THE RELATIONSHIP BETWEEN MEDIATIONAL STYLE AND THE ASSOCIATIVE LEARNING ABILITY OF CHILDREN

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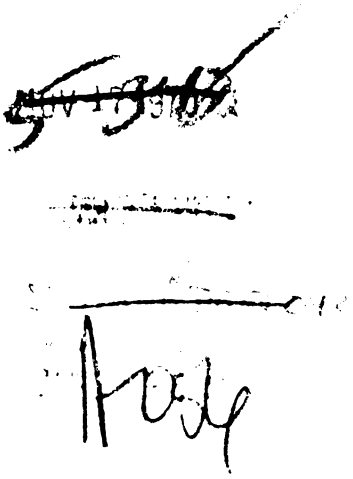

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ABSTRACT

THE RELATIONSHIP BETWEEN MEDIATIONAL STYLE AND THE ASSOCIATIVE LEARNING ABILITY OF CHILDREN

by Robert L. Hohn

This study analyzed individual differences in the verbal learning ability of fifth grade children. A mediational production task was developed whereby Ss' reported mediators to a paired associate list were scaled along a dimension of mediational complexity. Complex mediational producers, simple mediational producers and variable producers were identified. Subjects then learned a second paired associate list. During acquisition, Ss in each group were supplied with complex mediators, simple mediators or no mediators.

The results revealed that complex mediators resulted in more rapid learning than no mediators, which in turn, produced faster learning than simple mediators. Moreover, complex producers and variable producers learned more rapidly than simple producers. Although the degree of original learning was the same for all groups, similar results were obtained on retention. Regardless of mediational style, complex experimenter-supplied mediators facilitated learning and retention.

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INTRODUCTION

The complex phenomena of memory have been of interest to psychologists and educators for several decades. Without memory the past would vanish; intelligence, often called the ability to learn from experience would be absent, and life would present immense obstacles to be overcome daily. Memory is central to intelligent behavior and as such deserves careful experimental analysis. Its enhancement in the individual merits the full attention of the educational researcher.

Perhaps the key to understanding memory or retention lies in the basic concept of an association. Traditionally, association has been viewed as the linking together of mental processes so that if at some later time one event is presented, it can in turn arouse the recall of a second event. Memorizing then becomes the process of developing associations strong enough to make it probable that when certain perceptions or ideas appear, their appearance will elicit other responses. It has been assumed by the British Associationists that the repetition of new associations would thus ensure their recall.

Recently however, theorists have suggested that the subject himself imposes a certain degree of organization on the material he must learn and remember. Most theorists now agree that behavior is not just an outcome of stimuli passively received, but involves an active process which selectively focuses upon certain aspects of incoming stimuli. The time and effort that goes into the task of memorizing is devoted to ensuring that there will be some way to gain

access to an association, when recall is required. It is as if the organism is "executing a plan" designed to maximize the probability that he will accurately remember the association when necessary. In fact, Miller, Galanter and Pribram in their book Plans and the Structure of Behavior (1960) have used just these terms. A plan is any "hierarchical process in the organism that can control the order in which a sequence of operations is to be performed." While memory has been considered to represent a fairly simple cognitive process, it too may involve the development of plans.

The fact that individuals differ in their capacity to recall events has long been observed. In fact, most intelligence tests require Ss to recall series of digits. While there are large individual differences in such abilities, researchers have not examined the qualitative differences in the way people store information in memory. Moreover, little research has been done on the plans individuals typically employ. Miller, Galanter and Pribram (1960) suggest that differences in "planning" may arise among individuals according to the flexibility, detail, speed of implementation, or retrieval characteristics of their respective plans. Some related research has come from those investigators interested in "styles" of behavior, although the thrust of these investigations has been directed at personality processes, rather than learning and retention processes.

The purpose of this investigation is to examine the types of plans which learners employ in forming new associations, and to

examine the effectiveness of these plans during learning and retention. Also of interest is the question of whether or not there are stable individual differences in the execution of such plans. If it is determined that some plans are more efficient than others, then it may be possible to facilitate the learning of individuals who employ less efficient plans.

Paired associate learning tasks are particularly useful in investigating the occurrence of plans. Underwood (1964) has recognized that Ss are not responding passively in studies of rote verbal learning. He and Schulz (1960) have noted that many college Ss report using "associations" in connecting stimulus and response terms in paired associate learning. These associations have been characterized as direct (sheer memory) and indirect (mnemonic devices) by Clark, Lansford and Dallenbach (1960).

