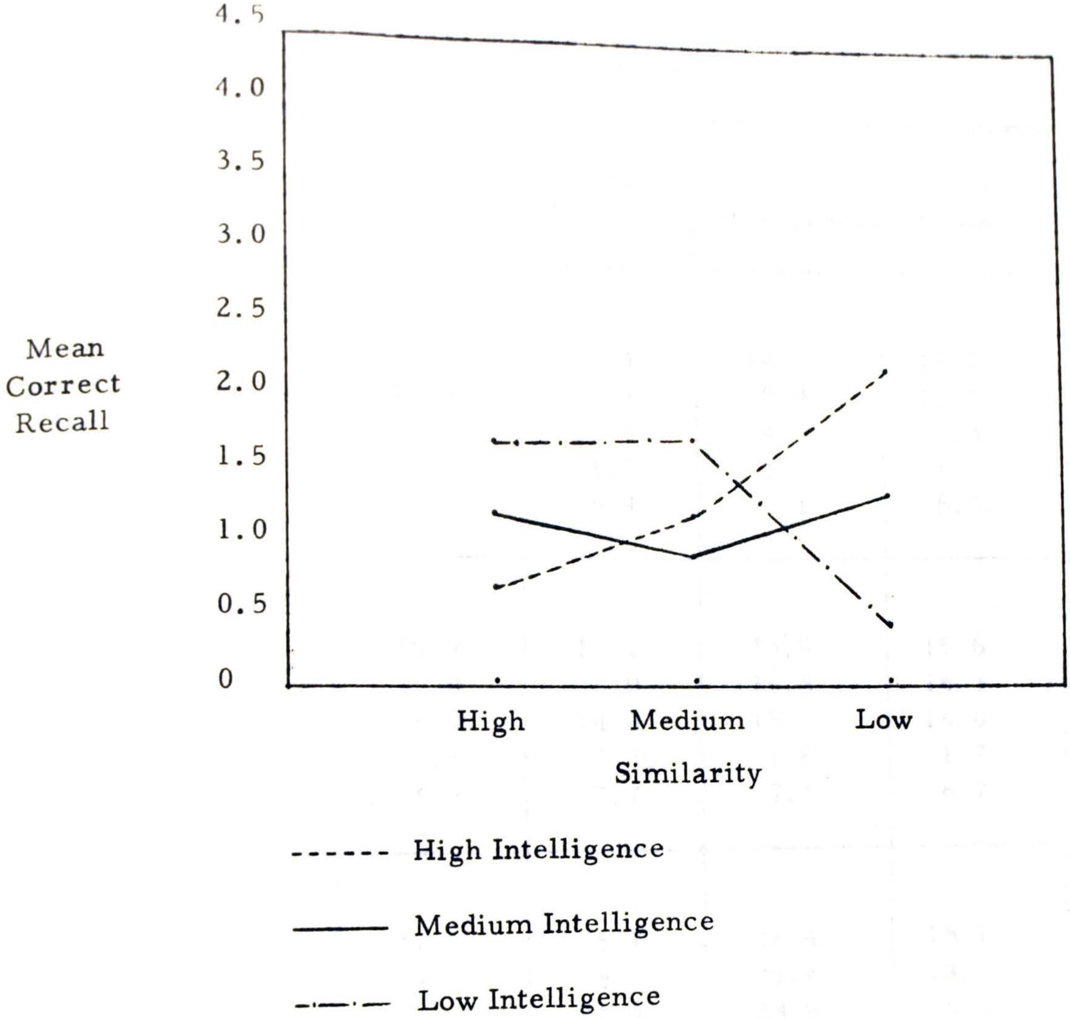

Figure 2

Interaction of Similarity and Intelligence on Recall

TABLE IV

PERFORMANCE MEANS

	High Intelligence	Medium Intelligence	Low Intelligence	Mean of Rows
High Similarity				
A	13.1	16.4	18.4	15.0
B	11.4	10.7	9.9	10.7
A+B	12.3	13.6	14.1	13.3
Recall	0.6	1.1	1.6	1.1
Relearning	7.9	5.4	6.1	6.5
Medium Similarity				
A	19.9	13.1	13.9	15.6
B	10.0	16.0	16.8	14.3
A+B	15.0	14.6	15.3	15.0
Recall	1.1	0.86	1.6	1.2
Relearning	5.3	7.7	7.1	6.7
Low Similarity				
A	10.9	15.1	28.4	18.1
B	5.3	8.7	29.4	14.5
A+B	8.1	11.9	28.9	16.3
Recall	2.1	1.3	0.4	1.3
Relearning	4.4	9.1	16.7	10.1

TABLE IV (Continued)

	High Intelligence	Medium Intelligence	Low Intelligence	Mean of Means
Mean of Columns				
A	14.6	14.9	20.2	16.6
B	8.9	11.8	18.7	13.1
A+B	11.8	13.4	19.4	14.6
Recall	1.3	1.1	1.2	1.2
Relearning	5.9	7.4	10.0	7.7

A: Mean trials to criterion on list A.

