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THE RELATIONSHIPS AMONG READING ABILITY, GRADE LEVEL, SYNTACTICAL MEDIATION IN PAIRED-ASSOCIATE LEARNING.

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THE RELATIONSHIP BETWEEN READING ABILITY AND SYNTACTICAL MEDIATION IN PAIRED-ASSOCIATE (PA) LEARNING WAS EXAMINED. SUBJECTS WERE 64 FOURTH AND SECOND GRADERS IN WISCONSIN WHO WERE GROUPED ACCORDING TO GRADE LEVEL, TWO READING LEVELS, TWO TYPES OF INSTRUCTION, AND SEX. THE INSTRUCTIONAL TYPES WERE MEDIATION AND NONMEDIATION. THE STIMULI WERE 16 PICTURES PAIRED TO MINIMIZE ASSOCIATION VALUE. THE NUMBER OF TRIALS TO CRITERION AND ANALYSIS OF VARIANCE WERE USED TO ANALYZE THE DATA. BOYS AND GIRLS DID NOT DIFFER ON THE PA TASK, NOR DID THE GOOD AND POOR READERS. MEDIATION INSTRUCTION FACILITATED PA LEARNING. FOURTH GRADERS PERFORMED BETTER THAN SECOND GRADERS. THERE WAS AN INTERACTION AMONG READING ABILITY, INSTRUCTION, AND GRADE LEVEL. INTELLIGENCE AND READING ACHIEVEMENT WERE MORE CLOSELY RELATED IN FOURTH GRADE THAN IN SECOND GRADE. REFERENCES ARE INCLUDED. THIS PAPER WAS PRESENTED AT THE AMERICAN EDUCATIONAL RESEARCH ASSOCIATION CONFERENCE (CHICAGO, FEBRUARY 6-10, 1968). (BK)

The Relationships Among Reading Ability, Grade Level, Syntactical Mediation in Paired-Associate Learning*

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The purpose of the present study was to examine the relationship between reading ability and syntactical mediation in a paired-associate (PA) learning task. Mediation has received much attention in the literature, but relatively little has been written about subject variables associated with syntactical mediation. Some researchers have recently been concerned with the variables of age and cultural environment. The present study was designed to see how differences in reading ability affect performance on a PA learning task with or without syntactical mediation.

Related Research

Syntactical Mediation and Learning

A survey of the literature in this area reveals the strong, consistent conclusion--linguistic structure as a mediator greatly facilitates learning. Epstein, Rock, & Zuckerman (1960) demonstrated in a series of seven experiments with college students that pairs of familiar items were easier to associate

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than were pairs of novel items; that when the pairs were in a three-word phrase, Ss learned faster if the middle word was a reasonable connective than if it were unreasonable; that pairs of pictures were learned faster than pairs of nouns; and than when pictorial pairs were presented as one unit (e.g., a card in a glass), Ss learned faster than if the pictures were separated. All of these results support the contention that mediation is an important factor in PA learning.

Epstein (1961, 1962), also using college students, compared the learning rates of syntactically structured and unstructured strings of nonsense words and meaningful words. He found that the meaningful words and the structured strings were learned faster, and that the facilitating effects of syntactical structure of nonsense words were about the same as those of meaningfulness in an unstructured string (1961, 1962). However, when the words were put on a memory drum in the same serial order as they had appeared before, there were no differences due to structuredness. This was interpreted as indicating Ss not perceiving chains of immediate probabilistic associations in a structured sentence, but rather perceiving the structural character as a unit (1962).

The effect of mediation in both serial and PA learning was investigated by Jensen & Rohwer (1963b, 1965) and Jensen (1965). In the first of these (Jensen & Rohwer, 1963b), it was hypothesized that one of the major differences between these two types of learning is the degree to which verbal mediation plays a role. Using mentally retarded adults to avoid the possibility that normal adults would spontanteously mediate, two experiments were performed. In the first, all Ss were given a PA task with four pairs of pictures of common objects as materials. During the first week, all Ss were asked just to name the pictures on the first trial. During the third

week, all Ss were given mediation instructions in which they were asked to make up sentences linking the two members of each pair. During the fifth week, the Ss were divided into two groups, equated for number of errors made in Week 1. Then one group received the mediation instructions and the other received the non-mediation. The results showed that the mediation instructions greatly facilitated learning, and that the mentally retarded adults did not retain the instructions to mediate that they had received in Week 3. Essentially the same procedure was used in the second experiment, but a serial learning task was added. In the mediation instructions, sentences were provided for the Ss, and the sentences linked successive items in the serial learning task. As before, the tasks were subject-paced, but 20 trials were given instead of the 10 in the previous experiment. The results showed that mediation had facilitated performance only on the PA task. The PA groups were given another set of pictures with the non-mediation instructions 10-12 days later to see if the previous mediation group had retained the benefit, but the groups did not differ.

