

EFFECT OF MNEMONIC INSTRUCTIONS
ON PAIRED-ASSOCIATE LEARNING

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ON PAIRED-ASSOCIATE LEARNING

By

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SCOPE AND CONTENTS:

Different instructions for associating concrete nouns were given in a paired-associate learning situation. Material was varied to produce different types of interference against which to evaluate the effectiveness of the different instructions.

The major findings were: (1) Specific instructions for association produced fewer errors than no specific instructions on the first list a subject learned. (2) After the first list, only the instructions which asked the learner to produce a logical scene from the nouns produced fewer errors than non-specific instructions. (3) Specific instructions did not interact with material.

Little evidence was found that the significant instructional effects were due to the specific characteristics of the learners' mediations. These effects were more plausibly attributed to such general mechanisms as either giving the mediations during learning or having learning time occupied with irrelevant activity.

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CHAPTER ONE

INTRODUCTION

Mnemonic devices have been advocated for centuries as highly successful aids to memory. The major interest of the mnemonicists has been to develop a course of instruction which would improve the ability of a student to remember any material he desired. However, the effectiveness of these mnemonic devices has been documented only by the testimonials of the mnemonicists and their students. Rarely have mnemonic systems been considered in the psychological literature and never have they been systematically investigated to test their purported efficacy.

The bulk of the literature and research on memory and learning has been concerned with the built-in mechanisms which the individual is presumed to use automatically in learning. The variables which have been studied, in keeping with the associationist tradition, have been those of physical presentation such as rate, frequency of presentation, sequence of presentation (e. g. interference) and general characteristics of the material such as associative frequencies. By contrast, very few experiments have been designed to influence the deliberate modifications in the material made by the learner at the time of learning.

A type of experiment which would investigate such modifications would be one in which instructions as to how to deal with the material were altered from one group of learners to another. The effectiveness of the various mnemonic systems could be tested by instructing some learners to form associations of the type advocated by the mnemonicists and comparing these groups with groups which were given the same material but which were not given special instructions for handling the material. The following experiments incorporate these precepts.

CHAPTER TWO

HISTORICAL REVIEW

Mnemonic Systems

A variety of mnemonic systems have been advocated for centuries. These systems usually involve variations of two main strategies: 1. visualizing the various elements of the material to be learned in a vivid scene or 2. emphasizing the logical relations which obtain between these elements. Many of the variations have involved systems by which the above two devices could be extended to a wide variety of learning tasks. A recent version of a "visualizing" system has been presented by Bruno Furst (1949). In this system students are instructed to use two mechanisms:

1. The transformation of the material into two concrete nouns. Suppose you want to remember that the eleventh item you have to buy is a bottle of milk. The number 11 could be transformed into a pair of consonants by means of reference to a short table which has been previously memorized. The transformation here would be "t" and "t". A vowel is added between the two consonants, in this case an "o", to form a concrete noun ("tot"). You now have the two concrete nouns "tot" and "milk".

2. The association of the two nouns. You are instructed to vividly visualize the two nouns in a scene which should be ludicrous and which should involve motion. Here, you could picture the tiny tot in a white diaper lying in the bath tub drinking out of a three-quart jug of milk through a nipple. Thus, when trying to remember what the eleventh item is, the sequence "ll-tot-milk" would come to mind.

Students learn to transform the material quickly after a short practice period and this becomes a very useful, efficient memory aid.

Miller, Galanter and Pribram (1960) cited a system which included the same two mechanisms as above. They described how a long list can be easily committed to memory after having been heard once and how the recall of the list was accurate and effortless. They state that this is an extremely interesting and potentially profitable lead for research.

This visualizing type of mnemonic system was first suggested around 470 B. C. by Simonides. His system for remembering a list of objects was to visualize each one of them in separate places around a well-known room. Any given object in the list, say the fourth, could be remembered by thinking of the fourth position in that room and then recalling what had been visualized there. Romans such as Quintilian extended this device to longer lists by using

whole apartment houses as locating devices.

In the sixteenth century several systems were developed for converting numbers (and therefore ordinal position) into "locating" keys. The consonant-digit conversion system mentioned above has been the most successful of these devices.

An example of a mnemonic system which emphasizes the logical relations is given in Bacon (1898). An extensive bibliography of the mnemonic literature is given in Young (1961).

The mnemonicists' main interest has been in improving their methods of instructions and in the practical applications of these methods. They did not attempt to produce a system which would encompass all mental phenomena. In addition, their basic operations, such as visualizing or mental comparison, have not appealed to the positivistic tradition which has dominated research in verbal learning. Regardless of the precise reasons, however, the notions of the mnemonicists have not resulted in a large body of research.

Research in Verbal Learning

As stated previously most research in verbal learning has concentrated on such variables as word frequency, rate of presentation and order of presentation of lists. In most of these studies the learner has been treated as a relatively passive participant in the learning process. Recently, however, there has been a turn towards studies

which give the subject an active role in transforming the material to be learned. Examples of this trend include studies which investigate the role of instructions in the traditional verbal learning paradigm and studies on free recall, which are designed to demonstrate the learner's organizational processes.

Jenkins (1963), most of whose research has been firmly in the associationist tradition, made several suggestions for improving mediation in a four-stage paradigm. One of these suggestions was to instruct the subjects to use responses as mediators to facilitate transfer. This indicated that he believed that there can be active deliberate changes made in the learning process.

The studies of Jensen and Rohwer (1963, 1965), Dallett and D'Andrea (1965) and Earhard and Mandler(1965) have looked at the effects of systematically varying instructions to mediate in the usual "A-B, B-C, A-C", "chain of responses", situation. When the subject was instructed to mediate, significant differences in facilitation of learning were found when compared with subjects not instructed to mediate, except in the Dallett and D'Andrea study.

Jensen and Rohwer (1963) state that it is virtually impossible to suppress mediation in adult subjects. They tend to mediate spontaneously. If one uses mentally deficient adult subjects, one could implant verbal associations and

mediators by directly instructing the subjects to use them. This produces a great facilitative effect on paired-associate learning but no discernible effect on serial learning. When a comparison was made with a group receiving no such instructions, subjects instructed to mediate learned a paired-associate list much more quickly.

In a later paper (Jensen and Rohwer, 1965) the effects of instructions to mediate at different age levels was studied. Mediating instructions produced great facilitation in the age range from seven to thirteen years. Since, with increasing age there is a corresponding increase in the number of subjects who spontaneously mediate, instructions to use verbal mediators facilitate learning by causing those who would have mediated anyway to mediate earlier in the learning cycle. Thus, mediation instructions were found to lead to one trial learning of an entire list. This is similar to the findings of mnemonicists who state that even long lists can be learned in a single showing.

Earhard and Mandler (1965) report an unpublished study on the effects of giving their subjects cues as to what was the best strategy for learning. After learning List I, subjects were provided with "B-C" pairs from List II and were told that these relations would be useful. Then these subjects' performances were compared to the performances of subjects in a control group who were not provided with information about List II relations. It was found that

instructing the subjects about an appropriate strategy resulted in better test-list performance.

On the other hand, the study of Dallett and D'Andrea (1965) using differential instructions was unsuccessful in finding faster learning on List II in a group instructed to mediate as compared with a group instructed to unlearn List I. After learning a first list of the "A-B" type, half of the subjects were instructed to find a bizarre connection between the List I responses they had just learned and the List II responses they were about to learn and half were instructed to unlearn List I responses as quickly as possible as they would interfere with List II learning. They were then trained on an "A-C" list and tested with a variety of the MMFR to see the amount of unlearning of List I responses. Dallett and D'Andrea found that there was no difference in the rate of learning List II but that there were differences in individual List II item difficulty. In List I recall, mediation subjects were slightly better and reported more cases of interlist mediation than did unlearning subjects. The effectiveness of using mediation responses is questioned as no increase in speed of learning of List II items was evidenced with or without mediation even when one could be relatively certain that mediation was in fact being used.

In studies in free recall situations, subjects have been found to reorganize material that is presented to them

so that the order of output of the material is drastically different from what it was in input. Cofer (1965) reviews research dating back to 1953 which has demonstrated this effect, but attempts to explain much of it as the operation of associational norms.

Tulving has found his subjects using two main types of reorganization: "clustering" and "subjective organization". The former describes the phenomenon which occurs when objects of the same category seem to be combined and are recalled as a unit. When the output order in recall is consistent over recall trials, the phenomenon of "subjective organization" is said to have occurred. A positive correlation between the degree of organization and performance has been found. (Tulving, 1962 (b)). The more subjectively organized the material is, the better is the recall and vice versa.

Tulving (1962 (a)) in his work on free recall has also occasionally provided his subjects with differential instructions. He presented two groups of subjects with the same experimental conditions of presentation, recall and materials but with different instructional conditions. One group was merely told to recall as many words as possible while the other group was given instructions to organize the words alphabetically. He found a large and obvious difference in favour of the group instructed to organize the words alphabetically.

It seems, then, that many recent experimentalists,

while not rejecting the associationist results and methods, are now arguing that material is not merely put into a passive receiver, linked up involuntarily by certain rules, stored in and retrieved from memory. The human organism can voluntarily transform material and can be instructed as to which methods are best for handling this transformation. This viewpoint is not very different in principle from that of the mnemonicists who advocate improving memory by specifically instructing their students how to handle the material for better learning.

CHAPTER THREE

EXPERIMENT I

This experiment investigates the effects of three types of instructions on the learning of three types of material in a paired-associate situation.

INSTRUCTIONS

The types of instructions were:

Ridiculous Scene. In the ridiculous scene condition subjects were instructed to incorporate the objects into a vivid mental picture which was as ludicrous or ridiculous as possible. Many mnemonists have advocated this type of visualizing as an outstanding memory aid (Furst, 1949. Also the system cited in Miller, Galanter and Pribram, 1960). Among the reasons given for its alleged effectiveness is that the resulting associations would be both distinct and idiosyncratic to the learner.

Logical Relation. In the logical relation group subjects were asked to relate the three objects with such common characteristics as size, shape, colour, texture, location, or common verbal characteristics. Philosophers such as Aristotle and Locke asserted that people remember objects by automatically associating them by similarity, contrast or contiguity (Mandler and Mandler, 1964). Some mnemonists (Bacon, 1889) have advocated the deliberate

and systematic use of such a method as a memory aid.

No Specific Instructions. Subjects in the no specific instructions condition were not given any specific method. They were merely told to learn the material. This condition serves two purposes:

I. It is probable that subjects occasionally spontaneously adopt mnemonic aids similar to those outlined above. This group provides an opportunity to evaluate the effect of the spontaneous use of mnemonic-like devices. That is, speed of learning the individual items can be correlated with the characteristics of the mnemonic devices reported by this group.

II. Differences found between this group and the other two should show the effect of explicitly and systematically adopting the mnemonic devices given in the instructions.

MATERIAL

Concrete nouns were used as the material to be learned in this experiment since they can be easily put into a scene and also easily logically related to one another. This material is particularly relevant to testing mnemonic systems since an important part of the learning strategies adopted by many mnemonicists is to convert as many tasks as possible into the association of a pair of concrete nouns. However, a list of nouns is often too easy and is therefore learned so quickly that any differences that could be found would be washed out. Two precautions were taken to avoid this

ceiling effect. Trios instead of pairs of words were used as items in the lists, which increased the sheer amount of material to be learned. Using trios of objects, in addition to increasing difficulty, reduces the number of possible ways of visualizing or logically relating the objects, and therefore possibly decreases the variety of spontaneously adopted mnemonic devices.

The second method for avoiding the ceiling effect was to create a large amount of within and between list interference. The traditional way of creating this interference has been to pair words which were infrequently associated together and to have high associates to each stimulus at other places in the lists. However, the usual word association norms, such as those established by Palermo and Jenkins, 1964, are not usually collected in sets of three and, in any event, do not specify concrete nouns as response words. Rather than piece together materials from previous norms, new material was standardized. Subjects were given the name of a concrete object and were asked to respond with two objects that had been experienced most frequently with the given object in their past. These trios formed the "experientially related" (E) list. The responses were scrambled (each response independently) and re-paired with the original stimuli to produce a "non-experientially related" (NE) list. A third list, the "unrelated" (U) list was formed of scrambled trios completely different from

either the stimuli or responses in the other two lists.