B: Mean trials to criterion on list B.

A+B: Mean trials to criterion on list A and list B.

Recall: Mean number of correctly anticipated responses on list A following the learning of list B.

Relearning: Mean trials to relearn list A following the learning of list B.

TABLE V

ANALYSIS OF VARIANCE: INITIAL LEARNING PERFORMANCE

Source	df	MS	F
Total	125		
Between Ss	62		
Intelligence	2	696.34	8.74***
Similarity	2	93.25	1.17
Intelligence x Similarity	4	521.29	6.55***
error	54	79.63	
Within Ss	63		
Lists	1	373.72	8.14**
Lists x Intelligence	2	47.20	1.03
Lists x Similarity	2	42.25	0.92
Lists x Intelligence x Similarity	4	121.51	2.65*
$error_w$	54	45.89	

***$p < .001$

**$p < .01$

*$p < .05$

rejected and H_o8 failed to be rejected. The failure to reject H_o8 once again fails to support Osgood's (1949) predictions concerning interlist stimulus similarity. Again from Table IV, comparison of high and low similarity mean of rows column for A+B indicates the reverse trend. The Ss in high similarity groups learned both lists an average of three trials sooner than those Ss in low similarity groups. A comparison of the column mèans for A+B (Table IV) indicates that the differences in learning which were accounted for by intelligence were in the expected direction, i.e., the high intelligence groups learned in the fewest trials followed by medium and low intelligence groups.

Table V indicates that the interaction of intelligence and similarity also had a statistically significant effect upon learning (F ratio 6.55, $p < .001$) which rejected H_o9. Figure 3, plotted from data in Table IV, illustrates the nature of this interaction which accounted for differences in overall learning. Figure 3 shows that the high IQ Ss performed only slightly better than low IQ Ss under the high and medium similarity conditions, but under low similarity the high IQ Ss improved in performance while low IQ Ss deteriorated in performance.

Table IV shows that the within Ss effect between lists A and B yields an F ratio of 8.14 which was significant at the .01 level. The mean of means portion of Table IV indicates that the mean number of trials of each S to learn list A was 16.6 compared with 13.1 for list B. This finding rejected H_o10.