To answer the question of whether retarded Ss would differ from normals, Jensen (1965) matched retarded adults and normal children for mental age (MA was about 9-6). Serial and PA learning tasks were given with mediation and non-mediation instructions, and the procedure used was the same as in Experiment II of the above study. The results showed that the normals made fewer errors than the retarded Ss in all conditions' PA learning was greatly facilitated by mediation, but serial learning was not; the non-mediation PA task was harder than the non-mediation serial task, while the reverse was true for the mediation groups; and mediation in PA learning decreased within-group heterogeneity, while the reverse happened in serial learning.

Jensen & Rohwer (1965) used normal children of various ages (5-17 years) in PA and serial learning tasks with mediation and non-mediation instructions to see whether the results from the other studies hold across

age levels. They hypothesized that the S's past verbal experiences and their availability influences PA learning but does not affect serial learning. The procedure was essentially the same as in the above studies, except that Ss made up their own sentences in the mediation conditions, each list consisted of 10 pictures or pairs of pictures, and each S was given both the serial and PA tasks in a counterbalanced order. The results showed that mediation did not facilitate serial learning for any age level, while it greatly benefited PA learning for all ages except 5, 13, and 17. The order of tasks was nonsignificant. It was suggested that the older Ss did not differ because they were mediating spontaneously, but it was also pointed out that a "ceiling" effect is almost inevitable with older Ss when a single task is used with a wide range of ages. The 5-year-olds had difficulty making up sentences, and tended to connect the pictures with the conjunction "and."

Jensen & Rohwer (1963a) did another study in which they investigated the retention of the mediation process in retarded adults, using just the PA task. The materials were six pairs of common objects, with the stimulus object attached to the lid of a small cardboard box and the response object placed inside the box on the first trial. With the mediation instructions, Ss were given a sentence which they repeated, linking the members of each pair on the first trial. Ss given non-mediation instructions just named the objects. The Ss were self-paced and run to a criterion of one errorless trial. One week later, all Ss were given the same task with non-mediation instructions. Mediation resulted in faster orignial learning. In relearning, the non-mediators learned significantly faster than they had originally, while the mediators did about the same; the groups did not differ in relearning. These results suggest that the degree of retention is unaffected by the method of learning, and that instructions to mediate are not retained by retarded Ss.

Davidson (1964) and Rohwer (1964) investigated the relationship between amount of syntactical structure and learning. The former study, using second graders, showed 20 pairs of pictures of common objects to a group of Ss. On Trial 1, the entire list was exposed. Then two trials were given, in which only the stimulus member was shown, and Ss circled the response on an answer sheet that contained a list of all response members. On the basis of the number of correct responses, Ss were divided at the median into high and low ability groups. Two weeks later, each of these groups was further subdivided into experimental conditions. Differing on the first trial only, the conditions were: A, same as original learning, pictures not named; B, pictures were named; C, pictures were named and the pairs were joined by a preposition; D, pairs were named in a nine-word sentence; and E, the same sentences as in D were given, and the pictures were shown as described in the sentence (e.g., a pipe was in the mouth of a fish). Conditions C, D, and E, the ones that provided some syntactical structure, resulted in more correct responses than Conditions A and B; thus even a connection by a single preposition was as effective a mediator as was a nine-word sentence and a juxtaposition of the pictures to depict the sentence. There were also ability group differences, but these remained constant across conditions and were equally facilitated by structure (Davidson, 1964).

Rohwer (1964) used a complex design in which he varied semantic structure (English words vs. nonsense words), syntactic structure (grammatical vs. scrambled order), constraint (pairs connected with a conjunction, preposition, or verb), IQ (four levels), and lists (two). There were also two control groups: consonant control (CC) Ss read consonants instead of words to control for warm-up effects and time

allowed for rehearsal; and paired-associate control (PAC) Ss were given a standard PA anticipation task to obtain a comparison with previous studies on the effect of syntactic structure alone. The lists consisted of eight pairs of pictures of common objects (one of the lists was used in the present study), and were presented on a memory drum. Reading practice of the verbal strings minus the S-R pairs was given to all groups except PAC. The learning procedure following the pretraining study trial was the same for all Ss. The essential results showed that (1) syntactically structured English words produced better learning than did the usual PA condition, thus replicating the findings of the previous studies; (2) syntactic structure facilitated only those receiving English words; (3) semantic structure facilitated only those receiving syntactically structured strings; (4) constraint facilitated only those receiving syntactically structured strings; (5) verbs and prepositions produced the same effect, while both of these were more facilitating than conjunctions; (6) the CC condition differed from the conjunction conditions and resulted in the slowest learning; and (7) IQ was a significant effect, but this was due to the superiority of the highest level Ss. Rohwer concluded that there is a continuum of facilitation, ranging from a CC condition to a condition that uses verbs in both semantically and syntactically structured strings. He also concluded that both semantic and syntactic structure are needed to facilitate PA learning, and that these conditions must be accompanied by a preposition or a verb. Although Rohwer distinguished between semantic and syntactic structure, both are implied in the term "syntactical mediation" as used in the present study.