By using this material it was possible to produce two main types of interference:

I. Within list interference. There would be relatively little interference within the E list, but more in the NE list and the U list, since in the latter lists responses which "belong" with one stimulus were paired with another.

II. Between list interference. Each subject learned two lists of six trios each. In List I, subjects learned either the E list, the U list or an NE list. When the criterion of zero errors or six complete trials had been reached, an NE list was given to all subjects.

INSERT TABLE I ABOUT HERE

In this design there are three types of interference of List I on List II:

(1) unrelated -- Low interlist interference. The U list followed by an NE list constitutes an "A-B, C-D" paradigm.

(2) emphasizing natural interference -- The E list is composed of trios which go together according to the "experiential" norms. When the responses are scrambled and re-paired to form the second list (an "A-B, A-Br" design, "A-Br" means that the "B" responses are re-paired with the "A" stimuli), the interference from List I is provided by

TABLE I

The design of Experiment I. The name of each of the 9 groups is given in the appropriate cell.

MATERIAL		INSTRUCTIONS		
LIST I	LIST II	Ridiculous Scene	Logical Relation	No Specific Instructions
E	NE	scene E	relation E	none E
NE	NE	scene NE	relation NE	none NE
U	NE	scene U	relation U	none U

items which had high associative bonds.

(3) re-pairing -- The responses of the NE list as List I are scrambled and re-paired to form a second NE list (once more an "A-B, A-Br" design). Here, the proactive interference for List II is provided by items which were themselves learned under conditions of high within list interference. Both (2) and (3), above, were included in this experiment since conceivably proactive interference generated by highly related trios would interact differently with the mnemonic strategies than would interference generated by scrambled trios.

It is particularly important to have a variety of types of interference in this experiment since an attempt will be made to separate two possible classes of effects that the mnemonic instructions might have:

1. Alteration of the general strategy and conditions of learning. If a learner were instructed to spell out every other word backwards during his study time, this might decrease his speed of learning by simply interfering with his normal learning processes. On the other hand, giving his mediations out loud under the critical inspection of the experimenter might improve his learning time simply by forcing him to be more explicit. In neither case would it be correct to attribute these changes in learning time to the specific characteristics of the mediations themselves.

2. Specific characteristics of the mediations

themselves. Treating a particular item "visually" or "logically" might in itself lead to different rates of learning. If so, the "visual" or "logical" characteristics of the mediations might be predictive of these different types of processes. Since these processes might be differentially applicable to different items and types of interference one would expect that the instructions variable would interact with interference conditions and the order of learning items within each list. By providing a variety of material and interference conditions it is hoped that this experiment will maximize the chance of finding specific effects due to instructions.

In most verbal learning experiments the amount of time spent learning the material is very rigidly controlled. However, if viewing time were held constant in this experiment the individual might either not have time to use the suggested memory aid or have enough extra time to rehearse former trios or lose interest. Therefore, all subjects were given as much time as they felt they needed to form the necessary mediation. The time each subject actually spent viewing each card was recorded so that this factor could be evaluated when explaining the results. One could then state whether or not the better performance displayed by one group when compared with another could be attributed to longer times spent viewing the cards.

Summary. This experiment is designed to investigate the

relative effectiveness of two memory aids, formation of ridiculous scenes and formation of logical relations. Within and between list interference are created by the material and by an "A-B, A-Br" design to provide appropriate conditions for testing the effectiveness of the memory aids.

METHOD

Subjects

The subjects were 45 male and 45 female students enrolled in first and second year Psychology courses at Mc Master University. None of the subjects had ever participated in an experiment which involved mnemonic devices.

Material

The material used in this experiment was obtained by the following method. Fifty concrete nouns were chosen from the 500 words occurring most frequently and from the 500 words occurring next most frequently lists of the Thorndike-Lorge Teacher's Word Book of 30,000 Words. These were administered to 78 first year Introductory Psychology students who were instructed to give, first, the object they most frequently saw with, used with or experienced with, the given object and, then, to give a second object which they had experienced most frequently in conjunction with the former two objects as a pair. (For the Instructions and a List of the words see App. A.)

A frequency count was made to determine the most

frequent responses to each stimulus. For the purposes of this count no distinction was made between singular and plural or whether the word was the first or second response to the given stimulus. The "experientially related" (E) list was derived from this frequency count by selecting responses which had been given as a pair with high frequency. These words also had high individual frequencies, i. e., they each appeared with high frequency to that stimulus word irrespective of what other response word had been given.

The "unrelated" (U) list was derived from the frequency count by selecting responses which had not appeared as a pair with high frequency but which had high individual frequencies. These twelve response words were then mixed and randomly re-paired with the six stimulus words.

The third and fourth lists, the "non-experientially related lists A and B" (NE-A and NE-B), were formed by keeping the given words of the E list as stimulus words and mixing and randomly assigning to them the twelve response words ensuring that no response word appeared with the same stimulus or response word in any of the three lists. Thus, any two of the E, NE-A and NE-B lists could form material for an "A-B, A-Br" design. (For a list of the material used see App. B)

Trios of words for instruction and practice were

selected from groups in the frequency count with high combination frequencies but whose words had low individual frequencies. For presentation, these materials were typed on 5" x 8" white cards.

Design

There were nine groups of subjects in this experiment. (See Table I)

The experiment was run in a presentation trial - test trial procedure. That is, a complete trial consisted of two parts: (I) the presentation of six cards containing the word trios for learning, followed by (II) the presentation of six cards containing only the stimulus word for testing for recall of the other two words in each trio. This procedure was repeated until criterion was reached, i. e., until there were zero errors in recall or six complete trials had been executed.

The order of presentation of each set of cards was a predetermined random sequence, the only restriction being that the last item in each list could not be immediately followed by the same item in the ensuing list.

In all cases, the intertrial interval was determined by the length of time it took the experimenter to place the set of cards in their new order. This was approximately ten seconds.

Procedure

The subjects were run individually in a session of

approximately thirty minutes duration. Each subject was randomly assigned to an experimental condition. The instructions were read to him. (For Instructions see App. C)

The experiment was run as a subject-paced experiment. Each subject was warned to take all the time he needed to form the mediation or to learn the words and then to signal when he was ready to proceed to the next trio. The subject was aware that he was being timed.

An error was scored when the subject either did not respond or when he verbalized an incorrect word as one of the responses to a stimulus. Each of the two response words in each trio was counted separately; it was thus possible to make a total of twelve errors per trial on a six trio list.

After criterion was reached on the first list, the stimulus-only cards were presented again in the scene and relation groups and the subject was asked to give the scene or the logical relation that he had used to help him remember the three objects. At no time were his mediations criticized. The procedure was identical for the second list. After criterion had been reached, the subjects in the none group were also asked if they had adopted any particular method in trying to remember the three objects.

The subjects in all groups were asked if they had actually pictured in their "mind's eye" any of the groups of three objects in some relation to each other or any of

the three objects. If they replied that they had, the mediations were repeated and the subjects were asked to indicate which of these they had actually visualized.

At the conclusion of the experiment subjects were given a brief explanation of the experiment and its purpose.

RESULTS AND DISCUSSION

Analyses were carried out on total errors to criterion and errors on trial 1 alone. Only trial 1 data will be presented since most of the conclusions were identical using the two dependent variables.¹ The trial 1 data can be seen in Figures I and II.

INSERT FIGS. I AND II ABOUT HERE

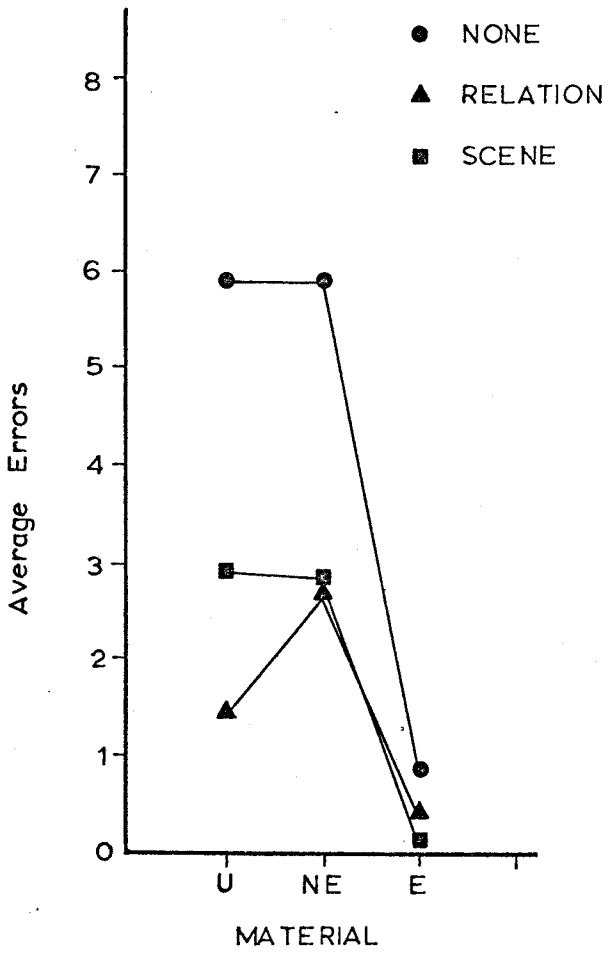
List I

Material. It was expected that on List I those groups who had received the E list of words would have fewer errors than any other group regardless of instructional condition.

¹One exception involves comparisons between the scene-NE and none-NE conditions on List I. In trial 1 data there was a significant difference ($p < .05$) between these two. In the overall data there was no significant difference. ($t=1.66$, $.2 > p > .1$)

Comparisons of the relation and none conditions under both the E and NE material conditions on List II were significant in trial 1 data but not in overall data. In the comparison under the E material, one subject in the relation group did not reach zero errors during six trials. When this subject was eliminated, a comparison between the none and relation conditions in overall data was significant at the .05 level. ($t=2.32$, $p < .05$)

(a) LIST I



(b) LIST II

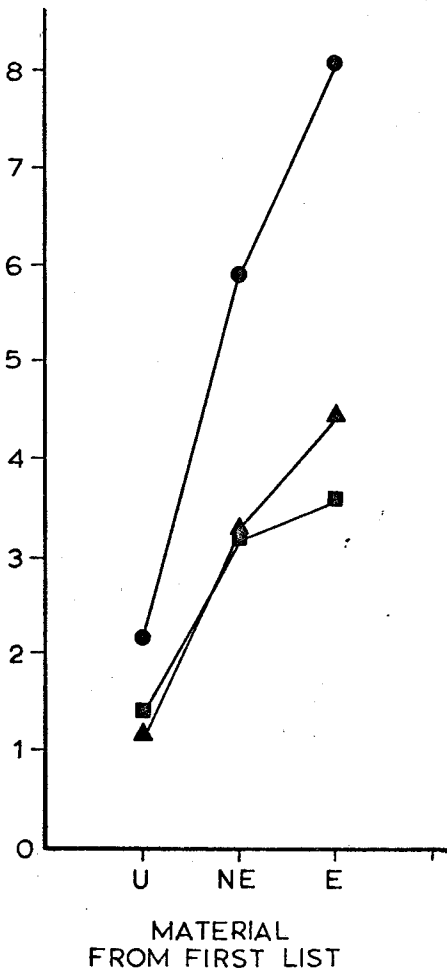
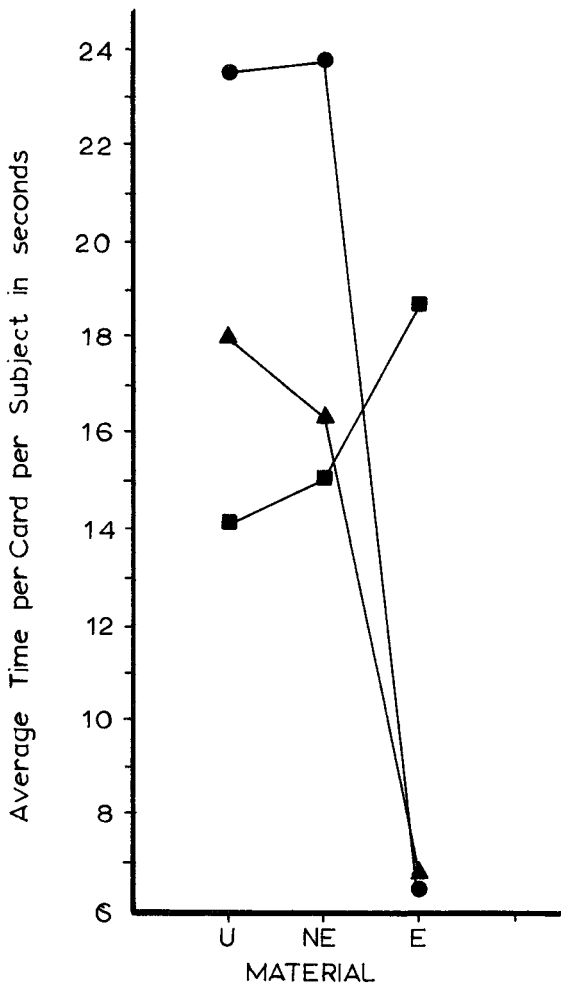


Fig. 1
The average number of errors of the three instructions groups as a function of material.