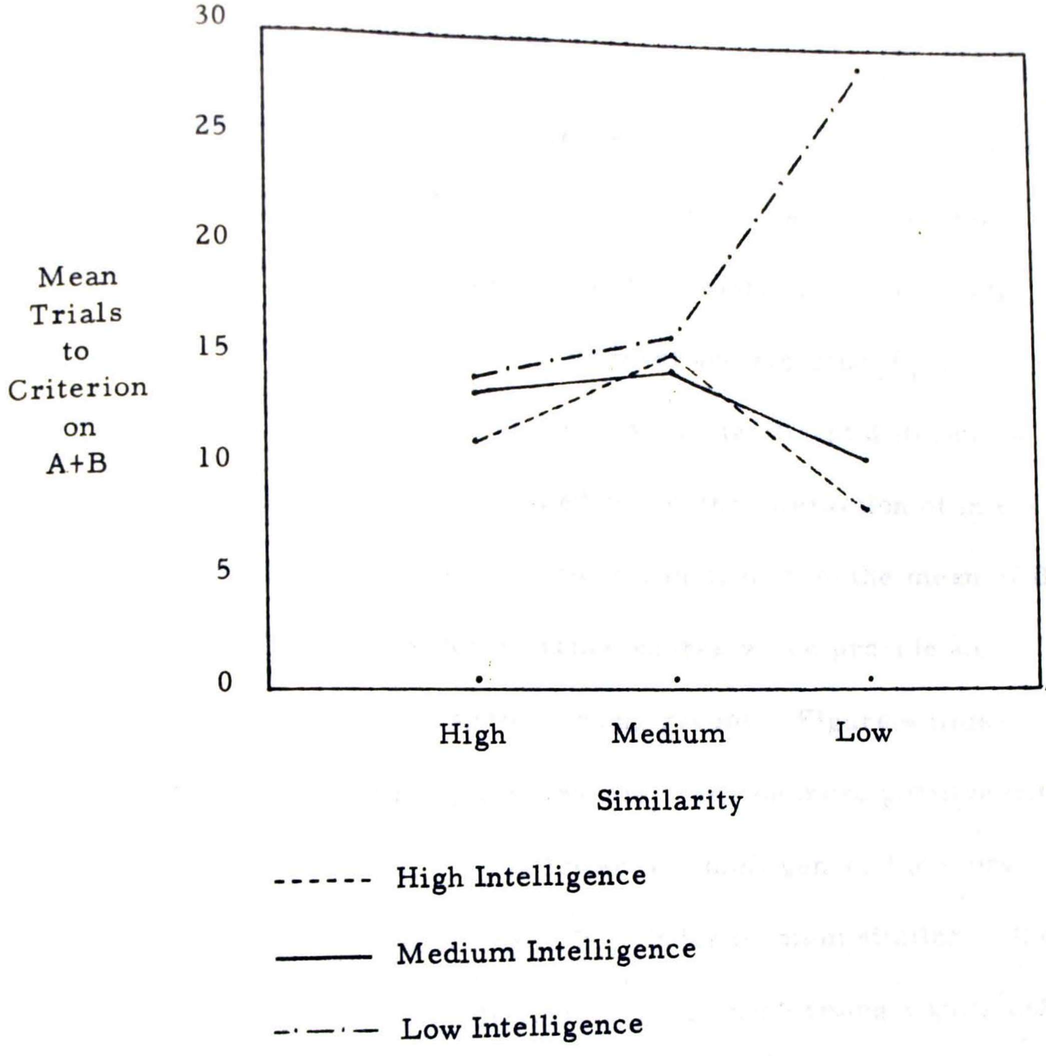

Figure 3

Interaction of Intelligence and Similarity on Learning

The interaction of both intelligence and similarity with lists did not yield a statistically significant F ratio which failed to reject H_o11 and H_o12. Thus there were no differences between lists which could be accounted for by either intelligence or similarity alone. The interaction effects of list and intelligence and similarity yields an F ratio of 2.65 which was significant at the .05 level and rejected H_o13. Therefore it can be concluded that there were significant differences between lists which could be accounted for by the interaction of intelligence and similarity. Subtracting the mean of A from the mean of B (Table IV, page 25) results in difference scores which provide an index of relative proactive transfer among groups. Figure 4 illustrates that, under high similarity, transfer became more positive with decrease in intelligence, i.e., the lower the intelligence, the more learning A facilitated the learning of B. Under medium similarity the trend reversed with the high intelligence group performing significantly better on list B after having learned list A and both the medium and low intelligence groups' performance on list B deteriorated after learning list A. The results of the low similarity condition also shows that the high intelligence group's performance on task B improved after learning list A and that the low intelligence group's performance on task B deteriorated only slightly after learning task A. The medium intelligence group's performance under low similarity was almost identical to the performance under high similarity.