The way in which verbal associations are formed may be directly related to how well they are later recalled. Miller (1956) has proposed that stimulus information amenable to "recoding" or "chunking" procedures is perhaps most easily recalled. Since there is an inherent limitation imposed on our immediate memory span, it is important for the learner to organize incoming stimuli into units or chunks. "Our memory span is a fixed number of chunks, but we can increase the number of bits of information (binary alternatives) that each contains simply by building larger and larger chunks." This is his process of recoding.

The simplest way to recode is to translate incoming stimulus

events into a verbal code, and remember the code by "secondary elaboration" of the details that seem consistent with the particular verbal code we have formed.

When Ss employ plans during learning, the type of plan influences the recall of the material. A study by Carmichael, Hogan and Walter (1932) well illustrates this point. These investigators labeled ambiguous figures for their Ss at the time of original presentation and measured the immediate reproduction of these figures at the conclusion of the series. Many of the reproductions displayed the influence of the verbal label. These results suggest that the precision of Ss recall of recoded material is partially governed by the association, or "mediator", originally formed.

Corrobation for this view of stimulus recoding comes from other workers. Epstein, Rock and Zimmerman (1960) in their examination of the factors involved in the meaningfulness of verbal material observed that meaningful material allows the formation of "conceptual units" which combine separate items into new wholes. They hypothesized that learning was enhanced by the formation of these units. Subjects were provided with two lists; one containing items composed of two nouns and a connective such as "Bank-on-Roof", the other consisting of two nouns joined by an irrelevant connective; "Bank-late-Roof". It was assumed that the pairs connected by means of a preposition (and thus forming one conceptual unit) would be more readily learned. Their hypothesis was confirmed; unit formation seemed to be the crucial factor in the learning of meaningful material.

Underwood (1964) has asked what the critical training procedures for the development of associations are. If recoding is such an important variable in associative learning, how can it best be facilitated? One research area that has benefitted from the successful application of facilitative training procedures has been the area of creative thinking. Maltzman, Simon, Raskin and Licht (1960) have assumed that if original behavior can be evoked repeatedly it will be more likely to occur in new situations. By continuously eliciting varied responses to the same free association materials, these experimenters have induced increased original thinking by their Ss on later trials. Moreover, these originality training effects seem to persist over time.

What may in fact be occurring in the evocation of associative responses may be the development of "mediating structures", linking two previously remote elements together. Mednick (1962) has defined the creative thinking process as the forming of associative elements into new combinations, in which the requisite associative elements are "made contiguous through the mediation of common elements". This way of bringing associative elements into contiguity with one another is of great importance in areas where the effective use of language symbols is required. Mednick, Mednick, and Mednick (1964) have facilitated the formation of these associative links by a method of "priming" the correct responses. Subjects were given a simple analogy problem in which the correct response was relevant to a particular item on the Remote Associates Test (RAT).

For example, solving the analogy TV : channel as Radio : (station), facilitated performance on a RAT item in which Ss must supply the associative link between the elements: "break-train-battle". Subjects receiving associative priming gave more correct answers on the RAT after an incubation period than did non-primed Ss.

The ability to produce "remote associates" is probably not so far removed from the ability to produce mnemonic devices that can aid one in recalling paired-associates. Both remote associates and associative devices entail some form of detachable representation of the nominal stimulus or stimuli. Constructing these representations or "mediating associations" is a basic process involved in verbal learning as well as creative thinking.

Spiker (1960) attempted to determine whether the teaching of mnemonic devices in a paired associate task would transfer to a second task. Mnemonic devices or "tricks" such as visualizing a "cake-boat" or a "clown riding on a surfboard" were introduced to fifth grade children. Following the presentation of this list in which tricks were introduced, E suggested to each S that during the next list he should invent his own devices. The mean total correct anticipations on the second list for the group of Ss aided in this manner was significantly larger than a non-facilitated group's score. The magnitude of this positive transfer effect was similar to the effect of increased practice on List I and instructions to rehearse. Spiker suggests that Ss may discover mnemonic techniques independently of special instructions, if they are allowed enough practice on the

original list.