(a) LIST I



(b) LIST II

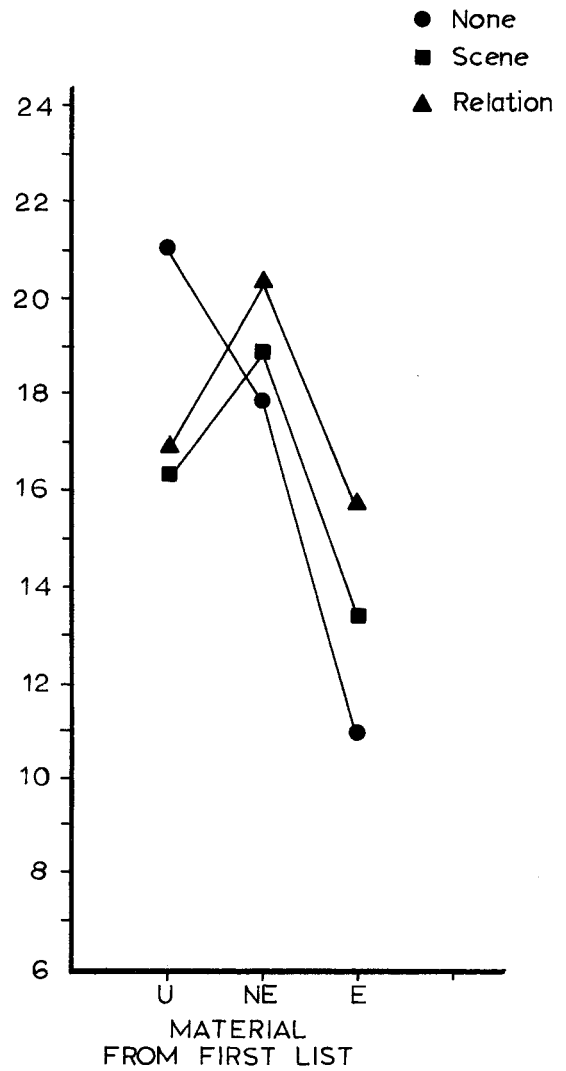


Fig II
The average viewing time per card of the three instructions groups as a function of material.

This expectation was confirmed. Significant differences were found between the group learning the E list and both other groups under each instructional condition. (See Table II.)

INSERT TABLE II ABOUT HERE

It was expected that there would be no significant differences between the U list and the NE list in number of errors on trial 1 because the responses for both lists were selected in the same manner. Comparisons between U and NE in each of the instructional conditions showed that there were no significant differences in number of errors between these two conditions. (See Table III and Fig. I (a).)

INSERT TABLE III ABOUT HERE

Instructions. Comparisons between the three instructional groups which had received the E list as List I revealed no significant differences due to instructions when this kind of material was used. (See Table IV.)

INSERT TABLE IV ABOUT HERE

In both the NE groups and the U groups no significant differences were found between the scene instructions and the relation instructions treatments. Significant differences were found under both treatments in each of the other

TABLE II

Comparisons between the E condition and each of the other two material conditions under each instructional condition on List I.

	<u>E vs NE</u>	<u>E vs U</u>
SCENE	U=1.5 (p < .001)*	U=26.5 (p < .05)
RELATION	t=2.95 (p < .01)	t=2.19 (p < .05)
NONE	t=3.73 (p < .01)	t=3.54 (p < .01)

*Fmax tests were carried out for these and all subsequent analyses. If a significant Fmax was found, the Mann-Whitney U test was carried out; if not, a parametric test was used.

TABIE III

Comparison of number of errors on List I in the U condition with those in the NE condition.

<u>SCENE</u>	<u>RELATION</u>	<u>NONE</u>
U=48.5 n.s.	t=1.59 n.s.	t < 1 n.s.

TABLE IV

Comparisons between the three instructional groups which had received the E list as List I.

	<u>SCENE</u> <u>vs</u> <u>RELATION</u>	<u>SCENE</u> <u>vs</u> <u>NONE</u>	<u>RELATION</u> <u>vs</u> <u>NONE</u>
Value of U	54 n.s.	54 n.s.	38.5 n.s.

comparisons and these differences were in the same direction for both types of lists. (See Table V and Fig. I (a).)

INSERT TABLE V ABOUT HERE

Therefore, the only difference due to instructions on List I was the one between the none condition and each of the other two instructions groups when learning either the U or NE lists.

Presentation time was under the control of the subject, therefore these findings could conceivably be accounted for by variations in length of viewing time. This possibility was eliminated by the results of comparisons carried out on the average viewing time per card. (See Fig. II.)

Under the E material condition the scene group took significantly more viewing time than did either the relation or the none conditions which did not differ between themselves. However, there were no significant differences in errors among the three groups so this factor is not sufficient to explain the findings.

The comparisons between U and E and NE and E under each of the none and relation conditions showed that subjects in the E condition spent significantly less time viewing the cards. It must be noted, however, that they also made significantly fewer errors than subjects in the U and NE conditions under both instructions conditions. All other

TABLE V

Comparisons between the three instructional conditions under two material conditions on List I.

	<u>SCENE vs NONE</u>	<u>RELATION vs NONE</u>
NE	t=2.52 (p < .05)	t=2.44 (p < .05)
U	t=2.17 (p < .05)	t=3.67 (p < .01)

comparisons were non-significant. It can be concluded that except for the subjects mentioned above, all subjects were taking approximately the same amount of time viewing the cards and therefore time cannot explain the differences in errors found between the groups.

List II

All groups received NE as List II. Different interference effects provided by the different materials given as List I were expected to be evidenced on List II learning and possibly to interact with instructions.

INSERT TABLE VI ABOUT HERE

Material. The U groups had consistently fewer errors on List II than either of the other two material groups, which did not differ between themselves. This result might be expected from interference theory alone since both E and NE, and NE and NE constitute "A-B, A-Br" designs, while U and NE constitute an "A-B, C-D" design. However, the differences in errors reached significance for individual group comparisons only in the no specific instructions conditions and in the relation condition where E and U were compared.

The fact that the subjects in the none-U condition made significantly fewer errors when compared with the none-E condition could be explained by the fact that these subjects were also spending significantly more time viewing the cards.

TABLE VI

t tests comparing number of errors on List II under each instructional condition.

	<u>SCENE</u>	<u>RELATION</u>	<u>NONE</u>
E vs NE	< 1 n.s.	1.08 n.s.	1.79 n.s.
E vs U	1.81 n.s.	3.46 (p<.01)	5.70 (p<.01)
U vs NE	1.39 n.s.	< 1 n.s.	3.61 (p<.01)

However, this is the only difference in this or the subsequent experiment which was in this direction. This explanation is therefore suspect.

The subjects in the none-NE condition did not make significantly fewer errors than the subjects in the none-E condition. Therefore, the finding that they spent significantly more time viewing the cards than the subjects in the none-E condition is not sufficient to explain the findings.

No overall (3 x 3) analysis was carried out since neither all three instructions nor all three material conditions formed a single dimension of interest.

Instructions. The no specific instructions groups made the most errors under all material conditions. However, significance was found only in a few of the individual group comparisons (See Fig. I (b) and Table VII). As in the first list, significance was found only between the no

INSERT TABLE VII ABOUT HERE

specific instructions group and each of the other groups and then only with high interference material. The one exception to this generalization is the comparison between the scene and none groups for the NE material. The lack of significance in this case can be partially attributed to one subject in the scene group who made ten errors out of a possible twelve, which is an unusually high score. If this

TABLE VII

t tests comparing number of errors on List II between instructional conditions under each material condition.

	<u>E</u>	<u>NE</u>	<u>U</u>
SCENE vs NONE	3.25 (p<.01)	1.87 n.s.	<1 n.s.
RELATION vs NONE	2.94 (p<.01)	2.34 (p<.05)	1.42 n.s.
SCENE vs RELATION	<1 n.s.	<1 n.s.	<1 n.s.

subject were eliminated the comparison was significant at the .05 level.

Interaction. To obtain conclusions on interactions between material and instructions, two by two analyses of variance were carried out comparing the effects of the U list with each of the other two material conditions under all pairs of the instructions conditions. The only significant interaction was in the analysis involving U and E, none and scene. Only in this one case did specific instructions level the difficulty provided by different amounts of interference. Once again, comparisons of viewing time under each condition were non-significant in all cases.

Spontaneous Mnemonic Devices. The recorded verbalizations of the subjects in the none groups were inspected to see if mnemonic devices had been used spontaneously. The criteria used to group the mediations were the following:

1. Subjects who rote memorized. -- Subjects did not report adopting any particular method to help them learn the trios other than repeating the trio over or merely stating that they had "memorized".

2. Subjects who used logical scenes. -- The mediations seemed to be natural scenes which occur frequently. Reported scenes which seemed to be contrived were not included. If a subject used more than one mediation that was of a different kind out of a possible twelve mediations, he was not included in this group.

3. Subjects who used a combination of methods. -- This included subjects who had not consistently adopted one method but had used some combination of rote memorization, logical relations, verbal characteristics, logical scenes and ridiculous scenes.

The number of subjects who fell into each category were:

1. Two subjects who had merely rote memorized.
2. Seven subjects who had consistently pictured logical scenes.
3. Twenty-one subjects who had not adopted one consistent method but who had used a combination of methods.

A second independent judge inspected the mediations of the thirty subjects in these groups according to the criteria. There was disagreement on the categorization of only two subjects. The reliability is thus 91%.

Comparisons were carried out between groups 1 and 2, 1 and 3, and 2 and 3 on number of errors on each of List I and List II. Significant differences were found on List I only between subjects who had used logical scenes and each of the other two groups. However, no significant differences were found on List II comparisons.

The lack of significant differences between the scene and relation groups in any of the error comparisons was an unexpected finding. In an effort to find some differential effect of these instructions, the number of

errors per trio were tabulated and the distributions compared between the two instructional conditions. The experimenter expected to find a difference between the error distributions since some trios might be more difficult to handle in one or the other of the specific instructions conditions and thus affect the outcome. However, there were no significant differences.