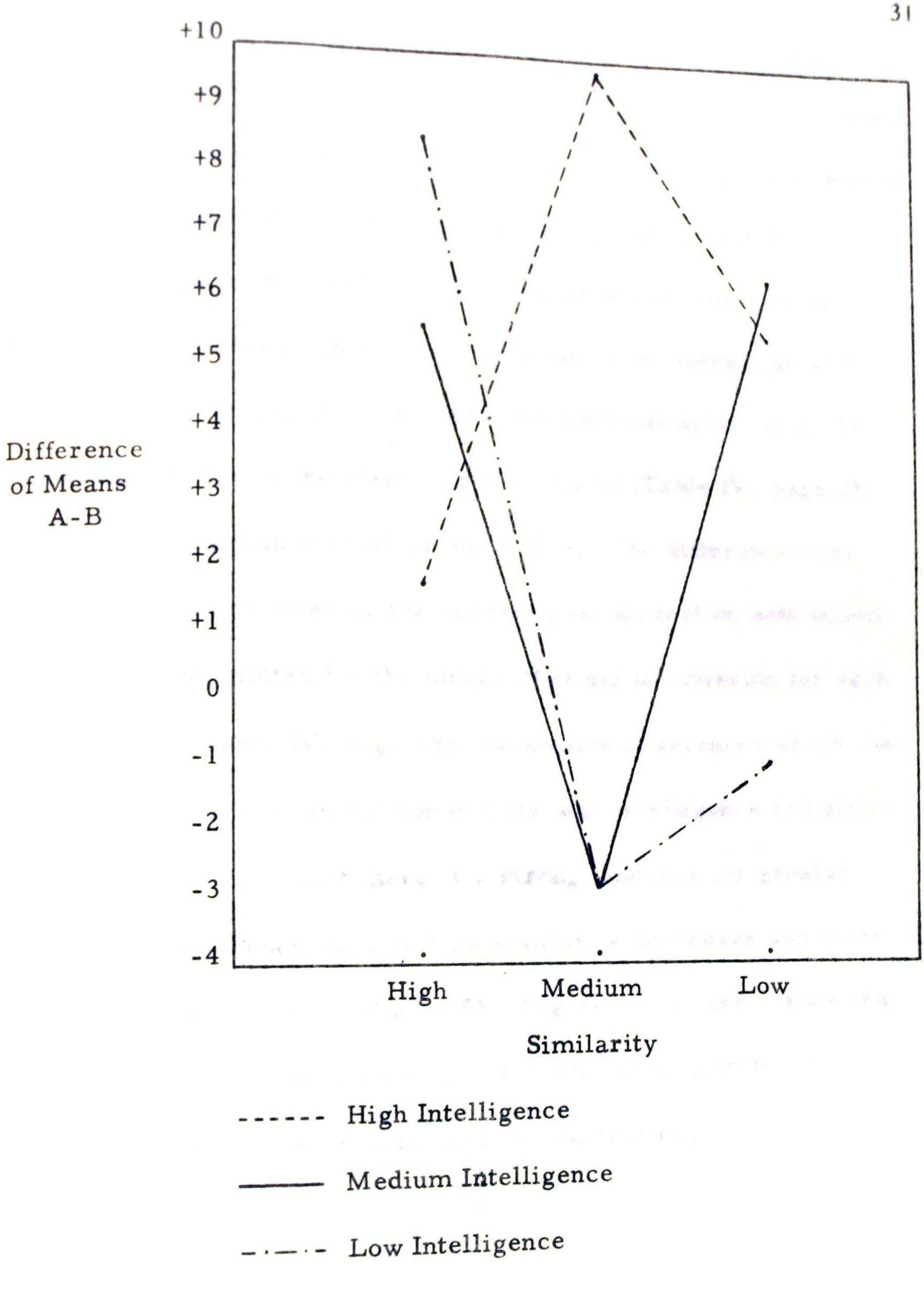

Figure 4

Group Mean Difference Scores (Task A - Task B)

Figure 4, however, does not indicate separate absolute scores for the learning of tasks A and B and it does not demonstrate the interaction effect of intelligence and similarity with lists. Figure 5, plotted from the means of trials to criterion for each group on task A (Table IV, page 25), demonstrates differences which cannot be accounted for by similarity of intelligence alone or in interaction with each other because: (1) Task A conditions were identical for all Ss and (2) Each figure in the mean of rows column (Table IV, page 25) is based on groups with equivalent mean IQ's. The differences are probably due to some other factor operating in interaction with intelligence. Figure 6, plotted for the means of trials to criterion for each group on task B (Table IV, page 25), illustrates differences which can be accounted for by the interaction of lists with intelligence and similarity. Figure 6 shows that there is a strong tendency for greater differences among means on list B as similarity decreases and there is a similar trend on list A (Figure 5). Figures 1, 2, and 3 show that this trend for less variance under the low similarity condition is also present in relearning recall, and overall learning.