Jensen and Rohwer (1963) have examined the effects of verbal mediation on the learning rate of retarded Ss. These investigators reasoned that if the performance of retarded adults in rote learning tasks was facilitated when they were given explicit instructions to form verbal associations between stimulus and response elements, then it could be assumed that they do not spontaneously produce such mediating associations. An initial experiment indicated that retarded Ss did in fact fail to employ verbal mediators. When instructed to do so, they were able to reach a criterion of mastery of a paired associate list at a much faster rate than did control Ss who were only asked to name the stimulus and response terms. In a succeeding experiment, the Es provided a standard set of mediating verbalizations upon initial presentation of PA pictures. Subjects who were not given a mediator made significantly more errors than did Ss in the mediated condition. However, this difference was not maintained on a ten day retention test, in which all Ss were given non-mediation instructions.

Davidson (1964) also believed that low-ability learners could increase their performance level if an experimenter were to provide mediating links. He felt that "there is a point along a presumed continuum of facilitating conditions beyond which additional mediating cues are redundant to efficient learning." Using second-grade children as Ss, Davidson devised five conditions designed to facilitate the acquisition of a paired associate picture list. The conditions

were as follows: (a) merely telling Ss that the two pictures "always go together", (b) naming the pictures, (c) naming them and joining them by a preposition, (d) naming them in nine word sentences, and (e) presenting the pictures in such a way that the sentence in the previous condition described the pairs. The results suggested that the link formed by a single preposition (Condition c) was as effective as sentence conditions (d) and (e) in facilitating learning. All three of these conditions were superior to conditions (a) and (b).

The author stated that the results justified his conception of redundancy in the effects of mediational links. He described the introduction of a preposition as a "minimal language cue", capable of facilitating learning by connecting two nouns of high lexical meaning. Prepositions have principally a syntactical function, forming in conjunction with nouns (content words) what Glanzer (1962) has called "multi-word units". Glanzer felt that these multi-word units may be a basic unit of language.

Underwood (1964) has asked for a more rigorous analysis of the different mediational techniques employed in facilitation tasks. He feels that little of a systematic nature is known about them. "The fact that many learners use 'coding habits' does not necessarily mean that this is the most efficient way of learning, although it is a compelling hypothesis. If associational aids were classified and evaluated experimentally as to their efficacy in various situations, teaching the use of them in the school situation could follow." A recent study by Martin, Boersma and Cox (1965) examined the associational

aids their Ss reported employing. They found it was possible to classify these associations into seven levels of increasing complexity. These "associative strategies" as they have been called, range from low, i.e. repetition or rote learning through relations involving similarities in letter composition to high, where the stimulus and response items are transformed into phrases or sentences. The entire associative strategy classification scheme is presented in Table 1. Significant positive correlations between these strategy levels and number correct on a paired associate task indicate that the higher the level of associative strategy used, the better the performance on the learning task.

A series of studies by Montague and his associates further supports the notion that the complexity of associative strategies employed by Ss in a factor in verbal learning. Keiss and Montague (1965) observed that "natural language mediators" (associations that Ss report in associative learning task) played an important role in the learning of paired associates. Items for which natural language mediators were reported after they were first given correctly were more often correct on later learning trials than those pairs for which no natural language mediator was reported. Montague, Adams and Keiss (1966) extended their investigation to retention phenomena and found a high correlation between the retention of natural language mediators and correct response at recall. Pairs for which the mediators used in acquisition were retained were recalled more than 70% of the time. Moreover, the number of mediators reported increased with the level

Table 1. Classification of associative strategies

Category Level	Type of Association S Reported Using	Example of Verbal Report
1. No Reported Association	S was not able to state how he managed to make the association.	Meardon-Army "I don't know how I learned this pair."
2. Repetition	S reported rehearsing or saying the words over to himself.	Sagrole-Money "I just kept repeating these words to myself."
3. Single letter cues	S reported using a single letter in each of the words to make the association.	Bodkin-Wagon "I saw that each word had an N in it."
4. Multiple letter cues	S reported using more than one letter in each of the items.	Delpin-Insect "Each word contains an IN."
5. Word Formation	S reported that an actual word was embedded in one or both of the words and made use of this word in making the association.	Meardon-Army "The word EAR is contained in Meardon and I remembered that EAR goes with Army."
6. Superordinate	S reported selecting elements from each of the two words that had some relationship to each other.	Standage-Salute "STAN AND SAL are both boy's names and I remembered them."
7. Syntactical	S reported selecting elements from each word and embedded these elements into a sentence, phrase or clause.	Icon-Office "I changed Icon to I come and thought "I come to the office."