We have evidence, therefore, that something about the process of making mediations increased the speed of learning. The scene and relation groups both did better than the none group and the subjects in the none group who reported consistently mediating did better than those who did not on List I. However, it is not clear whether these effects are due to some general characteristic of mediating rather than to the specific characteristics of the mediations themselves. For example, the relevant variable in speed of learning might be the mere expectation of having to give a mediation to the experimenter rather than whether that mediation contained a logical relation or formed part of a coherent scene. If the effect is due to the specific characteristics of the mediations themselves we would expect that conditions would interact with items. This was not the case. We would also expect that the scene and relation groups would differ between themselves. This was not the case. We would further expect that number of errors made by each subject in the no specific instructions group would

differ according to the mediations they spontaneously used. One such difference was observed on the first list but did not hold up for the second.

A possible reason, however, why there was no separation between these two groups was that there were insufficient differences between the mediations of the groups. The subjects in this experiment did not adhere to mediating instructions as well as did the subjects in previous pilot studies. Therefore to get evidence relevant to this point, greater precautions must be taken to insure that subjects do in fact produce mediations which differ widely in their specific characteristics.

CHAPTER FOUR
EXPERIMENT II

In the previous experiment the ridiculous scene and logical relation instruction treatments did not differ in number of errors but both groups differed from the no specific instructions groups. One reason for the finding of no difference between the specific instruction groups might be the fact that subjects did not produce sufficiently different mediations. In the present experiment two changes were introduced to try to separate the effects of these instructions:

I. Each subject was given a list of criteria which had to be fulfilled in his mediations. During learning the subjects were asked to give their mediations out loud and were corrected according to these specific criteria.

II. Each subject was given four lists to learn so that he would become proficient at making the required mediations. It was hoped that this combination of criticism and practice would produce very different mediations and thus different numbers of errors in each treatment. Another anticipated result of these changes in procedure was that the role of individual differences would be reduced as subjects became more familiar with the task.

In addition to the ridiculous scene, logical relation and no specific instructions groups used in Experiment I, two new groups were included:

Logical Scene. Subjects in the logical scene condition (scene-L) were asked to form a vivid picture of the three objects. No mention was made of making the scene ludicrous or ridiculous. This group was included because of statements by many subjects in Experiment I that it was too difficult to form a ridiculous scene and because many subjects in the none condition in the first experiment had spontaneously used non-ludicrous scenes.

No Specific Instructions with Recitation. One possible reason why subjects in the none group did more poorly than subjects in either of the two specific instructions groups in Experiment I could be that they had no expectation that they would have to report their mediations and therefore might not have produced mediations that were as explicit as those produced in the other two groups. One way to control for the influence of this factor was to introduce a no specific instructions group which did report their mediations after each list had been learned to criterion. (none-R). If expectation of recitation were an important determinant of speed of learning then this group should differ from a no specific instructions group which did not report their mediations.

As in Experiment I, subjects in the specific instructions conditions were allowed as much time as they needed to form the necessary mediations. Subjects in the control conditions, however, were forced to take thirty seconds viewing time for each trio. A possible reason that subjects had performed so poorly in the no specific instructions group in the first experiment was that they had not given themselves enough time to learn the material. Thirty seconds seemed to be the average amount of time that subjects in the three specific instructions groups took to form and recite their mediations (i.e., time spent actually viewing the card) during a pilot study for this experiment. Thus, the time was equated as nearly as possible so that differences in numbers of errors could not be attributed to this parameter.

Summary. This experiment is an attempt to separate the instructional groups by practice and criticism of the mediations used to help in learning and remembering. The variable of recitation is also examined to see if anticipation of recitation can account for better learning.

METHOD

Subjects

The subjects for this experiment were enrolled in psychology courses in summer school at Mc Master University in 1966. The twenty-five males and twenty-five females

ranged in age from sixteen to forty-four with a mean of 27.8. None had ever participated in an experiment which involved mnemonic systems.

Material

Four lists of material were used in this experiment. (See App. D). The "A" and "B" lists formed an "A-B, A-Br" design as did the "C" and "D" lists. The former two were the two NE lists of Experiment I while the "C" list was the U list of the last experiment from which the "D" list was constructed by re-pairing.

Design

There were two experimental days for each subject. Two lists of words were presented each day to be learned. On Day I half of the subjects received the two U lists and the other half the two NE lists. Half of the subjects who received the U lists on Day I were given them in the order U-A, U-B. The other half were presented with the reverse order. The same was true of the group receiving the NE material, half receiving the order NE-A, NE-B, half receiving the order NE-B, NE-A.

On Day II those subjects having learned the U lists the previous day were presented with the NE lists, counterbalanced for order of presentation. In the same way, subjects who had learned the NE lists on Day I were given the U lists on Day II with the order of presentation of the U-A and U-B lists similarly counterbalanced. The

order in which the cards were presented on each trial was a random predetermined sequence as in Experiment I.

In all cases the intertrial interval was determined by the length of time it took the experimenter to place the set of cards in their new order. On the average this was approximately 10 seconds.

The five instruction conditions included in this experiment were:

logical relation, ridiculous scene, logical scene, no specific instructions with recitation and no specific instructions.

Procedure

The Logical Relation, Ridiculous Scene and Logical Scene Conditions. Day I. The Subject was randomly assigned to a group.

The instructions were read to the subject. As the characteristics to be included in his mediations were described to him a 5" x 8" card was placed on the table in front of him which listed all of these "necessary characteristics" (See App. E). This card remained on the table for the duration of the experiment. In each case, three examples were given to show the subject how to include these characteristics in his mediations. After each example the characteristics included in it were pointed out specifically.

An ordinary stopwatch was used to record the amount of time the subject actually spent viewing each trio each

time it was presented.

The subject verbalized his mediations as he made them up for each trio and they were criticized according to whether they fulfilled the criteria listed on the card. Satisfactory mediations were recorded.

This procedure was repeated until criterion of zero errors or five complete trials was reached.

The same procedure was repeated for the second list. Day II. The same procedure was carried out on Day II except that there was no criticism of List IV mediations other than the rejection of unacceptable ones.

The No Specific Instructions with Recitation and the No Specific Instructions Conditions. Day I. In both of these conditions the subject was allowed to view each trio for thirty seconds. The stimulus cards were presented for the length of time it took the subject to respond.

The instructions were read to the subject (See App. E). In both conditions the cards were presented as above until the subject reached criterion. In the none-R condition the subject was asked to state whether he had adopted any particular method in trying to learn each trio of words. These methods were recorded. Subjects in the none condition were not asked to recite their methods. A second list was then presented in the same manner. When criterion had been reached methods of learning were once more requested in the appropriate condition.

Day II. The same procedure was carried out under both conditions as on Day I. After List IV had been learned to criterion subjects in the none condition were asked if they had adopted any method in trying to learn the words and were presented with the stimuli of List IV to describe their methods for each trio. These descriptions were recorded.

After criterion had been reached on List IV subjects in all five groups were given a brief explanation of the experiment and its purpose.

RESULTS AND DISCUSSION

In this experiment, as in Experiment I, only trial 1 data will be presented.²

INSERT FIGS. III AND IV ABOUT HERE

The findings on List I should replicate the findings of Experiment I unless giving mediations out loud during

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- ² Tests were carried out on overall data as well. Significant differences were found in comparisons between none-R and none and between scene and none-R. These were not found when trial 1 data was tested. However, trial 1 data did lead to significant differences between scene-L and none while similar tests on overall data did not show this. The effect of the variables could be seen as readily on trial 1 data without the confounding of subjects who made a high number of errors on succeeding trials and who took many trials to reach criterion in overall data. One subject who had made an unusually high number of errors over all trials was eliminated and an analysis of variance was carried out. A non-significant F was found on the comparison between the scene and none-R groups while this same comparison was significant at the .05 level with this subject included.

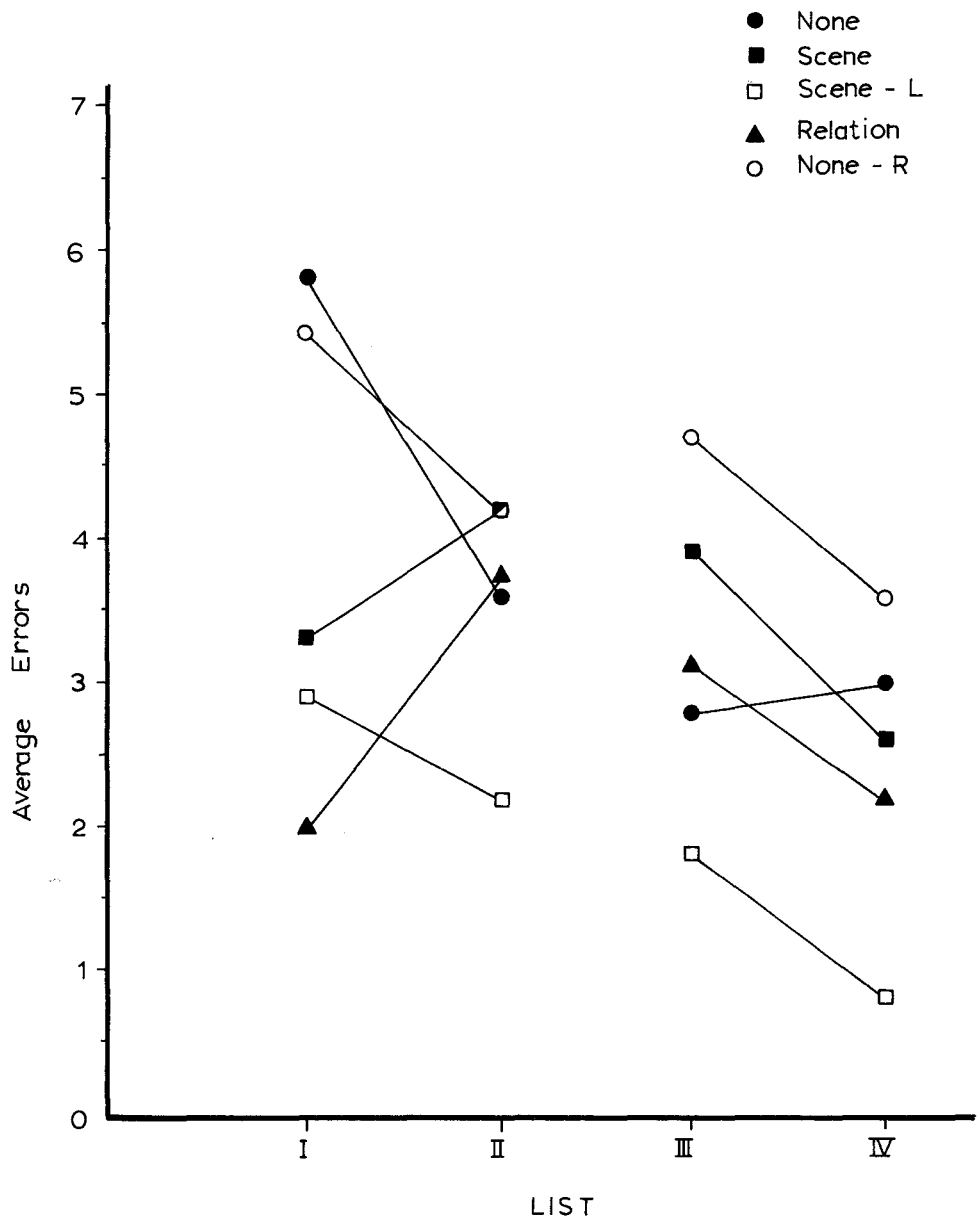


Fig. III

The average number of errors of the five instructions groups plotted against lists.