Reading Ability, Mediation, and Paired-Associate Learning

Learning to read is a paired-associate learning process. That is, a child must learn to respond orally when he sees a group of letters combined in an unfamiliar way. At first, even the letters are strange-looking, and he must associate each with a name and one or more sounds. The different approaches to learning to read, such a phonetic, sight word recognition, etc., all require the child to combine the sounds of individual letters or groups of letters into a single word. Comprehension is acquired by a similar PA process. First, the spoken word becomes meaningful through association with its referent. Then the written word must be associated with the spoken word. Typically, reading achievement tests measure both the skills of recognizing words and of comprehension.

In learning to read, a child may find it necessary to say sounds out loud, say them to himself, and/or move his lips. This, in a sense, is a mediation process in which the sounds are mediating between the written word and its recognition. This brings up the question of whether reading achievement is affected by individual differences in mediation skill, which is one point that is discussed in the present study.

There are some studies in which the relationship between reading ability and associative ability has been examined. Gates (1935) devised four tests to measure associative learning. Two involved pairs of visual symbols to be associated: geometric figures with pictures of common objects, and word-like figures with common objects. The other two involved association of visual with auditory symbols: geometric figures and word-like figures with spoken words. These tests were to be used in detecting lack of associative capacity and of associative learning technique in retarded readers.

Stauffer (1948) used the above tests to examine the relationships between these different tasks in retarded readers only. The Ss performed better on visual-auditory tests than on visual-visual, and on geometric figure tests than on word-like figures. Raymond (1955) obtained the same results, using reading achievers as Ss. However, in comparing these Ss with Stauffer's retarded readers, it was found that only the visual-auditory tests discriminated between the groups of Ss.

Walters & Doan (1962) used good, average, and poor readers in a task requiring them to associate colored lights with different compartments of a box. The poor readers took significantly more trials to learn than did the good and average readers, who did not differ. The authors concluded that the poor readers are deficient in associative ability. In a similar study, Walters & Kosowski (1963) used the same task as above but added another task that paired different tones with the compartments of the box. The Ss were good, average, and poor readers. The results confirmed the above finding that the poor readers learned much slower than the other Ss on both tasks, but a transfer effect from one task to the other eliminated the differences between the Ss. Also, the poor readers, when rewarded with a prize, did as well as the good and average readers. Thus, practice and attention to stimuli may be important factors in the relationship between reading ability and PA learning.

Giebink & Goodsell (1967) compared kinds of visual-auditory tasks, using good and poor readers with visuomotor deficits as Ss. The good readers performed better than the poor and the older Ss did better than the younger. They also found that the word-like figures were easier for the Ss to associate with a spoken word than were the geometric stimuli. This contradicts the results of Stauffer (1948) and Raymond (1955).

Otto (1961) used second, fourth, and sixth graders with average range IQs, and identified good, average, and poor readers from them. The PA list consisted of five geometric form-CVC trigram pairs, and was presented on a memory drum. The pairs were presented in serial order to a criterion of one errorless trial, then were presented in scrambled order to the same criterion. After 24 hours, Ss relearned the list, which was presented in scrambled order, to the same criterion. In addition, three modes of reinforcement were used: (1) auditory--E said name of response instead of showing the response; (2) visual--the response was shown as E named it; and (3) kinesthetic--the same as visual, plus having S trace the trigram with his finger. The results showed that each of the main effects was significant. The three reading ability levels differed from each other, showing that with an increase in ability, there was a decrease in number of trials to criterion. As grade level increased, number of trials decreased. Mode of reinforcement interacted with grade level but not with reading level; kinesthetic was most facilitating for the second grade, visual for the fourth, and kinesthetic and visual were equally effective for the sixth. In relearning, the different reading levels did not differ, while the fourth and sixth grades relearned in fewer trials than did the second graders. Finally, when Ss were asked for any associations they may have thought of to any of the stimuli or responses, the good readers named less than the average and poor who did not differ.