Reprinted from Martin, C. J., Boersma, F. J. & Cox, D. L. A classification of associative strategies in paired associate learning. Psychon. Sci., 1965, 3, pp. 455

of meaningfulness of the pairs. In a later study (Montague and Wearing; 1967), the complexity of natural language mediators were rated according to the Martin et.al. (1965) scale. Subjects learned a 12-item list to a criterion of 10 out of 12 pairs correct and were then asked to report any mediators they may have employed during learning. These authors found ease of learning to be a function of the complexity of the associative strategies reported, which was in agreement with the Martin et.al. (1965) results.

In a recent study Martin (1967) suggested that the introduction of associative strategies as aids by an experimenter can result in better acquisition on a paired associate task for both normally-achieving and retarded children. Retarded children and "slow-learning" normal children had reported significantly more of the lower level strategies (repetition) and significantly fewer higher level strategies (syntactical and superordinate) than did normally-achieving children. Since high strategy level utilization had been related to better performance on paired associate tasks, it was expected that the introduction of complex strategy aids would enable retarded and slow-learning Ss to perform more like their normally-achieving counterparts. This expectation was subsequently confirmed.

Analysis of the verbal reports of retarded and normal children in the Martin studies have revealed no differences in the number of intermediate strategies (single and multiple letter cues) reported. Martin, Boersma and Cox (1965) report that letter strategies occur 24% of the time in their Ss' verbal reports. In the studies using high

level strategies as aids, Ss in unaided control groups often mentioned using intermediate level letter cues. Reports of intermediate strategies were more likely to occur for S-R pairs such as "ZUMAP - VILLAGE", which contain highly distinctive initial consonants. Remembering the Z and V combination proved to be facilitating for some Ss. This suggests that intermediate strategies may be useful, and experimenter introduction of these as aids may also facilitate performance.

Reports of letter cue utilization receive mixed emphasis in the literature. Underwood and Schulz (1960) note that associations were formed from a single letter of a stimulus term in 62% of all reported associations in their data. Consonant-Vowel-Consonant (CVC) trigrams composed the stimulus terms and common three letter words served as responses in this study. The authors suggest that if the entire stimulus item is not readily associated, then Ss may merely select a particular part of the stimulus on which to base their associations. Feigenbaum and Simon (1963) in their description of the EPAM (Elementary Perceiver and Memorizer) model have stated that Ss not otherwise instructed adopt an "anchor-point strategy" for organizing a learning task. Subjects must learn to discriminate the stimulus item from other items in the set to be learned, and items with unique features (such as distinctive letter cues) are processed first, serving as anchor points.

On the other hand, Montague and Wearing (1967) report that only 2.6% of their Ss' responses were letter cue mediators on a twelve pair

CVC list. A second, more difficult list produced 13% letter cue associations, which is still disparate from the Underwood and Schulz data. List difficulty and the unavailability of "distinctive" letter cues may be factors accounting for this difference in results. Certainly the use of letter cue strategies in paired-associate learning merits further investigation.

Differences in the reported frequencies of the various associative strategy levels suggest that children vary in their associations to verbal stimuli. The fact that many children engage in differing approaches to learning situations has long been noted by researchers investigating problem-solving. Gardner (1954) has observed that some persons seem to be continually "honeycombing" stimuli into small compartments, while others seem most comfortable with more inclusive categorizations. Gardner's observation suggests that a "preferential mode" is at work; a factor not solely tied to intelligence.

These preferential modes are marked by their consistency across behaviors and events. They have been described by various researchers as "cognitive styles of categorization" (Kagan, Moss and Sigel; 1963) "selection strategies" (Bruner, Goodnow and Austin; 1956) "cognitive controls" (Gardner; 1954) or "leveling and sharpening" (Holzman and Gardner; 1960). Sigel (1963) has pointed out that many of these constructs have been brought together under the umbrella term "cognitive style". All these terms share in relating how an individual comes to recode various dimensions of the environmental

stimuli he encounters.