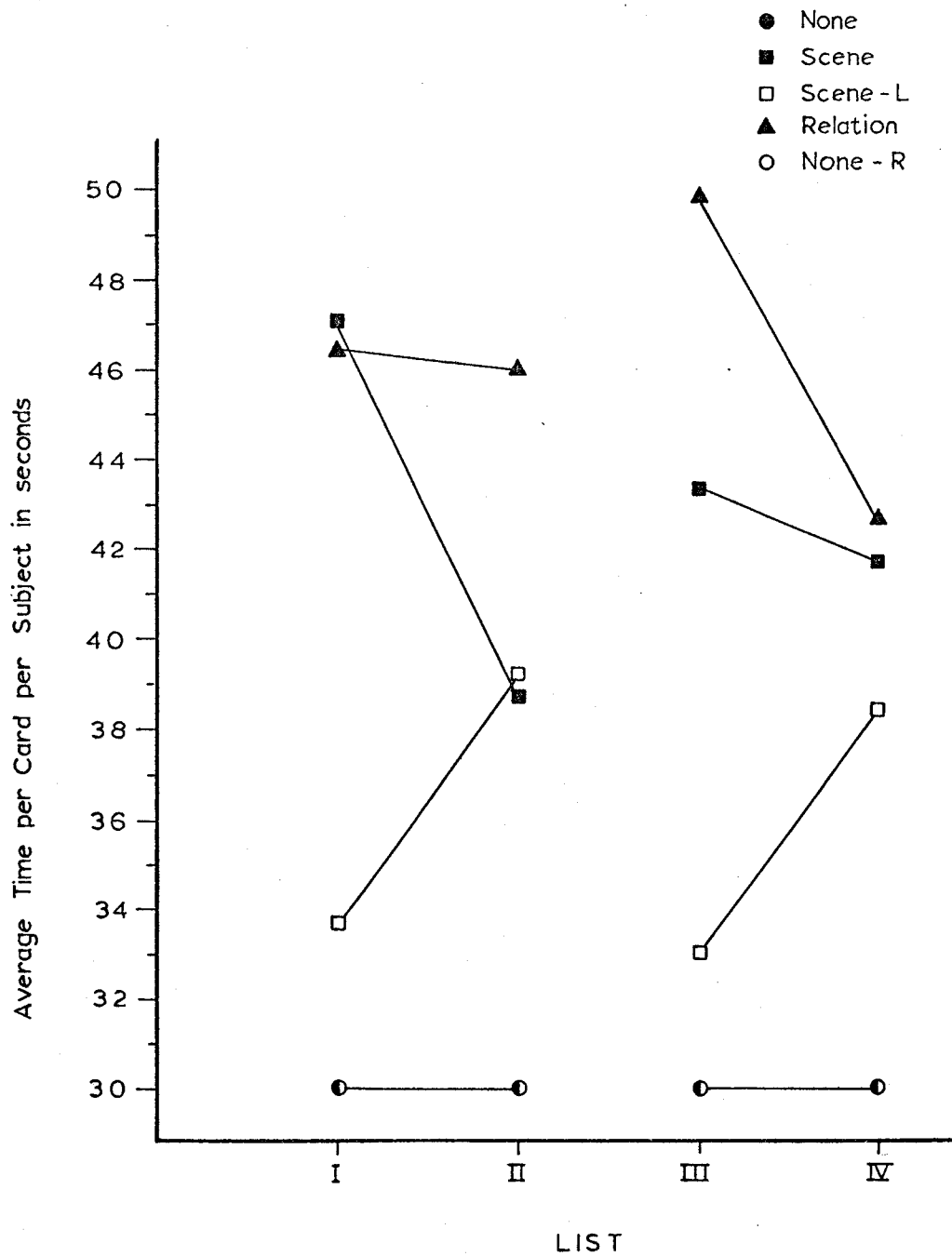


Fig. IV
 The average viewing time per card of the five instructions groups plotted against lists.

learning changes the effects of instructions. Comparisons were made by means of t tests on errors on List I. There should be no difference on the very first trial between the two no specific instructions conditions since these two conditions were treated identically until after this list. This expectation was confirmed. In addition, no significant differences were found between the three specific instructions conditions. This replicated the finding of Experiment I where the errors in the scene condition were not significantly different from those in the relation condition. Analogously with Experiment I, there were significant differences between each of the none conditions compared with each of the specific instructions conditions.

However, after List I, the relations among the instructional conditions change. Analyses of variance were carried out on each pair of instructional conditions, with lists as a second factor. The scene-L condition differed from all the other instruction conditions at the .05 level but no other pairs of instructional treatments differed among themselves. In none of these analyses was the interaction between lists and instructional conditions significant. These conclusions are identical when comparisons are carried out on List IV alone. Once again, viewing time cannot account for these findings since it was not systematically related to number of errors and in some cases, the

means were in the wrong direction. (See Figs. III and IV).

The fact that there was no overall difference between the two no instruction groups indicates that knowledge that they would have to give an explicit method of learning was not a critical variable. The fact that the scene and relation conditions did not differ among themselves cannot be accounted for by the fact that mediations were very similar. The mediations in each condition fulfilled criteria set out for the subjects and in fact were very different in all the specific instructions conditions.

A change in methods of learning over lists can be seen in the none-R group. At first all subjects were using a variety of methods to help them remember the three objects. (The mediations were categorized according to the same criteria as in the first experiment.) These methods included logical relations and scenes (both logical and ridiculous) and, in addition, rote memorization. By the fourth list nine of the ten subjects were using some logical scenes, six of these subjects using these scenes almost exclusively. Two of the remaining three subjects used logical scene in combination with logical relations. The remaining subjects did not adopt any particular method. Thus, by the fourth list it was no longer possible to do any systematic analysis of error rates associated with the different spontaneously adopted mnemonic devices.

Taken as a whole there is little evidence that the mnemonic instructions facilitated learning. Two of the specific mnemonic devices advocated, that is, ridiculous scenes and logical relations, do not seem to confer much of an advantage over the devices which subjects spontaneously adopt for this material. The effect of these instructions was to get the subjects to adopt these systems more systematically and earlier as evidenced on List I comparisons. However, the instructions to visualize logical scenes did facilitate learning even after the first list.

If this is due to the specific characteristics of the mediations themselves, one must explain why the none-R group who spontaneously adopted the more natural strategy of logical scenes did not do as well as the scene-L group. Perhaps this can be accounted for by the fact that the scene-L group gave their mediations out loud during learning while the none-R group did not overtly verbalize their mediations until after criterion had been reached on each list. Thus, it was not the expectation of having to explicitly produce a mediation that accounted for the difference in performance between these two groups. However, the actual act of reciting mediations out loud at the time of learning which was not controlled for in the none-R condition can account for the better performance in the scene-L condition.

However, if recitation is the critical variable one must explain why the ridiculous scene and logical

relations group did not perform as well as the scene-L group. All three groups had overtly recited their mediations during learning. However, the subjects in the ridiculous scene and logical relation groups were forced to apply a method which they found unnatural. Not only the subjects in this experiment, but also those in the first experiment, complained of the difficulties involved in making ridiculous scenes and logical relations. Logical scenes, in addition, were spontaneously adopted in the no specific instructions conditions in both experiments and were emitted by subjects in the ridiculous scene and logical relation groups in the first experiment where there had not been adequate control over their mediations.

The finding in both experiments that the difficulty of items in a list did not vary with the instructional conditions further supports the contention that the superiority of the logical scene group can be attributed to general characteristics of the mediation task such as giving mediations out loud during learning which are compatible with the subjects' normal learning process rather than to the specific characteristics of the mediations themselves.

CHAPTER FIVE

CONCLUSIONS

It has been found with this material that the associational strategies advocated by mnemonic systems do not yield an advantage over strategies spontaneously adopted by the subject. This statement, however, does not deny the possible usefulness of that portion of the mnemonic systems in which the material is converted into concrete nouns.

The above experiments contained a number of features designed to detect differences that the specific characteristics of mediations might have produced: a variety of types of interference were employed; the interaction of items with instructions was calculated; spontaneously given mediations were examined for differential error rates. Nevertheless, very little evidence was found to indicate that the specific characteristics of mediations make much of a difference.

With one exception, the facilitative effects due to the explicit instructions given to the subjects on List I as compared with the performance of subjects in the no instructions conditions were found to wash out on later lists as subjects in the no specific instructions groups spontaneously changed their methods of dealing with the material. The exception was the logical scene group. The possibility cannot be eliminated, however,

that the effect for this group was due to giving mediations out loud which were compatible with the subjects' normal learning strategies, rather than to the specific properties of the mediations themselves.

CHAPTER SIX

SUMMARY

In Experiment I the effects of three types of instructions (none, scene and relation) on the learning of three types of material (E, NE and U) were investigated. The E list produced the best learning on List I but was not influenced by instructions. For the other two material conditions, the no specific instructions group made significantly more errors than did either the scene or the relation groups. These latter two groups did not differ from each other.

On List II, which was an NE list for all groups, there were differential interference effects from List I. The U list produced the least interference while the NE and E lists as List I produced more interference but did not differ significantly from each other. Once again, the no instructions condition differed significantly from each of the other two and these latter did not differ from each other. A significant interaction between instructions and material was found in only one case.

In Experiment II, two more instructional conditions (none-R and scene-L) and two more lists of words for

each subject were added. The data on List I were analogous to the findings of Experiment I, i.e. the two no specific instructions groups were not significantly different from each other but each differed significantly from each of the three specific instructions conditions. The latter did not differ significantly among themselves. These findings washed out after List I. After List I, a significant difference was found only between the scene-L condition and all other conditions. The lack of significant differences between the two none groups suggested that the expectation of having to verbalize a method of learning had no effect on learning.

Little evidence was found to support the contention that the specific characteristics of mediations produced at the moment of learning influenced the speed of learning. It was suggested that the effects of instructions that were found were due to relatively non-specific mechanisms such as interference with normal associative processes or reciting out loud during learning.

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APPENDIX A

INSTRUCTIONS
AND MATERIAL FOR STANDARDIZATION

The following is a list of concrete nouns. For each word you are to write down a noun in Column I that you have used with or seen with the given noun most frequently in your past experience. Take your time & think about it. The first word that comes to your mind is not necessarily the object most frequently experienced with the given object. For example, the answer to 'army' would not be 'navy' but more likely 'uniform'.

In Column II you are to write down the name of an object you have seen with or used with the other two objects in conjunction most frequently in the past. For example, if 'army' was the given object and 'uniform' the object in Column I, then 'rifle' might be the answer in Column II.

WORK THROUGH THE WHOLE LIST SLOWLY. Keep in mind that the words you put down have been seen together with or found frequently with the given object in your past experience.

Please read the instructions over again.

Are there any questions?

NAME _____

SEX _____

	<u>Column I</u>	<u>Column II</u>
House		
baby		
king		
book		
woman		
bag		
flower		
snow		
car		
head		
dog		
train		
salt		
gate		
boy		
sun		
ball		
egg		
window		
smoke		
bear		
river		
school		
horse		
door		
table		

NAME _____

Column IColumn II

rain

fish

heart

shoe

hat

bed

road

dress

tree

bridge

ice

money

stone

garden

coal

sea

milk

father

hill

paper

grass

church

cloud

lake

APPENDIX B

Material used in Experiment I.

	<u>E</u>	<u>NE-A</u>	<u>NE-B</u>		<u>U</u>
GATE	-- fence yard	-- head leaf	-- rider pen	KING	-- rifle wheel
PAPER	-- pen ink	-- hair rider	-- yard mother	BED	-- queen student
TREE	-- branch leaf	-- fence child	-- ink head	RAIN	-- garage sheet
HORSE	-- saddle rider	-- yard ink	-- hair branch	SCHOOL	-- cub pillow
FATHER	-- mother child	-- branch pen	-- saddle fence	BEAR	-- clouds book
HAT	-- head hair	-- mother saddle	-- leaf child	CAR	-- crown umbrella

APPENDIX C

Instructions for Experiment I.

FOR ALL SUBJECTS

I'm going to show you a list of objects presented in groups of three. Your task is to learn which objects go together so that if one of the objects is given to you, you will be able to recall the other two in that group.