Otto (1967a, 1967b) did two more studies comparing good and poor readers; in these he investigated the effect of color cues in PA learning. Both studies used second, fourth, and sixth graders who had IQs in the average range. One list consisted of five geometric form-CVC trigram pairs. The pairs were presented in either black-and-white or in color, and the color was never pointed out to the Ss. The criteria for learning were one errorless trial with serial presentation and one errorless trial with the scrambled presentation

which immediately followed. Grade and Reading Levels were significant, but Presentation was not. The good readers learned faster, but unlike the earlier results of Otto (1961), the fourth and sixth graders did not differ. Although no interaction was significant, the means indicated trends of increasing benefit from color cues with better reading ability and increasing grade level (1967a). In the other study, the six-pair list consisted of cards with three Greek letters paired with spoken common English words. The stimuli were in either black-and-white or color. When the colored stimuli were used, the presence of color was pointed out to S. The criteria were the same as in the above study. The analysis of serial trials showed significant effects of Grade, Reading Level, and Presentation, while the analysis of total trials showed only Sex and Presentation as significant. The colored cards and girls required fewer total trials. The interactions were not significant, and only one trend was noted; the second graders tended to benefit more from the color cues. This is the opposite of the trend noted in the above study. No trend was discernable for the interaction between reading level and presentation (1967b). Both studies together indicate that the color cues were beneficial only with a task that was similar to a reading situation or only when the Ss were made aware of the cues. In the second study, when the color was beneficial, there could be at least two explanations. First, because of the low intralist similarity, the color cues may have produced a greater amount of differentiation. Second, the Ss may have been attending only to the color and disregarding the unfamiliar characters. These explanations are presently being explored by Otto.

The Problem

Research related to the fields of syntactical mediation, reading ability, and learning was reviewed above to give some background to the problem posed in the present study. It is evident that syntactical mediation facilitates PA learning but not serial learning. Learning to read is at least in part a PA learning task, and good readers were found to learn such a task faster than poor readers. However, there is still some question about the relationship between reading ability and the tendency to select and utilize cues that may aid learning. The present study is related to this latter question in that some Ss were asked to select mediating cues, while other Ss were told nothing about cues and were left to decide by themselves whether to look for cues and use them or not. The specific hypotheses examined by the present study are as follows:

(1) Boys and girls will not differ in performance on a paired-associate task.

(2) Good readers will perform better than poor readers on a paired-associate task.

(3) Mediation instructions will facilitate task performance.

(4) Fourth graders will perform better than second graders on the same task.

(5) There will be no interactions between any of the main variables.

Method

Subjects and Design

Subjects were second and fourth grade pupils in a small Wisconsin school system. Good and poor readers were identified on the basis of

reading subtest scores from the Stanford Achievement Tests; those pupils who were above the 64th percentile or below the 34th percentile on all of the relevant subtests were considered good and poor readers, respectively. Total IQ scores from group intelligence tests were obtained for all good and poor readers, and an attempt was made to identify those subjects whose IQ scores were as clsose to their class means as possible. The second grade class mean IQ was 109.00 with a standard deviation of 11.14; and the fourth grade class mean IQ was 104.88 with a standard deviation of 12.22.

Equal numbers of boys and girls from each reading level and each grade level were then selected, equating each of these groups on the basis of IQ scores, to receive one of two types of instructions. The mean IQs and standard deviations for each group are given in Table 1. The IQ scores for each group were ranked, with the odd-numbered ranks receiving the mediation instructions and the even-numbered ranks receiving the non-mediation instructions. Thus, the design was 2 (boys and girls) x 2 (good and poor readers) x 2 (grades 2 and 4) x 2 (mediation and non-mediation instructions) with four replications.

/ See Table 1 /

Task

The stimulus materials were 16 pictures of common objects, drawn with black ink on 4" x 4" squares of white poster borad. The objects used were taken from and paired according to Rohwer (1964). This insured that they were high frequency nouns (classes A and AA in the Thorndike-Lorge tables) and were paired so as to minimize the association value. The pairs were MOP-CAKE, TREE-HAT, CLOCK-HOUSE, FISH-BED, CAT-SHOE, SOAP-FORK,COMB-GLASS, and COW-BALL. Pictures of these objects were taken from a first grade workbook.

Procedure

Each subject was tested individually in a small room containing a table and two chairs. The experimenter and the subject sat beside each other, with the pairs of cards placed face down on the table before them. The pictures had been placed so that the stimulus picture was on top of the response picture and the pairs were ordered the same for all subjects at the beginning. On the first trial, each pair was exposed for 15 seconds and then turned face down again. Subjects receiving the non-mediation instructions were told:

> There are pictures drawn on the other side of these cards. I'm going to show you two at a time. All you are to do right now is to name them. For example, if I showed you a bird and a book, you would say "Bird, book." Do you understand? Here are the first two.