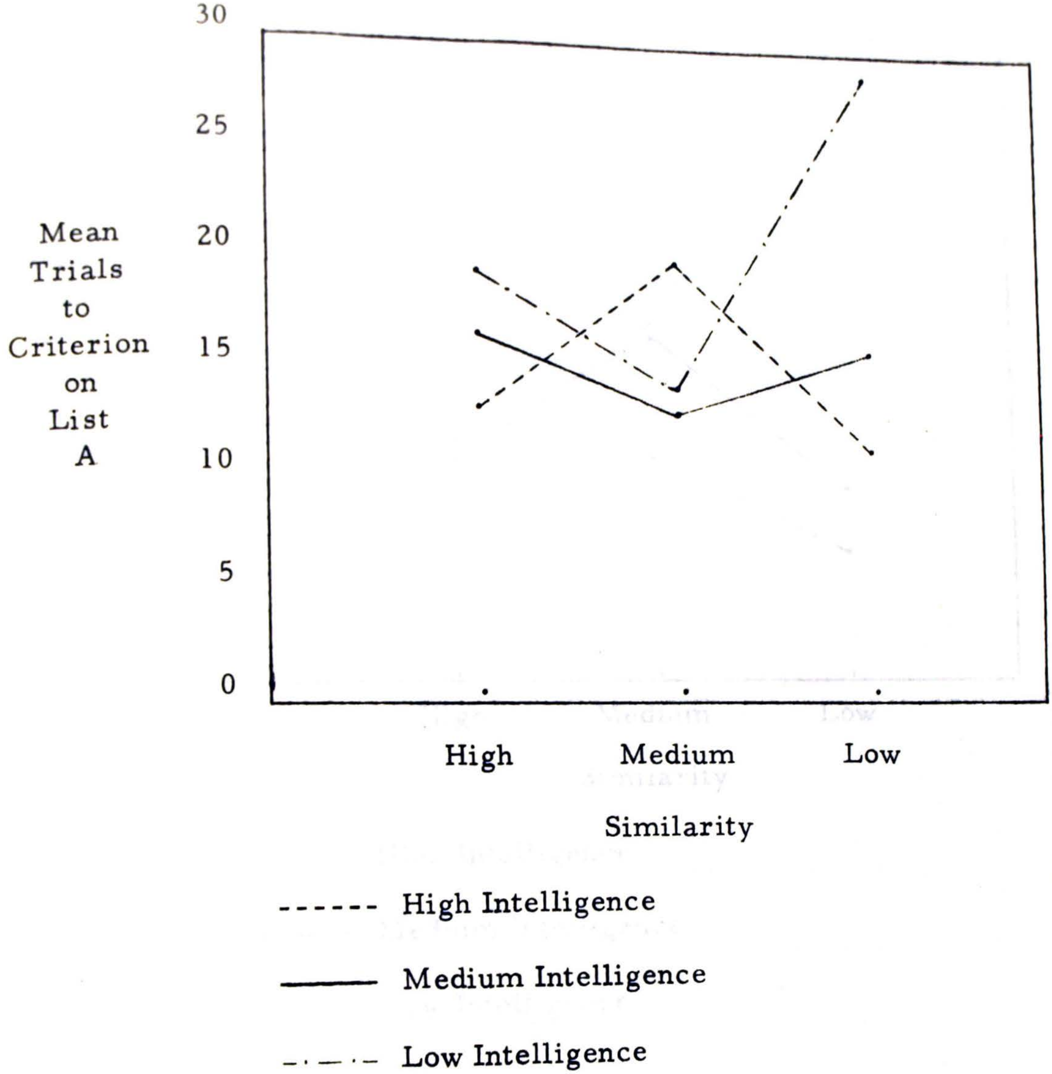

Figure 5

Interaction of Intelligence and Similarity on Performance on List A

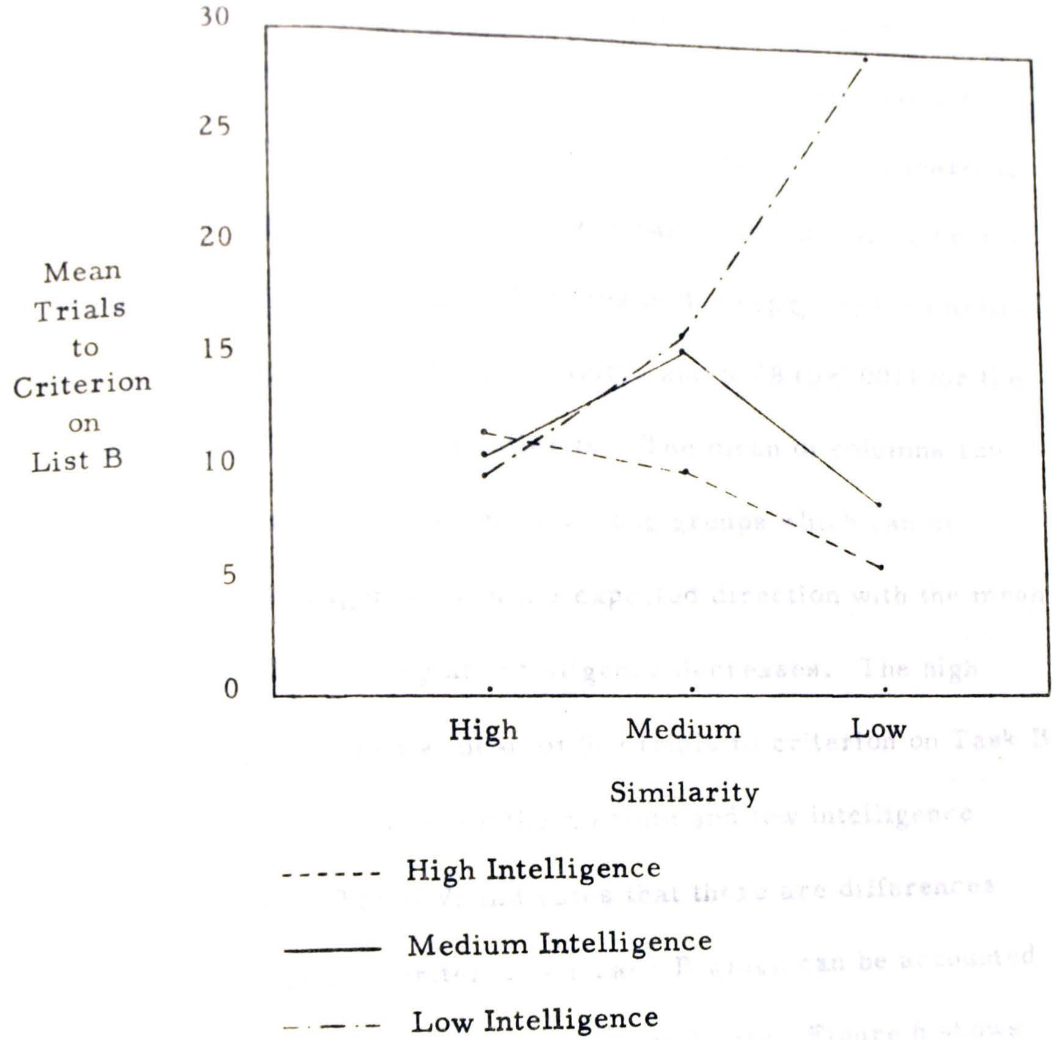

Figure 6

Interaction of Intelligence and Similarity on Performance of List B

After the present paper based on the preceding analysis was presented to and approved by the committee, an additional analysis of data was performed in order to account for the differences in learning Task B with the effects of learning Task A partialed out. An analysis of covariance (Table VI) produced F ratios of 4.65 ($p < .05$) for intelligence, 1.25 (not significant) for similarity, and 6.28 ($p < .001$) for the interaction of intelligence and similarity. The mean of columns row in Table IV indicates that differences among groups which can be accounted for by intelligence is in the expected direction with the mean trials to criterion increasing as intelligence decreases. The high intelligence group required a mean of 8.9 trials to criterion on Task B compared with 11.8 and 18.7 for the medium and low intelligence groups respectively. Table VI indicates that there are differences among groups in trials to criterion on Task B which can be accounted for by the interaction of intelligence and similarity; Figure 6 shows the nature of that interaction. The trend for the low intelligence groups to deteriorate in performance as similarity decreases and for the high intelligence group to improve with decreasing similarity is significant. However, the differences among groups are extremely small under the high similarity condition and become increasingly larger as similarity decreases. This confirmation of the significance of less variance on Task B under high than under low similarity indicates that on Task B, the Ss of different intelligence levels reacted differentially under the low similarity but not under high similarity.

This analysis of covariance has, therefore, eliminated the effects of any original differences among groups in their ability to learn nonsense syllables. However, this additional analysis does not account for other unknown factors which may be operating under both Task A and Task B such as the variables causing differences among groups on original Task A.

TABLE VI

ANALYSIS OF COVARIANCE: LEARNING PERFORMANCE ON TASK B

Source	df	MS	F
Total	62		
Intelligence	2	314.43	4.65*
Similarity	2	84.50	1.25
Intelligence x Similarity	4	425.00	6.28***