Kagan, Moss and Sigel (1963) have most clearly expressed the cognitive style position in reference to problem-solving situations. Their styles of categorization refer to stable, consistent, individual preferences in perceptual organization and conceptual categorization of the environment. These styles reflect an individual's preference in approaching new materials rather than his ability.

The authors developed a Conceptual Style Test, consisting of 30 cards, each with three black and white drawings of familiar objects. Subjects were instructed to "pick out two pictures that are alike or go together in some way and state the reason for your grouping." Subjects responses were classified into three basic conceptual categories. The first response pattern has been called an "analytic descriptive attitude" in which Ss pair objects according to similarities in an objective attribute that is a differential part of the total stimulus. For example, "the watch and ruler both have numbers". A relational attitude was identified which involves pairings based on functional relationships between stimuli. An example is "the hat goes on the man". A third inferential-categorical class included pairings that depended upon similarities in some inferred quality. For example, "they are all articles of clothing." Analysis of the responses of over 800 elementary school children revealed that with age, analytic responses increased while non-analytic responses decreased. Moreover, at any one age there appeared to be stable individual differences in the analytic attitude. The authors summarized their studies by stating that an

"individual's preferred conceptual strategy is implicated in a wide variety of behaviors ... including the organization of words for commitment to memory".

In a later study, Lee, Kagan and Rabson (1963) attempted to determine whether the analytic approach to stimuli was related to concept learning. A group of 30 third grade boys (IQ 105-134) were identified as analytic or non-analytic, based on the number of analytic responses produced on the CST. Fifteen Ss fell into each group. All Ss were asked to learn two analytic concepts, two relational concepts and two inferential-categorical concepts. The analytic Ss learned the analytic concepts more readily than the other two types, while non-analytic Ss learned the relational concepts more easily. The authors concluded from these results that individual differences in the cognitive products of children may be due to preferences in the initial processing of information. "The final outcome of a conceptualization task is not merely a function of the ability to form associations between stimuli and responses, but is also influenced by an individuals' preferred focus of attention during the initial stage of learning".

The factors responsible for individual differences in these response styles has been the subject of much discussion and research. Bruner, Goodnow and Austin (1956) have cited the "acquired distinctiveness of cues" phenomenon of Lawrence (1949) to account for it. Making a cue relevant in one situation increases the probability that it will be tried out and used if appropriate to a new situation. Past

experiences of successful performance do contribute to the formation of problem-solving strategies. In a more recent analysis of the issue, Olson writing in Bruner, Olver, and Greenfield's Studies in Cognitive Growth (1966) has emphasized the developmental aspect of the use of conceptual strategies. Children move through a hierarchy of "modes of representation", from the enactive, through the ikonic and finally to the symbolic mode. "The mode of representation should effect the pattern of hypotheses the child formulates en route to problem solution."

The view expressed by Bruner and associates seems to stress the learner's creation of his own strategies. A subject in a novel learning situation learns best when he is able to employ the type of strategy or approach he most often uses. If E attempts to impose an alternative method upon the S, then an incongruent situation is established which could adversely affect his learning. Bruner (1961) reports that children seem to do best in "recovering materials tied together by the form of mediator they most often use." Data collected by Bruner revealed that 95% of a thirty item list was recalled by Ss told to remember the pairs by producing a word or idea that could tie the stimulus and response members together. This level of performance was superior to that of a second group of Ss which were supplied with the mediators created by the first group. "Material organized in terms of a person's own interests and cognitive structures" is material that has the best chance of being accessible in memory.

Support for Bruner's position is offered by Restle (1962).

"Subjects have difficulty with cue learning problems to the degree that they use strategies (habits or patterns of responses as he defines them), which conflict with the strategy intended by E." Restle views cue learning as the selection of appropriate responses.

Davidson, in the study previously mentioned (1964), noted that a learner's usual language habits played a decided role in the observed facilitation. For high scorers on an original learning task, "the giving of names of stimuli may have actually interfered with learning if the Ss were spontaneously providing their own, slightly different names."

The above views may be at variance with the position of Martin and associates, of Jensen and Rohwer, and other researchers who find that experimenter-induced mediators can facilitate learning. The use of higher level strategies tends to facilitate learning and recall, regardless of the predominant cognitive approach of the learner. The introduction of high level strategies to learners typically producing few syntactical strategies of their own would constitute an incongruent situation. On the other hand, requiring an individual who ordinarily utilizes syntactical strategies to employ lower level ones would also be incongruent.