Subjects receiving the mediation instructions were told:

> There are pictures drawn on the other side of these cards. I'm going to show you two at a time. First I want you to name them and then make up a sentence using both of those names. For example, if I showed you a bird and a book, you would say, "Bird, book. The bird is pecking at the book." Or any other sentence you can think of using those two words. Can you think of another one? (If not, the subject was prompted by being told, "There are lots of sentences with those two words. I'll give you another one, and then you give me one." Very good. Sometimes the only sentence you can think of is a silly one, but that's all right, as long as both words are in the same sentence. Tell it to me as soon asyou can think of it. Here are the first two.

If the subject could not give a sentence after 5 seconds, he was asked "Can you think of a sentence?" If not, then, "Well, I'll tell you one." The sentences that were used if the subject could not think of one were very similar to sentences made up by third graders used as practice subjects. They were as follows:

1. I will MOP the floor after I eat the CAKE.
2. My HAT was stuck in the TREE.
3. We have a CLOCK in our HOUSE.
4. The FISH was in the BED.

5. The CAT was sleeping in the SHOE.
6. The SOAP will clean the FORK.
7. We wash the COMB in the GLASS.
8. The COW chased the BALL.

Before the second trial all subjects were told:

Now I will mix up the order. Now when I point to a picture, I want you to tell me which picture is underneath. Then I will show you so you can see if you were right or not. But if you take too long in answering, I will show you anyway. So try and tell me what the bottom picture is before I show you. If you can not remember, then take a guess. Do you understand?

One at a time, each pair was turned over so that the stimulus picture was in view for about five seconds. Then it was lifted and placed beside the response picture for another five seconds whether the subject responded or not. Then both pictures were placed face down again. Between trials, the pairs were scrambled in order. This allowed for a 10 second intertrial interval. Subjects were run to a criterion of one errorless trial or 20 trials, whichever came first.

Following the learning, all subjects were asked in an informal manner how they had been trying to remember and if they had been thinking of anything else besides the pictures they saw. This was done to identify the subjects who were mediating whether they had been instructed to or not.

Results

Number of Trials

Using number of trials to criterion as a measure, means and standard deviations for each group were calculated (see Table 2). An analysis of variance was performed and is summarized in Table 3. On the basis of these results, the first hypothesis, that boys and girls will not differ on a PA task, was not rejected. The good and poor readers also did not differ in

performance; therefore, the second hypothesis was not supported.

/ See Tables 2 and 3 /

The third hypothesis, that mediation instructions will facilitate PA learning, was supported at the .001 level of significance. The magnitude of this variable, assessed by ω^2 (Hays, 1963), was .52, indicating that 52% of the variance could be attributed to the type of instructions.

The fourth hypothesis, that fourth graders will perform better than second graders on the same task, was also supported ($p < .025$). However, the magnitude of this effect was rather small ($\omega^2 = .07$).

The fifth hypothesis, that there will be no interactions between any of the main variables, was partially rejected. That is, the Reading Ability x Instructions x Grade interaction was significant ($p < .05$), and is graphically depicted in Figure 1. Using the Scheffe' technique of post-hoc comparisons (Hays, 1963), it was found that the second grade poor readers given mediation instructions did not differ significantly from any of the fourth grade groups. Also, the fourth grade good readers given non-mediation instructions did not differ significantly from any other group. However, a t test between the fourth grade good and poor readers given non-mediation instructions was significant ($t = 3.09$).

/ See Figure 1 /

IQ

To help explain the above interaction, an analysis of variance of IQ scores was performed and is summarized in Table 4. Reading Ability was significant, with the good readers having higher IQs than the poor readers. The ω^2 technique showed that 26% of the variance was due to reading ability.

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/ See Tables 2 and 3 /

The third hypothesis, that mediation instructions will facilitate PA learning, was supported at the .001 level of significance. The magnitude of this variable, assessed by ω^2 (Hays, 1963), was .52, indicating that 52% of the variance could be attributed to the type of instructions.

The fourth hypothesis, that fourth graders will perform better than second graders on the same task, was also supported ($p < .025$). However, the magnitude of this effect was rather small ($\omega^2 = .07$).

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The Grade x Reading Ability interaction was also significant; a Scheffe' post-hoc comparison showed that the fourth grade poor readers has lower IQs than all of the good readers, while the second grade poor readers did not differ from any other group.