(a) THE NONE CONDITION

This is the kind of material you'll be dealing with. (For the subjects in the NE and U groups, "dog, bank, stars" and "train, leash, skates" were given. For the subjects in the E group, "ice, skates, winter" and "dog, collar, leash" were shown.) Now I'm going to give you a series of cards. Your task is to get all the objects correct on the next trial. Take as long as you think you need while trying to learn the words so that you will get them all right on the next trial. Please let me know when you're ready to go on to the next by saying "okay". I'm not timing you but I am keeping a record of how long you think you need to learn the three objects. Remember take as long as you need to learn the objects. Okay, any questions?

(b) THE SCENE CONDITION

In order to help you remember these objects, I want you to picture them in a ludicrous or silly scene. For example (in the NE and U conditions), "dog, bank, stars" might be pictured in this scene: "The dog jammed the stars into his piggy bank. Or, "train, leash, skates": "The man on skates held onto the leash which was attached to the train and thereby got a fast ride." Or,

For example (in the E condition), "ice, skates, winter" might be pictured in this scene: "Old man winter was skating along blowing the water in front of him to freeze it into ice. Or, "dog, collar, leash": "The dog was leading his master by the leash which was attached to his collar."

Now, as I present each card with the three objects on it, I want you to describe the ludicrous scene to me, and I will tell you if you have the right idea. (Two practice trios were given.)

Now I'm going to present a series of cards to you. I want you to picture the three objects in a silly or ludicrous scene. You have all the time you want to form these scenes. You don't have to tell them to me but would you please say "okay" when you are ready to go on to the next card. I'm not timing you. I am taking a record of how long it takes you to form these scenes. I'm not trying to rush you. Please take as long as you think you need to form a silly scene to help you remember the objects. Okay, any questions?

(c) THE RELATION CONDITION

In order to help you remember these objects I want you to give me a logical relation or common characteristic of the three objects. For example (in the NE and U conditions), "dog, bank, stars": "The dog and the bricks of the bank are both brown and the stars are shiny like the coins kept in a bank." Or, "train, leash, skates": "The train and skates can both be used for transportation. Skates have laces which look like a leash". Or, For example (in the E condition), "dog, collar, leash": "The collar and the leash are made of leather. The dog and the collar are

usually brown." Or, "ice, skates, winter": "They are all found when it is cold outside." In other words associations of size, shape, colour, common locations, common usage, objects often seen together, common letters, etc. are the desired associations.

Now, as I present each card with the three objects on it, I want you to tell me your logical relation or common characteristic and I will give you an idea if you are right. (Two practice trios were given.)

Now I'm going to present a series of cards to you. I want you to form the logical relation between the three objects or between pairs of the three objects. You have all the time you want to form these associations. You don't have to tell them to me, but would you please say "okay" when you are ready to go on to the next card. I'm not timing you. I am taking a record of how long it takes you to form these relations. I'm not trying to rush you. Please take as long as you think you need to form a logical relation to help you remember the three objects.

AFTER FIRST PRESENTATION TRIAL FOR ALL SUBJECTS

Now I'm going to present just one of the objects from each group of three. I want you to give the other two objects that were shown with it.

AFTER ZERO ERRORS OR SIX COMPLETE TRIALS

(a) THE SCENE AND RELATION CONDITIONS

Now as I show you one of these words again would you please describe the ludicrous scene (or logical relation) that you used to help you remember the three objects.

Now we'll do the same thing with a second list of words. As you are shown each card, please form a ludicrous scene (or logical relation) to help you remember the three objects so that if I show you just one of the objects, you will be able to remember the other two that were shown with it.

(b) THE NONE CONDITION

Now we'll do the same thing with a second list of words. I want you to learn the words so that, if one of the objects is shown to you, you will be able to recall the other two in that group.

AFTER ZERO ERRORS OR SIX COMPLETE TRIALS ON THE SECOND LIST

(a) THE SCENE AND RELATION CONDITIONS

Now as I show you one of these words again would you please describe the ludicrous scene (or logical relation) that you used to help you remember the three objects.

(b) THE NONE CONDITION

Now as I show you one of these words on both lists, would you tell me if you adopted any particular method to help you learn the three words and try to describe the method to me.

APPENDIX D

Material Used in Experiment II

	<u>A</u>	<u>B</u>		<u>C</u>	<u>D</u>
GATE	--head leaf	--rider pen	KING	--rifle wheel	--sheet cub
PAPER	--hair rider	--yard mother	BED	--queen student	--garage clouds
TREE	--fence child	--ink head	RAIN	--garage sheet	--crown pillow
HORSE	--yard ink	--hair branch	SCHOOL	--cub pillow	--queen umbrella
FATHER	--branch pen	--saddle fence	BEAR	--clouds book	--student wheel
HAT	--mother saddle	--leaf child	CAR	--crown umbrella	--book rifle

APPENDIX E

Instructions for Experiment II

(a) THE NONE CONDITION

You will be presented six groups of words, each group containing three common everyday objects. Your task is to learn the words so that if the first word is shown to you you will be able to recall the other two in that group.

You will be allowed to look at each card for a fixed amount of time and then the next card will be shown to you. Remember your object is to get them all right on the next trial. You will be shown the same list over and over until you get all six groups of three completely correct. This is the kind of material you'll be dealing with.

Okay, any questions?

After criterion. You will now be presented with another six groups of three words. Once again your task is to learn all three words so that if you are presented with the first word of each group you will be able to recall the other two in that group. Once again, you will be shown each card for a fixed amount of time.

Day II. Today you will be presented with two more lists of six groups of words. You will be expected to learn all three words so that if the first one is shown to you, you will be able to recall the other two in that group. Remember your object is to get as many correct as possible. Once

again, you will be shown each card for a fixed amount of time.

After criterion. You will now be presented with another six groups of three words. You will do the same thing as you did before.

After criterion on the fourth list. Did you adopt any particular method in trying to learn these words? (If the subject answers that he had, the following was asked.) As I show you one word only from each group of three in this last list would you please describe the method you adopted to help you remember the three objects?

(b) THE NONE-R CONDITION

You will be presented six groups of words, each group containing three common everyday objects. Your task is to learn the words so that if the first word is shown to you you will be able to recall the other two in that group.

You will be allowed to look at each card for a fixed amount of time and then the next card will be shown to you. Remember your object is to get them all right on the next trial. You will be shown the same list over and over until you get all six groups of three completely correct. This is the kind of material you'll be dealing with.

Okay, any questions?

After criterion. Did you adopt any particular method in

trying to learn these words? (If the subject answers that he had, the following was asked.) As I show you one word only from each group of three would you please describe the method you adopted to help you remember the three objects?

You will now be presented with another six groups of three words. Once again your task is to learn all three words so that if you are presented with the first word of each group you will be able to recall the other two in that group. Once again, you will be shown each card for a fixed amount of time.

After criterion on the second list. As I show you one word only from each group of three would you please describe the method you adopted to help you remember the three objects?

Day II. Today you will be presented with two more lists of six groups of words. You will be expected to learn all three words so that if the first one is shown to you, you will be able to recall the other two in that group. Remember your object is to get as many correct as possible. Once again, you will be shown each card for a fixed amount of time.

After criterion on the third list. As I show you one word only from each group of three would you please describe the method you adopted to help you remember the three objects?

You will now be presented with another six groups of three words. You will do the same thing as you did before.

After criterion on the fourth list. Once again, as I show you one word only from each group of three would you please describe the method you adopted to help you remember the three objects?

(c) THE SCENE CONDITION

You are going to be shown six groups of words, each group containing three common everyday objects. Your task is to learn the words so that if the first word is shown to you, you will be able to recall the other two in that group.

In order to help you remember these words, I want you to:

1. mentally picture the three objects as vividly as possible
2. try to make the picture as ludicrous or ridiculous as possible
3. try to include some kind of action in your picture
4. try to include at least one colour.

(A card containing these four criteria was placed on the table and left there for the duration of the experiment.)

For example:

TRAIN LEASH SKATES

These words might be pictured this way: "The fat old man dressed in a red Santa Claus outfit wearing skates was chasing the leash which was attached to the train so that he would get a fast ride." This scene includes: 1. a

vivid mental picture in my mind. 2. ludicrousness because he was chasing the leash to get a fast ride. 3. the action of chasing and 4. the colour, red.

MONEY FURNACE COLLAR

These words might be pictured this way: "The woman wearing a mink collar threw yellow one hundred dollar bills into the furnace for fuel." This scene includes: 1. a vivid mental picture in my mind 2. ludicrousness in using money for fuel 3. the action of throwing and 4. the colour, yellow.

DOG BANK STARS

These words might be pictured this way: "The purple and orange polka dot dog stuffed the stars in his piggy bank." This scene includes: 1. a vivid mental picture in my mind 2. ludicrousness in the purple and orange polka dots and stuffing stars into the piggy bank 3. the action of stuffing and 4. the colours, purple and orange.

As you are shown a card with the three words on it, please describe the scene you are picturing to me. I will tell you if it qualifies as an acceptable scene or not. Try to use the scenes to help you remember the objects.

This list (point to the card) will be left on the table to help you remember the required characteristics.

You will be presented the same list over again until you get all six groups of three completely correct. Okay,

any questions?

After first trial. (Only if the subject did not get zero errors.) Now, try to use the same scenes as you described the last time and repeat them to me.

After criterion. You will now be presented with another six groups of three words. Once again your task is to learn all three words so that if you are presented with the first word you will be able to recall the other two in each group. Include each of the characteristics on this card in your description of the scene and I will tell you if it qualifies as an acceptable scene or not.

Day II. Today you will be presented with two more lists of six groups of words. You will be expected to learn all three words so that if the first one is shown to you, you will be able to recall the other two in that group. In order to help you remember the words I want you to include the same characteristics in a vivid mental picture which includes all three objects. Here is the same list with the necessary characteristics on it as you had yesterday. (The card is placed on the table.)

(The rest of the instructions follow as they did above.)

(d) THE SCENE-L CONDITION

You are going to be shown six groups of words, each group containing three common everyday objects. Your task is to learn the words so that if the first word is shown to you, you will be able to recall the other two in that

group.

In order to help you remember these words I want you to:

1. mentally picture the three objects in some scene as vividly as possible
2. include some kind of action in your picture
3. include at least one colour in your picture

(A card containing these three criteria was placed on the table and left there for the duration of the experiment.)

For example:

TRAIN LEASH SKATES

These words might be pictured this way: "The little boy got a train and a pair of black skates for Christmas. While the train was going around the track, he attached the leash to the dog and went out for a walk." This scene includes:

1. a vivid mental picture in my mind
2. an action, "was going" and "attached" and
3. the colour, black.

MONEY FURNACE COLLAR

These words might be pictured this way: "Disgusted with the cold in the house, the man looked into the furnace to see if it was going and found it was empty. He put on his ragged black coat, turned up the collar, grabbed some money from the teapot and went out to buy some fuel." This scene includes: 1. a vivid mental picture in my mind 2. the action of "grabbing" and "went out" and 3. the colour, black'.

DOG BANK STARS

These words might be pictured this way: "The little boy dropped the quarters into his coin bank which was shaped like a dog. As each one went in, the orange eyes which were shaped like stars lit up." This scene includes:

1. a vivid mental picture in my mind
2. the action of "dropping" and "lit up" and
3. the colour, orange.

As you are shown a card with the three words on it, please describe the scene you are picturing to me. I will tell you if it qualifies as an acceptable scene or not. Try to use the scenes to help you remember the objects.

This list (point to the card) will be left on the table to help you remember the required characteristics.

You will be presented the same list over again until you get all six groups of three completely correct. Okay, any questions?

After first trial. (Only if the subject did not get zero errors.) Now, try to use the same scenes as you described the last time and repeat them to me.

After criterion. You will now be presented with another six groups of three words. Once again your task is to learn all three words so that if you are presented with the first word you will be able to recall the other two in each group. Include each of the characteristics on this card in your description of the scene and I will tell you if it qualifies as an acceptable scene or not.

Day II. Today you will be presented with two more lists of six groups of words. You will be expected to learn all three words so that if the first one is shown to you, you will be able to recall the other two in that group. In order to help you remember the words I want you to include the same characteristics in a vivid mental picture which includes all three objects. Here is the same list with the necessary characteristics on it as you had yesterday. (The card is placed on the table.)