error	54	67.69	

*$p < .05$
***$p < .001$

CHAPTER VI

DISCUSSION

The results of this study generally fail to support either the predictions of the effects of similarity on verbal learning and retention (Gibson, 1940; Osgood, 1949) or the predictions which are made within the Zeaman-House (1963) attention model. The present results indicate that inhibition theory does not adequately explain the interaction effects of intelligence and similarity on discrimination learning. Inhibition theory in the Zeaman-House attention model has been used only to predict and explain differences in retardate and normal learning, but if the same IQ differences are used in the normal range of intelligence, as in the present study, the theory predicts that low IQ Ss should show relatively greater deleterious effects on performance and relatively greater amounts of retroactive and proactive inhibition than high IQ Ss as interference increases. This, it is argued, is due to an inability to inhibit attention to irrelevant stimuli. The present study failed to support these predictions and it is in general agreement with Johnson and Sowles (1970) and Johnson and Blake (1960). The present study found a great deal of evidence to indicate a reverse trend than would be predicted by inhibition theory: As similarity increased the performance of low IQ Ss on learning and retention generally improved and the performance of high IQ Ss deteriorated. This finding suggests that inhibition theory may have serious limitations, but it is possible that it might be adapted to include the learning to learn phenomenon. The fact that all Ss under all conditions learned task B in fewer trials than task A indicates that learning to learn factors were operating here. It is reasonable to assume that fourth grade students have had little prior experience with either paired associate learning or nonsense syllables. This fact lends further support that learning task A would help them to learn how to learn paired associates. Hall (1970) and Jung (1968) discuss learning to learn as a phenomenon in transfer studies. Here it appears that under high similarity conditions, the probability of the low IQ Ss' attending to the relevant cue is increased in spite of the increased interferences. Thus, in order for the low IQ student to utilize his learning to learn abilities, he must be able to see this learning as applying to the subsequent task.