/ See Table 4 /

To gain more information about the relationship between IQ and reading ability, Pearson product-moment correlations were computed between the IQ scores and the grade equivalent scores on each of the reading subtests used for all the second and fourth graders. These coefficients are shown in Table 5. The correlations for the second grade are much lower than those for the fourth grade.

/See Table 5 /

Mediation

Following the learning task, all subjects had been asked what they had been thinking of to help them remember. All of the subjects given mediation instructions reported that they had been thinking of their sentences. Of the subjects given non-mediation instructions, some reported making some sort of associations between the stimuli and the responses. The number of subjects who just named the pairs is broken down in Table 6 according to whether they were mediating or not. The largest difference is between the good and poor readers in the fourth grade.

/ See Table 6 /

A Fisher exact probability test (Siegel, 1956) was used for each grade level to test whether the number of spontaneous mediators and non-mediators among the good and poor readers differed significantly. In the second grade, the probability that the number of mediators and non-mediators did not differ was 0.4999. In the fourth grade, however, the probability was 0.0594, barely missing the one-tailed .05 level of significance. This

is interpreted to mean that about 94 times in 100, there will be more good readers than poor readers in the fourth grade who will mediate spontaneously.

A similar analysis was performed to test whether the number of spontaneous mediators and non-mediators in the two grade levels differed. As seen in Table 6 five second graders and six fourth graders were mediating. The probability was 0.5624 that these numbers did not differ. However, when broken down further by reading ability, the analogous probabilities were 0.1580 for the good readers and 0.2851 for the poor. Neither reaches a level of significance to reject the null hypothesis.

Discussion

Subjects instructed to mediate learned the PA list in fewer trials than those not so instructed. In fact, this variable accounted for most of the variance, as there was little overlap between the two groups. This phenomenon has been consistently found in studies using different subject populations, different materials, and different instructions for mediation; the present results merely lend more support to this general conclusion.

The fourth graders learned in fewer trials than second graders. This replicates the results of Jensen & Rohwer (1965) which showed that performance improved with increasing age. In fact, their second and fourth grade groups with both types of instructions have almost the same mean number of trials to criterion as do the comparable groups in the present study, even though their PA list contained two items more. These results also compare well with the significant grade level variable found by Otto, 1961.

In the present study, the good and poor readers did not differ in PA learning, unlike the results of Walters & Doan (1962), Walters & Kosowski (1963), Giebink & Goodsell (1967), and Otto (1961). However,

the task used in the present study involved a visual-visual association that was different from the visual-visual and visual-auditory tasks used in the other studies. Therefore, the results of the present study may lend some support to the hypothesis that good and poor readers will differ in number of trials needed to learn a PA list only under certain task conditions.

Since the main effects of Grade and Instructions were significant, the interaction of Reading Ability x Instructions x Grade may be due to the difference between the good and poor readers in the fourth grade who received non-meidation instructions. The good readers had learned in significantly fewer trials than the poor readers. There are two possible explanations for this better performance: (1) differences in IQ may account for the differences in performance, and (2) more of the fourth grade good readers were mediating spontaneously than the fourth grade poor readers. Each of these possibilities will be further discussed.

Reading Ability and Reading Ability x Grade were significant effects in an analysis of variance of IQ scores. Means for these effects are shown in Table 1. Since each grade level had been given a different intelligence test, it would be best to discuss the grades separately.

The correlations between IQ and reading achievement subtests shown in Table 5 clearly demonstrated that, for the population used in this study, IQ and reading achievement are more closely related in the fourth grade than in the second. Since these correlations for the fourth grade were high, and since the Reading Ability x Grade interaction was largely due to the difference between fourth grade good and poor readers, the variables of intelligence and reading achievement are confounded in the fourth grade Ss used in this study. Therefore, the Reading Ability x Instructions x Grade interaction for number of trials could very well be due to intelligence instead of reading ability, or an interaction of the two.

An incidental finding of the present study was that over one-third of the Ss given the non-meidation instructions reported they had been mediating in some way (Table 6). Although an equal number of Ss in each grade was mediating spontaneously, in the second grade the number is again divided about equally between the good and poor readers, but in the fourth grade there was only one poor reader as compared with the five good readers who reported mediating. The Fisher exact probability test showed that the fourth grade distribution of mediators and non-mediators approached a significant level, suggesting that good readers may be more likely to mediate spontaneously. Also, a trend was indicated that there may be an interaction between reading ability and grade operating that may affect tendency to mediate spontaneously. The results of the Fisher tests are roughly comparable to the Grade x Reading Ability x Instructions interaction for number of trials. Therefore, this latter interaction may be explained in terms of spontaneous mediation as well as intelligence, although these two constructs may well be closely related to each other.