(The rest of the instructions follow as they did above.)

(e) THE RELATION CONDITION

You are going to be shown six groups of words, each group containing three common everyday objects. Your task is to learn the words so that if the first word is shown to you, you will be able to recall the other two in that group.

In order to help you remember these words I want you to form a logical relation between them and include:

1. making the verbal link as logical as possible
 2. common characteristics, such as, located in the same place, used for the same thing, same size, shapes, colours, textures, hardness, etc.
- or verbal characteristics of the words, such as, the words start with the same letter, they rhyme, they sound the same, they contain the same letters, etc.
3. no action verbs
 4. can be done pairwise if you find it difficult to find one link common to all three objects.

5. do not use abstract categories -- use definite ideas.

(A card containing these characteristics was placed on the table and left there for the duration of the experiment.)

For example:

TRAIN LEASH SKATES

All three objects contain some metal: the train on the outside, the buckle on the leash and the blade on the skates. In this logical relation: 1. the link is logical 2. common characteristics are included 3. there are no action verbs 4. there was no difficulty in finding one link between all three objects and 5. a definite idea was used.

MONEY FURNACE COLLAR

Money and furnaces are both made out of metal and coat collars are often black like furnaces. In this logical relation: 1. the links are logical 2. common characteristics are included 3. no action verbs are included 4. it was difficult to find a link between all three objects so the links were done pairwise and 5. a definite idea was used.

DOG BANK STARS

The coins kept in a bank and stars are both shiny and the dog and the bricks of the bank are often brown. In this logical relation: 1. there is a logical link 2. there is the use of a common colour and a common characteristic, shiny 3. no action verb is included 4. the links were done in a pairwise fashion and 5. a definite idea was used.

As you are shown a card with the three words on it, please tell me your verbal association. I will tell you if it qualifies as an acceptable relation or not. Try to use these relations to help you remember the three words.

This list will be left on the table to help you remember the required characteristics.

You will be presented the same list over again until you get all six groups of three completely correct. Okay, any questions?

After first trial. (Only if the subject did not get zero errors.) Now, try to use the same logical relations as you described the last time and repeat them to me.

After criterion. You will now be presented with another six groups of three words. Once again your task is to learn all three words so that if you are presented with the first word you will be able to recall the other two in each group. Include each of the characteristics on this card in the logical relation you are using to help you remember the words and I will tell you if it qualifies as an acceptable relation or not.

Day II. Today you will be presented with two more lists of six groups of three words. You will be expected to learn all three words so that if the first one is shown to you, you will be able to recall the other two in that group. In order to help you remember the words I want you to include the same characteristics in a logical relation including all three objects. Here is the same list with

the necessary characteristics on it as you had yesterday.

(The card is placed on the table.)

(The rest of the instructions follow as they did above.)

APPENDIX F

RAW DATA

Data for the None-E Group, Experiment I

ERROR SCORES				AVERAGE VIEWING TIME			
LIST I		LIST II		LIST I		LIST II	
<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>
2	2	9	30	4.17	3.75	6.83	16.39
0	0	7	7	5.17	5.17	9.17	9.09
0	0	9	26	3.50	3.50	4.50	5.14
0	0	9	13	4.83	4.83	9.00	7.43
0	0	3	6	10.67	10.67	19.00	12.11
0	0	11	11	8.17	8.17	17.33	20.58
0	0	11	16	8.67	8.67	13.50	12.29
0	0	5	5	7.00	7.00	11.67	10.42
0	0	6	6	6.17	6.17	8.83	8.92
6	6	11	17	5.83	6.00	9.17	11.13

Data for the None-NE Group, Experiment I

ERROR SCORES				AVERAGE VIEWING TIME			
LIST I		LIST II		LIST I		LIST II	
<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>
1	2	6	7	25.17	15.95	22.83	17.83
11	21	10	10	11.67	13.38	21.00	20.34
1	1	1	1	17.50	12.09	16.83	12.00
9	16	5	5	12.33	12.44	13.50	11.59
8	11	6	8	18.00	12.79	13.83	10.50
7	12	8	15	32.83	14.33	13.83	9.12
2	2	4	4	13.00	8.50	14.17	10.09
7	8	3	3	65.50	38.61	49.00	36.67
7	10	8	16	18.33	12.44	13.67	11.67
6	8	0	0	22.67	16.71	23.67	23.67

Data for the None-U Group, Experiment I

ERROR SCORES				AVERAGE VIEWING TIME			
LIST I		LIST II		LIST I		LIST II	
<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>
10	11	5	5	15.67	17.22	18.83	15.08
1	1	0	0	9.17	5.75	7.17	7.17
11	18	1	1	32.33	36.75	59.67	34.84
9	10	3	4	29.00	19.05	38.17	16.61
8	11	4	4	7.67	4.21	5.00	4.59
0	0	1	1	29.67	29.67	24.00	16.75
6	24	2	2	24.17	11.73	23.00	15.75
3	3	4	5	59.33	41.00	31.83	36.05
5	5	0	0	9.67	8.92	9.67	9.67
6	14	2	4	19.00	7.97	22.67	12.11

Data for the Relation-E Group, Experiment I

ERROR SCORES

AVERAGE VIEWING TIME

LIST I		LIST II		LIST I		LIST II	
<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>
0	0	8	19	11.17	11.17	13.50	13.53
0	0	5	6	6.17	6.17	13.50	9.67
0	0	2	2	4.00	4.00	6.33	5.67
0	0	3	3	10.33	10.33	31.17	21.25
0	0	4	5	7.67	7.67	14.83	11.28
0	0	2	2	7.83	7.83	44.83	34.50
0	0	2	2	6.50	6.50	9.17	7.17
0	0	4	6	7.33	7.33	11.33	10.56
2	3	10	27	3.33	2.72	4.17	5.03
2	4	5	8	3.17	2.92	8.50	5.50

Data for the Relation-NE Group, Experiment I

ERROR SCORES				AVERAGE VIEWING TIME			
LIST I		LIST II		LIST I		LIST II	
<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>
6	10	4	6	8.50	7.61	13.17	11.06
0	0	7	12	10.33	10.33	8.33	6.17
4	4	3	3	23.17	16.42	55.67	32.92
0	0	2	2	19.67	19.67	31.83	21.75
3	3	6	8	24.50	18.59	25.50	19.83
2	2	5	7	13.50	9.75	16.67	12.04
4	6	1	1	19.67	15.11	20.33	14.83
0	0	0	0	10.17	10.17	7.17	7.17
2	2	3	5	12.00	8.34	9.67	6.28
6	6	2	2	18.83	14.25	14.50	10.75

Data for the Relation-U Group, Experiment I

ERROR SCORES

AVERAGE VIEWING TIME

LIST I		LIST II		LIST I		LIST II	
<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>
2	3	0	0	20.83	11.44	25.33	25.33
4	4	0	0	26.00	27.17	22.33	22.33
1	2	0	0	16.50	7.00	10.00	10.00
1	1	4	5	12.33	7.25	8.83	6.16
0	0	2	2	17.33	17.33	11.33	10.00
2	2	1	1	22.33	15.42	16.33	12.42
1	1	3	3	15.17	12.50	18.67	19.92
1	2	1	1	8.50	5.39	8.33	6.67
2	2	1	1	25.00	17.84	31.00	19.67
0	0	0	0	14.00	14.00	16.67	16.67

Data for the Scene-E Group, Experiment I

ERROR SCORES				AVERAGE VIEWING TIME			
LIST I		LIST II		LIST I		LIST II	
<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>
0	0	3	3	25.83	25.83	14.17	11.84
0	0	2	2	15.83	15.83	8.17	7.00
0	0	0	0	15.17	15.17	8.00	8.00
0	0	5	6	25.67	25.67	8.17	5.72
0	0	10	15	9.67	9.67	19.50	15.42
0	0	0	0	17.50	17.50	16.67	16.67
0	0	1	1	37.50	37.50	31.67	19.09
0	0	5	5	16.50	16.50	9.17	9.00
1	1	8	8	11.50	8.50	9.50	8.67
0	0	2	2	11.00	11.00	8.33	5.58

Data for the Scene-NE Group, Experiment I

ERROR SCORES				AVERAGE VIEWING TIME			
LIST I		LIST II		LIST I		LIST II	
<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>
3	3	1	1	23.00	18.84	26.67	19.34
2	3	4	5	10.17	8.06	10.67	9.00
1	1	2	2	13.00	11.25	15.00	11.42
1	1	1	1	14.33	9.17	7.00	5.17
6	8	10	10	13.00	11.61	15.17	14.34
2	4	8	15	4.83	3.61	7.83	6.42
4	4	0	0	33.17	26.00	47.33	47.33
1	1	0	0	14.67	9.09	15.67	15.67
5	19	0	0	13.50	5.56	15.67	15.67
3	3	6	6	10.17	9.92	27.00	27.50

Data for the Scene-U Group, Experiment I

ERROR SCORES				AVERAGE VIEWING TIME			
LIST I		LIST II		LIST I		LIST II	
<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>
5	10	2	4	6.00	3.83	7.17	4.06
0	0	0	0	13.00	13.00	16.33	16.33
3	3	0	0	12.00	8.00	10.67	10.67
4	4	4	8	8.17	7.17	11.67	11.89
2	2	2	5	27.50	17.00	28.67	10.75
6	6	5	7	11.33	10.67	10.67	6.00
0	0	0	0	16.33	16.33	29.00	29.00
4	7	1	1	8.17	6.45	9.83	7.67
5	5	0	0	12.83	14.67	18.50	18.50
0	0	0	0	25.17	25.17	20.17	20.17

Errors per trio on E List as List I, Experiment I

	OVERALL			TRIAL 1		
	<u>RE-</u> <u>LATION</u>	<u>SCENE</u>	<u>NONE</u>	<u>RE-</u> <u>LATION</u>	<u>SCENE</u>	<u>NONE</u>
HAT	0	0	2	0	0	2
GATE	3	1	1	1	1	1
PAPER	0	0	0	0	0	0
TREE	2	0	2	1	0	2
HORSE	2	0	2	2	0	2
FATHER	0	0	1	0	0	1

Overall
 Errors per Trio on NE-A and NE-B as List I,
 Experiment I

	NE-A			NE-B		
	<u>RE-</u> <u>LATION</u>	<u>SCENE</u>	<u>NONE</u>	<u>RE-</u> <u>LATION</u>	<u>SCENE</u>	<u>NONE</u>
HAT	0	9	3	0	2	8
GATE	6	3	9	4	6	10
PAPER	4	9	8	1	0	10
TREE	4	2	6	0	0	9
HORSE	10	12	10	2	2	7
FATHER	7	1	6	0	1	5

Trial 1

Errors per Trio on NE-A and NE-B as List I,
Experiment I

	NE-A			NE-B		
	<u>RE- LATION</u>	<u>SCENE</u>	<u>NONE</u>	<u>RE- LATION</u>	<u>SCENE</u>	<u>NONE</u>
HAT	0	3	3	0	2	5
GATE	4	4	6	0	6	6
PAPER	3	3	5	0	2	6
TREE	2	3	4	0	0	5
HORSE	10	3	8	2	1	4
FATHER	6	0	4	0	1	3

Errors per trio on U List as List I, Experiment I

	OVERALL			TRIAL 1		
	<u>RE-</u> <u>LATION</u>	<u>SCENE</u>	<u>NONE</u>	<u>RE-</u> <u>LATION</u>	<u>SCENE</u>	<u>NONE</u>
KING	7	11	10	7	11	10
BED	2	4	8	2	2	6
RAIN	1	4	14	0	5	10
SCHOOL	3	8	25	2	4	11
BEAR	1	7	24	1	5	12
CAR	4	1	15	2	2	10