The most salient of all the results is the tendency for low IQ Ss to recall more, to take fewer trials to relearn, to learn the interpolated list in fewer trials and to learn to learn more readily than high IQ Ss under high similarity conditions with the opposite tendency under the low similarity conditions. This trend indicates that low IQ Ss perform better on verbal learning tasks when they see the two tasks as being more similar to each other. This effect more than cancels out any interference due to increased similarity. High IQ Ss conform more closely to the laws of interference and inhibition -- their performance increases as similarity decreases. Apparently, under some conditions, lower IQ Ss perform and learn just as well or better than high IQ Ss. This finding supports Jensen's (1960) suggestion that there are several learning abilities rather than a single, unitary one and that these learning abilities are often unrelated to IQ. Jensen argues that usual intelligence tests are really achievement tests and they do not test the capacity to learn in a novel situation. Jensen (1965) found that individuals also differ in their susceptibility to factors which cause proactive and retroactive inhibition. He further relates learning abilities to phenomenon such as learning to learn but maintains that the basic learning abilities have not been identified or measured.

In order to identify those basic learning abilities, it is suggested that other measures of individual differences be investigated in interaction with a variety of verbal material. Another useful approach would be to hold stimulus similarity constant and vary response similarity or to use a different criterion for similarity than the formal similarity used in the present study. Finally, it is strongly recommended that the present study be replicated in order to eliminate the probable extraneous factors which interacted with intelligence to cause similarity group differences in learning task A and to confirm the validity of the relationships found in the present study. In replication of this study, it is recommended that the E more carefully balance factors across groups which are known to effect learning performance such as socio-economic level and the number of Ss in each group which came from one school. The time of day a S is tested may have a greater effect on younger Ss than is generally realized. If possible, E should minimize interruptions in the testing situations which can arise from many sources such as announcements on intercom system or malfunctions in the testing apparatus. All of these factors may have confounded the present study.

REFERENCES

Baumeister, A. A., Beddle, R., and Hawkins, W. F. "Transposition in Normals and Retardates under Varying Conditions of Training and Test." American Journal of Mental Deficiency, 1964, 69, 432-437.

Borkowski, J. G. "Interference Effects in Short-Term Memory as a function of level of intelligence." American Journal of Mental Deficiency, 1965, 70, 458-465.

Briggs, G. E. "Acquisition, Extinction, and Recovery Functions in Retroactive Inhibition." Journal of Experimental Psychology, 1954, 47, 285-293.

Bruning, James L. and Kintz, B. L. Computational Handbook of Statistics. Glenview, Illinois: Scott, Foresman and Company, 1968.

Bugelski, B. R., and Cadwallader, T. C. "A Reappraisal of the Transfer and Retroaction Surface." Journal of Experimental Psychology, 1956, 52, 360-366.

Campbell, Donald T. and Stanley, Julian C. Experimental and Quasi-Experimental Designs for Research. Chicago: Rand McNally and Company, 1963.

Dallett, K. M. "The Transfer Surface Re-examined." Journal of Verbal Learning and Verbal Behavior, 1962, 1, 91-94.

Evans, Ross A. "Some Stimulus Factors Involved in the Discrimination Learning of Mental Retardates." American Journal of Mental Deficiency. 1968, 76, No. 1, 61-69.

Gaudreau, Jean. "Interrelations Among Perception, Learning Ability, and Intelligence in Mentally Deficient School Children," Journal of Learning Disabilities. May, 1968.

Gibson, E. J. "A Systematic Application of the Concepts of Generalization and Differentiation to Verbal Learning." Psychological Review, 1940, 47, 196-229.

Gibson, Eleanor J. "Retroactive Inhibition as a Function of Degree of Generalization Between Tasks." Journal of Experimental Psychology, 1941, 28, 93-115.

__________. Principles of Perceptual Learning and Development. New York: Appleton-Century-Crofts, 1969.

Hall, John F. Verbal Learning and Retention. New York: J. B. Lippincott Company, 1971.

Heal, L. W., and Johnson, J. T. "Inhibition Deficits in Retardate Learning and Attention." In N. R. Ellis (ed.), International Review of Research in Mental Retardation. Vol. 4. New York: Academic Press, 1970.