Jensen & Rohwer (1965) had found that as age increased, the differences between the groups given different instructions decreased, but there was still a significant difference at the second and fourth grade levels. They had raised the possibility that the older Ss were mediating spontanteously, but had gathered no data to support such a hypothesis. The data gathered in the present study indicates that at least some Ss at the lower grade levels were aware of mediating spontaneously, and the suggestion is that this phenomenon may be more likely to occur in children of higher intelligence and/or achievement level.

The latter hypothesis, that children of higher intelligence and/or achievement levels may be more likely to mediate spontaneously, is worth further exploration. A future, well-designed experiment could shed some

light on the question. For present purposes, however, some of the data from this study were compared; namely, the IQ scores of the spontaneous mediators vs. those of the non-mediators. The results of this comparison are as follows:

(1) The spontaneous mediators and non-mediators of each grade level were first compared. The mean IQ, standard deviation, and number of Ss for each group are shown in Table 7. A t test for the difference between the means was nonsignificant for the fourth grade, and barely reached the .05 level of significance using a one-tailed test for the second grade.

(2) With grades combined, the mean IQ and standard deviation for the spontaneous mediators were 106.55 and 12.18, respectively, and for the non-meidators these figures were 107.33 and 9.85. The difference between these figures is negligible.

/ See Table 7 /

A comparison between the good and poor readers, to see if achievement level is associated with the probability of spontaneous mediation, is impossible to make using the data of the present study for three reasons. First there were differences in IQ between the good and poor readers, confounding these two variables; thus, such a comparison would tell nothing about achievement level alone. Second, the grade levels could not be combined for such a comparison because each had been given a different reading achievement test. And third, the sample size is too small to permit such a comparison at each grade level.

Thus, the previously demonstrated relationship between PA learning and reading ability was not found in this study. Yet there was evidence that reading ability may be closely associated with both intelligence and the tendency to mediate spontaneously, and there may be interactions among these factors. The exact nature of this interaction need clarification through future research. Also, techniques for identifying spontaneous mediators

should be developed and used. Finally, the type of PA task may be the crucial factor in good and poor readers' PA learning. The fact that the present PA task comprised pictorial rather than verbal items may be the basis for the most straightforward explanation for the lack of a difference in the good and poor readers' overall performance. Further research is, of course, needed.

Summary and Conclusions

The purpose of the present study was to examine the relationships between syntactical mediation, reading ability, and paired-associate (PA) learning. It was hypothesized that good and poor readers would differ in the number of trials needed to learn a PA list, and that mediation instructions would facilitate learning. Sixty-four Ss were used in a 2 x 2 x 2 x 2 factorial design with two reading levels (good and poor), two grade levels (second and fourth), two types of instructions (mediation and non-mediation), and two sexes. Ss were chosen on the basis of consistently high or low reading achievement scores and average intelligence test scores. All Ss learned an eight-pair list of pictures of common objects to a criterion of one errorless trial or 20 trials, and then were asked how they had been trying to remember.

The results showed that the type of instructions received most affected the speed of learning, with the mediation instructions resulting in fewer trials. The older Ss also learned in fewer trials. A significant interaction between reading ability, grade, and instructions was discussed in terms of IQ and spontanteous mediation. The fourth grade good readers had higher IQs and mediated spontaneously more than the fourth grade poor readers.

Although statements made about these results should be tentative because of a small sample and IQ differences among the Ss, there are several trends that can be noted and conclusions that can be reached.

1. Syntactical mediation greatly facilitates paired-associate learning. The type of mediation used in the present study required Ss to make up their own mediators as did Jensen & Rohwer (1963b, 1965). Other studies which provided mediators for the Ss also found the same results. Therefore, this conclusion seems to be consistent across studies that differed in subject population, instructions, and materials. As long as the mediators have a certain amount of semantic and syntactic structure, it seems to make no diffference where they come from; the important factor is that the Ss are aware ofsuch a mediating association.

2. Older Ss perform better on a given PA task than do younger Ss. This conclusion, however, should not be interpreted without considering possibilities of spontaneous mediation and a possible "ceiling" or "basement" effect. The basement effect was found by Jensen & Rohwer (1965) with Ss 13 years and older, using a ten-pair list, but here again, spontaneous mediation could have been interacting with the comparative ease of the task for older Ss.

3. Factors affecting the probability that spontaneous mediation will occur are yet unidentified. Hypothesized variables are age, intelligence, reading achievement, and as Jensen (1966) has suggested, cultural environment. In the present study, there were no differences in IQ between spontaneous mediators and non-mediators, but since an attempt had been made to hold IQ constant and not systematically manipulated, the question needs further research. In the fourth grade, where there were high correlations between IQ and reading achievement subtests, there was a trend for more of the good

readers to mediate spontaneously than poor readers. There was no trend found to indicate that age might be an important variable.