The factor of how well verbal associations are originally learned is an important one in determining how well they are later recalled. Underwood (1964a) has maintained that the original degree of learning rather than the rate of learning is the critical factor in forgetting. "If the degree of original learning reaches a certain level,

it makes no difference how long it took to reach that level." Retention should be the same for all Ss if they all learned to the same criterion. In fact, if all Ss are given enough trials to reach the same criterion, Ss considered "slow learners" will retain as much as faster learners. Underwood (1964b) has pointed out that many studies comparing different experimental groups on retention measures have not ensured equal degrees of original learning. Belmont (1966) in a review of retention studies comparing normals and retardates, found that studies demonstrating a retardate memory loss generally failed to control for unequal original learning.

If this viewpoint is correct, then the introduction of complex mediators should not differentially facilitate Ss' long term retention of paired associates, if all Ss are allowed to attain equal levels of learning. It may be however that high level strategies, either those formulated by Ss themselves, or those supplied by E during acquisition, permit better storage and retrieval of learned associations. The recoding of these associations in the process of acquiring them may ensure better retention. If this is the case, then one may predict that differences in retention may result from Ss' utilization of different types of associative strategies.

In order to test the positions so far outlined, it is necessary to determine the strategy styles most generally employed by each S prior to the introduction of aided conditions on the learning task. Strategy scores obtained from the Martin classification scheme will be used for this purpose. Secondly, the nature of the paired associates to be

employed must be well-defined. Studies in the past have suffered from utilizing paired associate lists of unknown difficulty and uncontrolled composition. Lists should be designed so that all possible strategies can be employed with equal facility. Another important consideration would be to allow Ss to practice the paired associates presented on the learning task until all Ss had learned the entire list. This condition would permit the accurate measurement of how well Ss are able to recall the pairs at a later date. Finally, it will be necessary to record the associative strategies reported by Ss during the experiment, both at the time of original learning of the list and after the retention interval. Analysis of the strategies employed by Ss on these tasks would permit the determination of whether strategy styles remain stable during learning and retention.

The major hypotheses are:

1. Complex mediators serve as better storage devices than do simpler mediators. They permit better recoding of associations so that the retrieval of these associations at a later time is more rapid and more accurate. Complex mediators are more efficient whether they are supplied by E or produced by S himself in the form of high level associative strategies. This hypothesis can be tested directly by examining two sub-hypotheses:

a. A complex mediation treatment will result in more rapid learning of a paired associate list than will a simple mediation treatment. High level strategies are hypothesized to be intrinsically more effective in aiding learning than are low level ones.

b. High strategy producers should learn at a faster rate than both low strategy and variable producers. In the event that mediators supplied by E do not prove effective for some pairs, Ss would be expected to rely on their own mediational style. Subjects who typically produce high level strategies, which have been hypothesized to lead to more rapid learning, should then be at an advantage in learning the criterion list.

2. Performance of Ss in the control treatment condition will be superior to that of Ss in the simple mediation condition, but inferior to the performance of Ss receiving complex mediators. In the absence of experimenter influences, control Ss should be free to formulate their own strategies and may develop some high level associations of their own. Since it has been hypothesized that high level strategies lead to more rapid learning, control Ss may learn some pairs quite rapidly. Subjects receiving simple mediators on the other hand, will have their attention directed toward low level letter cues only. This type of aid will set Ss to attend to only certain elements of the associations to be learned, and they will not be able to develop high level strategies of their own. Since the hypothesis has been made that low level strategies lead to inferior performance, Ss receiving simple mediators should exhibit less rapid learning.

3. Variable strategy producers should learn at a faster rate than low strategy producers. Some Ss report forming both high and low strategies, with neither type being in the majority. These variable producers are more likely to produce high level strategies if the

mediators supplied by E fail to facilitate the formation of certain associations, and thus are expected to learn more rapidly than low strategy producers. Variable Ss should thus be at an advantage in performance when compared to low strategy producers.

4. If Bruner's congruency position is correct, then complex mediation aid will be most effective only for Ss typically producing high level strategies, and simple mediators will be most facilitative for Ss producing low level strategies. This view would predict an interaction between the type of strategy aid and S's predominant mediational style. The facilitation position on the other hand, maintains that there are qualitative differences in the types of mediators generally reported, with complex ones resulting in the most efficient learning. This facilitation view then, predicts that a complex mediation treatment will lead to significantly faster learning for all groups. Hence, no interaction between type of mediator supplied and mediational style is predicted.