House, B. J., and Zeaman, D. "Transfer of a Discrimination from Objects to Patterns." Journal of Experimental Psychology, 1960, 59, 298-302.

House, Betty J. and Zeaman, David. "Miniature Experiments in the Discrimination Learning of Retardates." In Lewis P. Lipsitt and Charles C. Spiker (eds.), Advances in Child Development and Behavior. New York: Academic Press, 1963, 313-374.

Iscoe, I., and Semler, I. J. "Paired-associate Learning in Normal and Mentally Retarded Children as a Function of Four Experimental Conditions." Journal of Comparative and Physiological Psychology, 1964, 57, 387-392.

Jensen, Authur R. "Individual Differences in Learning: Interference Factor." U. S. Office of Education Cooperative Research Project No. 1867. Berkeley, California: University of California. Cited in John P. De Cecco, The Psychology of Learning and Instruction: Educational Psychology. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1968.

__________. "Programmed Instruction and Individual Differences." Automated Teaching Bulletin, 1, 12-17. Cited in John P. De Cecco, The Psychology of Learning and Instruction: Educational Psychology. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1968.

Johnson, G. O., and Blake, K. A. Learning Performance of Retarded and Normal Children. Syracuse, N. Y.: Syracuse University Press, 1960. Cited by John T. Johnson and Cathie N. Sowles, "Proactive and Retroactive Inhibition as a Function of Intelligence." American Journal of Mental Deficiency, September, 1970.

Johnson, John T. and Sowles, Cathie N. "Proactive and Retroactive Inhibition as a Function of Intelligence." American Journal of Mental Deficiency, September, 1970.

Jung, John. Verbal Learning. New York: Holt, Rinehart, and Winston, Inc., 1968.

Kidd, John W. "The Discriminatory Repertoire: The Basis of All Learning." Journal of Learning Disabilities, October, 1970.

McManis, D. L. "Retroactive Inhibition in Paired-Associate Learning by Normals and Retardates." American Journal of Mental Deficiency, 1967, 71, 931-936.

Noble, Clyde E. "Measurements of Association Value (a), Rated Associations (a'), and Scaled Meaningfulness (m') for the 2100 CVC Combinations of the English Alphabet." Psychological Reports, 1961.

Osgood, C. E. "The Similarity Paradox in Human Learning." Psychological Review, 1949, 56, 132-143.

Pryer, R. S. "Retroactive Inhibition in Normals and Defectives as a Function of Temporal Position of the Interpolated Task." American Journal of Mental Deficiency, 1960, 64, 1004-1011.

Restel, Frank. "A Theory of Discrimination Learning." Psychological Review, 1955, 62, No. 1, 12-19.

Runquist, Willard N., and Blackmore, David. "Individual Differences in Interference from Stimulus Similarity." Journal of Experimental Psychology, 1971, 87, No. 1, 141-143.

Spivack, George. "Perceptual Processes." In N. R. Ellis (ed.), Handbook of Mental Deficiency. New York: McGraw-Hill Book Company, Inc., 1963, 480-511.

Stevenson, H. W. "Learning of Complex Problems by Normal and Retarded Ss." American Journal of Mental Deficiency, 1960, 64, 1021-1026.

Thorndike, E. L., and Lorge, I. The Teacher's Word Book of 30,000 Words. New York: Bureau of Publications, Teachers College, Columbia University, 1944.

Trabasso, Tom, and Bower, Gordon H. Attention in Learning Theory and Research. New York: Wiley Publishing Company, 1968.

Ullman, Douglas G., and Routh, Donald K. "Discrimination Learning in Mentally Retarded and Nonretarded Children as a Function of the Number of Relevant Dimensions." American Journal of Mental Deficiency, 1971, 76, No. 2, 176-180.

Underwood, Benton J. 'Interference and Forgetting." Psychological Review, 1957, 64, No. 1, 49-60.

Wimer, Richard. "Osgood's Transfer Surface: Extension and Test." Journal of Verbal Learning and Verbal Behavior, 1964, 3, 374-379.

Young, R. K., and Underwood, B. J. "Transfer in Verbal Materials with Dissimilar Stimuli and Response Similarity Varied." Journal of Experimental Psychology, 1954, 47, 153-159.

Zeaman, David, and House, Betty J. "The Relation of IQ and Learning." Cited in Robert M. Gagne (ed.), Learning and Individual Differences. Columbus, Ohio: Charles E. Merrill Publishing Co., 1967, 192-212.

_________. "The Role of Attention in Retardate Discrimination Learning." Cited in N. R. Ellis (ed.), Handbook of Mental Deficiency. New York: McGraw-Hill Book Company, Inc., 1963, 159-223.