Trial 1 Errors on NE-A as List II, Experiment I

	E AS LIST I			NE AS LIST I			U AS LIST I		
	<u>RE-</u> <u>LATION</u>	<u>SCENE</u>	<u>NONE</u>	<u>RE-</u> <u>LATION</u>	<u>SCENE</u>	<u>NONE</u>	<u>RE-</u> <u>LATION</u>	<u>SCENE</u>	<u>NONE</u>
HAT	1	1	7	1	0	2	1	1	1
GATE	6	5	8	0	2	5	0	2	6
PAPER	4	5	8	3	1	6	2	3	5
TREE	1	2	7	2	3	3	1	1	2
HORSE	7	4	8	4	4	5	3	0	0
FATHER	4	5	5	4	2	6	1	2	0

Overall Errors on NE-A as List II, Experiment I

	E AS LIST I			NE AS LIST I			U AS LIST I		
	<u>RE-</u> <u>LATION</u>	<u>SCENE</u>	<u>NONE</u>	<u>RE-</u> <u>LATION</u>	<u>SCENE</u>	<u>NONE</u>	<u>RE-</u> <u>LATION</u>	<u>SCENE</u>	<u>NONE</u>
HAT	1	2	11	1	0	4	1	2	1
GATE	14	4	18	0	5	6	0	3	6
PAPER	7	8	21	7	1	8	2	7	6
TREE	6	3	17	5	4	5	1	1	4
HORSE	7	4	15	4	5	5	3	2	0
FATHER	4	5	8	4	5	6	2	3	0

Trial 1 Errors on NE-B as List II, Experiment I

	E AS LIST I			NE AS LIST I			U AS LIST I		
	<u>RE-</u> <u>LATION</u>	<u>SCENE</u>	<u>NONE</u>	<u>RE-</u> <u>LATION</u>	<u>SCENE</u>	<u>NONE</u>	<u>RE-</u> <u>LATION</u>	<u>SCENE</u>	<u>NONE</u>
HAT	6	1	10	1	6	2	2	1	1
GATE	8	6	9	3	4	7	1	3	4
PAPER	2	0	5	5	2	5	0	0	0
TREE	2	4	7	5	2	6	1	2	2
HORSE	3	3	3	3	4	3	0	0	1
FATHER	1	0	4	2	2	1	0	0	1

Overall Errors on NE-B as List II, Experiment I

E AS LIST I

NE AS LIST I

U AS LIST I

	<u>RE-</u> <u>LATION</u>	<u>SCENE</u>	<u>NONE</u>	<u>RE-</u> <u>LATION</u>	<u>SCENE</u>	<u>NONE</u>	<u>RE-</u> <u>LATION</u>	<u>SCENE</u>	<u>NONE</u>
HAT	6	1	11	1	6	3	2	1	2
GATE	20	6	11	1	4	9	1	3	4
PAPER	9	0	5	4	2	7	0	0	0
TREE	6	4	10	7	2	8	1	4	2
HORSE	5	3	3	5	4	4	0	0	1
FATHER	1	1	6	2	2	3	0	0	1

Error Scores for the None Group, Experiment II

LIST I		LIST II		LIST III		LIST IV	
<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>
1	1	8	8	6	6	0	0
8	13	4	4	10	11	3	3
3	3	0	0	1	1	1	1
6	6	7	7	2	2	3	3
10	14	1	1	2	2	8	8
3	3	0	0	0	0	4	4
2	4	2	2	0	0	3	3
8	9	2	2	6	6	5	5
12	20	12	14	1	1	2	2
5	5	0	0	0	0	1	1

Error Scores for the None-R Group, Experiment II

LIST I		LIST II		LIST III		LIST IV	
<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>
6	8	9	21	4	4	8	11
4	4	2	2	4	5	5	5
9	23	1	1	8	18	2	2
5	10	0	0	2	2	4	4
10	11	2	3	7	7	0	0
2	2	5	5	2	3	0	0
10	18	4	4	6	6	5	5
6	12	6	15	6	6	6	6
0	0	4	4	2	2	2	4
2	2	9	15	6	6	4	6

Error Scores for the Scene Group, Experiment II

LIST I		LIST II		LIST III		LIST IV	
<u>TRIAL</u> <u>I</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>I</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>I</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>I</u>	<u>OVER-</u> <u>ALL</u>
4	4	0	0	0	0	2	2
5	6	1	1	2	2	2	2
0	0	2	2	2	2	1	1
0	0	1	1	0	0	0	0
5	5	7	7	7	10	0	0
1	1	3	4	6	8	1	1
4	4	5	9	5	11	3	3
6	11	7	10	1	1	4	6
3	4	11	38	8	11	7	9
5	6	5	5	8	8	6	6

Error Scores for the Scene-I Group
Experiment II

LIST I		LIST II		LIST III		LIST IV	
<u>TRIAL</u> <u>I</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>I</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>I</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>I</u>	<u>OVER-</u> <u>ALL</u>
3	3	5	9	1	1	4	4
3	10	8	8	2	2	0	0
6	7	1	1	4	4	3	3
6	17	0	0	0	0	1	1
6	6	1	1	2	2	0	0
1	1	6	6	1	1	0	0
0	0	1	1	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	1	1	0	0
4	6	0	0	7	7	0	0

Error Scores for the Relation Group, Experiment II

LIST I		LIST II		LIST III		LIST IV	
<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>
1	5	11	35	6	8	4	10
0	0	0	0	1	1	1	1
7	10	4	5	3	3	4	4
2	2	6	12	4	4	0	0
3	4	5	5	8	21	2	2
0	0	2	2	1	1	0	0
0	0	2	2	0	0	4	4
1	1	2	3	4	4	1	1
5	7	3	3	4	6	5	5
1	1	2	5	0	0	1	1

Average Viewing Time per card for the Scene Group
Experiment II

LIST I		LIST II		LIST III		LIST IV	
<u>TRIAL</u> <u>I</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>I</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>I</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>I</u>	<u>OVER-</u> <u>ALL</u>
37.17	25.00	43.50	43.50	77.33	77.33	70.67	35.67
32.67	23.67	36.33	26.67	49.00	32.17	58.83	29.42
44.50	44.50	26.83	19.92	22.83	14.92	23.17	11.58
29.00	29.00	24.17	16.00	42.33	42.33	33.67	33.67
38.50	25.75	33.17	25.17	32.17	17.08	23.50	23.50
69.17	42.83	49.67	26.61	44.67	21.54	47.67	30.50
41.17	29.17	43.50	25.33	38.50	21.58	39.50	26.25
33.17	19.83	30.17	20.94	26.50	19.17	29.50	18.50
43.67	29.00	29.50	19.83	24.67	19.22	24.83	18.22
101.00	48.17	70.50	43.83	75.17	48.75	65.50	41.00

Average Viewing Time per card for the Scene-L Group,

Experiment II

LIST I		LIST II		LIST III		LIST IV	
<u>TRIAL</u> <u>I</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>I</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>I</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>I</u>	<u>OVER-</u> <u>ALL</u>
25.50	18.17	26.50	14.89	24.83	19.00	34.33	24.00
45.67	19.90	46.50	31.33	38.67	26.42	48.00	48.00
43.00	22.83	49.83	35.42	37.50	28.17	45.67	30.42
28.50	18.04	39.50	39.50	42.67	42.67	48.33	32.92
33.50	24.08	22.17	15.92	22.00	15.58	24.50	24.50
26.50	19.17	23.00	17.75	24.83	17.08	20.67	20.67
28.50	28.50	23.17	16.08	31.17	31.17	29.50	29.50
40.33	40.33	59.00	59.00	37.83	37.83	33.00	33.00
33.00	33.00	47.83	47.83	31.17	19.42	37.17	37.17
32.00	24.06	54.17	54.17	39.33	31.50	62.83	62.83

Average Viewing Time per Card for the Relation Group, Experiment II

LIST I		LIST II		LIST III		LIST IV	
<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>	<u>TRIAL</u> <u>1</u>	<u>OVER-</u> <u>ALL</u>
30.00	18.90	34.67	21.70	81.33	38.06	47.17	17.67
23.83	23.83	29.67	29.67	26.17	17.75	24.33	16.25
48.67	22.11	45.67	22.28	36.33	25.67	62.83	40.67
40.50	27.08	39.67	20.13	55.50	36.18	41.17	41.17
46.00	24.50	69.67	43.75	46.33	10.91	39.67	41.93
66.00	66.00	69.00	41.50	83.50	48.50	55.83	55.83
40.17	40.17	39.33	24.00	37.67	37.67	42.50	21.25
53.17	34.67	31.33	18.00	43.50	29.42	27.33	17.67
40.17	20.17	54.17	18.92	49.00	29.62	46.67	31.75
75.83	38.25	45.50	17.79	38.33	38.33	39.50	19.17

Errors per Trio on Trial 1 List A, Experiment II

	<u>NONE</u>	<u>NONE-R</u>	<u>SCENE</u>	<u>SCENE-L</u>	<u>RELATION</u>
HAT	4	4	1	1	0
GATE	6	8	5	4	3
PAPER	11	13	6	2	6
TREE	4	11	3	5	5
HORSE	4	9	7	10	11
FATHER	10	11	9	6	9

Errors per Trio on Trial 1 List B, Experiment II

	<u>NONE</u>	<u>NONE-R</u>	<u>SCENE</u>	<u>SCENE-L</u>	<u>RELATION</u>
HAT	5	12	9	6	6
GATE	2	8	7	6	5
PAPER	6	8	6	1	5
TREE	5	4	9	6	4
HORSE	2	2	2	6	4
FATHER	0	0	3	0	0

Errors per Trio on Trial 1 List C, Experiment II

	<u>NONE</u>	<u>NONE-R</u>	<u>SCENE</u>	<u>SCENE-L</u>	<u>RELATION</u>
KING	5	7	4	3	5
BED	5	2	4	0	1
RAIN	4	4	1	2	3
SCHOOL	5	7	7	1	3
BEAR	10	14	6	2	3
CAR	6	4	2	0	0

Errors per Trio on Trial 1 List D, Experiment II

	<u>NONE</u>	<u>NONE-R</u>	<u>SCENE</u>	<u>SCENE-L</u>	<u>RELATION</u>
KING	10	9	12	5	13
BED	12	18	8	2	10
RAIN	8	19	11	4	5
SCHOOL	6	5	7	0	2
BEAR	15	17	6	4	2
CAR	7	7	2	0	5

Overall Errors per Trio on List A, Experiment II.

	<u>NONE</u>	<u>NONE-R</u>	<u>SCENE</u>	<u>SCENE-L</u>	<u>RELATION</u>
HAT	4	7	3	1	0
GATE	9	12	7	4	7
PAPER	16	19	6	2	10
TREE	4	12	3	5	6
HORSE	4	19	7	10	13
FATHER	10	13	9	6	11

Overall Errors per Trio on List B, Experiment II

	<u>NONE</u>	<u>NONE-R</u>	<u>SCENE</u>	<u>SCENE-L</u>	<u>RELATION</u>
HAT	5	12	13	7	6
GATE	2	9	8	12	10
PAPER	6	8	10	3	8
TREE	5	4	9	13	4
HORSE	2	2	3	12	4
FATHER	0	0	5	0	0

Overall Errors per Trio on List C, Experiment II

	<u>NONE</u>	<u>NONE-R</u>	<u>SCENE</u>	<u>SCENE-L</u>	<u>RELATION</u>
KING	5	7	4	3	5
BED	5	4	5	0	2
RAIN	4	6	1	3	3
SCHOOL	5	9	8	1	4
BEAR	12	15	11	2	4
CAR	6	8	2	0	5

Overall Errors per Trio on List D, Experiment II

	<u>NONE</u>	<u>NONE-R</u>	<u>SCENE</u>	<u>SCENE-L</u>	<u>RELATION</u>
KING	10	11	18	5	21
BED	14	25	9	2	20
RAIN	14	28	21	6	17
SCHOOL	8	11	9	0	2
BEAR	17	28	18	4	6
car	8	17	8	0	9