4. No evidence was found to indicate that reading ability is an important factor in PA learning. However, since this variable may be closely associated with intelligence and tendency to mediate spontaneously, there may be an interaction between these variables that would have an important implication for learning theory and school instruction. The exact nature of this interaction needs clarification through future research. Also, techniques for identifying spontaneous mediators must be developed and used. The type of PA task used may be an important factor in finding differences between good and poor readers. This variable also merits more research since it could greatly affect decisions concerning which method to use in teaching reading.

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Table 1

MEAN IQ AND STANDARD DEVIATION FOR EACH GROUP

		Grade 2		Grade 4	
		Good	Poor	Good	Poor
Male	Mean	114.50	103.63	117.88	100.13
	S.D.	10.24	16.17	5.64	5.62
Female	Mean	110.75	110.63	113.13	96.00
	S.D.	4.33	10.31	4.29	5.45
Male and Female Combined	Mean	112.63	107.13	115.50	98.06
	S.D.	7.84	13.59	5.43	5.76

Table 2

MEAN NUMBER OF TRIALS AND STANDARD DEVIATIONS FOR ALL GROUPS (N = 4)

			Grade 2		Grade 4	
			Male	Female	Male	Female
Good	Non-Mediation	Mean	12.75	15.25	5.75	7.75
		S.D.	9.74	4.99	1.71	4.65
	Mediation	Mean	2.25	2.00	1.50	1.75
		S.D.	0.96	0.00	0.58	0.50
Poor	Non-Mediation	Mean	11.00	13.25	11.50	11.75
		S.D.	5.48	5.50	4.65	5.68
	Mediation	Mean	3.25	3.75	1.25	1.00
		S.D.	2.50	1.71	0.50	0.00

Table 3

ANALYSIS OF VARIANCE FOR

NUMBER OF TRIALS TO CRITERION

Source	df	MS	F
Reading Ability (R)	1	15.02	0.89
Instructions (I)	1	1305.02	77.50***
Grade (G)	1	112.89	6.70**
Sex (S)	1	13.14	0.78
R x I	1	4.52	0.27
R x G	1	23.77	1.41
R x S	1	0.77	0.05
I x G	1	23.77	1.41
I x S	1	11.39	0.68
G x S	1	1.89	0.11
R x I x G	1	74.39	4.42 *
R x I x S	1	1.27	0.08
R x G x S	1	1.89	0.11
I x G x S	1	1.27	0.08
R x I x G x S	1	0.02	0.00
Error	48	16.84	

* $p < .05$

** $p < .025$

*** $p < .001$

Table 4

ANALYSIS OF VARIANCE FOR IQ

Source	df	MS	F
Reading Ability (R)	1	2104.52	25.04 **
Instructions (I)	1	102.52	1.22
Grade (G)	1	153.14	1.82
Sex (S)	1	31.64	0.38
R x I	1	6.88	0.08
R x G	1	570.01	6.78 *
R x S	1	129.39	1.54
I x G	1	87.53	1.04
I x S	1	37.51	0.45
G x S	1	76.14	0.91
R x I x G	1	3.53	0.04
R x I x S	1	0.03	0.00
R x G x S	1	102.52	1.22
I x G x S	1	23.77	0.28
R x I x G x S	1	0.00	0.00
Error	48	84.05	

* $p < .025$
** $p < .001$

Table 5

CORRELATION COEFFICIENTS BETWEEN

IQ AND READING SCORES

Grade	Stanford Achievement Subtests	Coefficient
2	Word Reading	.27
	Paragraph Meaning	.29
	Vocabulary	.35
	Word Study Skills	.21
4	Word Meaning	.72
	Paragraph Meaning	.70
	Word Study Skills	.77

Table 6

NUMBER OF MEDIATING AND NON-MEDIATING NAMERS

	Grade 2			Grade 4		
	Good	Poor	Total	Good	Poor	Total
Mediators	2	3	5	5	1	6
Non-Mediators	6	5	11	3	7	10

Table 7

MEAN IQs, STANDARD DEVIATIONS, AND NUMBERS OF MEDIATING AND NON-MEDIATING NAMERS

	Grade 2		Grade 4	
	Mediators	Non-Mediators	Mediators	Non-Mediators
Mean	100.80	111.55	111.33	102.70
S.D.	14.81	6.67	7.81	10.99
N	5	11	6	10

FIGURE 1. READING ABILITY X INSTRUCTIONS X GRADE INTERACTION