5. The contemporary view of retention as illustrated by Underwood's position maintains that the degree of original learning is the most critical variable influencing retention. If all Ss attain the same high degree of learning in acquisition, then there should be no differences in the measurement of retention, despite differences in the rate of learning. However, if it is true that high level strategies permit better storage of learned associations than this effect should manifest itself on retention. The facilitation position would predict that the complex mediation treatment will result in significantly better

retention of the criterion list than the simple mediation treatment.

6. Subjects typically producing high level strategies should perform significantly better on the retention tasks than will low strategy producers. Moreover, Ss who typically produce high level strategies, should recall these associations significantly better than low strategy producers.

METHOD

Subjects

One hundred and seventy-three fifth grade children, selected from three elementary schools participated in this study. The Ss ranged in age from 10-0 years to 11-10 years. All Ss were administered a strategy production task. Their responses to this task served as a basis for assigning them to one of three groups; - high strategy producers, low strategy producers or variable strategy producers. Enough Ss were tested until a minimum of 54 had been assigned to each of the three classifications. In order to keep the sample size the same in each group, a total of eleven Ss were randomly eliminated. Each group consisted of 54 Ss, totaling 162 Ss in all.

After being identified on the basis of strategy production patterns, Ss were randomly assigned to either a complex mediation treatment, a simple mediation treatment or a control treatment. The age, IQ, reading and grade achievement levels for all Ss were obtained from school records. The Otis Quick Scoring Test served as the IQ measure and had been administered to 159 of the Ss. Achievement scores on the Iowa Silent Reading Test and grade achievement levels based on the Stanford Achievement Test were available for 153 Ss. The small number of Ss for whom scores were not available were generally new students in the school who had not been tested. Tables 2, 3, 4 and 5 present the means and standard deviations for age, IQ, grade achievement level and reading achievement level, respectively.

Table 2. Age of experimental Ss by treatment and strategy style.

	Treatment Condition									Style		
	Complex Mediation			Simple Mediation			Control					
Style	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N
High Producers	11.0	.36	18	11.0	.36	18	10.75	.45	18	10.9	.40	54
Variable Producers	11.0	.35	18	11.1	.29	18	11.0	.42	18	11.0	.35	54
Low Producers	11.1	.41	18	11.1	.45	18	11.2	.36	18	11.1	.45	54
Treatment	11.0	.37	54	11.1	.36	54	11.0	.41	54			

Table 3. IQs of experimental Ss by treatment and strategy style.

	Treatment Condition											
	Complex Mediation			Simple Mediation			Control			Style		
Style	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N
High Producers	108.23	13.06	17	107.24	8.30	17	106.61	9.52	18	107.35	11.13	52
Variable Producers	105.83	9.05	18	108.39	8.26	18	102.17	9.78	18	105.50	9.41	54
Low Producers	102.78	7.74	18	104.28	6.84	18	105.65	11.13	17	104.20	9.02	53
Treatment	105.57	10.12	53	106.66	7.89	53	103.09	10.43	53			

Table 4. Grade achievement of experimental Ss by Treatment and strategy style.

	Treatment Condition									Style		
	Complex Mediation			Simple Mediation			Control					
Style	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N
High Producers	5.38	1.02	16	5.09	.89	15	5.12	.65	18	5.20	.89	49
Variable Producers	4.96	.59	18	5.07	.92	18	5.16	.77	17	5.06	.77	53
Low Producers	4.70	.81	17	4.64	.72	18	4.49	.85	16	4.61	.80	51
Treatment	5.01	.88	51	4.93	.84	51	4.92	.76	51			

Table 5. Reading achievement of experimental Ss by treatment and strategy style.

	Treatment Condition									Style		
	Complex Mediation			Simple Mediation			Control					
Style	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N
High Producers	5.38	1.11	16	5.11	.85	15	4.94	.79	18	5.14	.91	49
Variable Producers	4.91	.61	18	5.02	.89	18	5.01	.65	17	4.08	.72	53
Low Producers	4.55	.68	17	4.61	.57	18	4.52	.83	16	4.56	.69	51
Treatment	4.95	.81	51	4.91	.78	51	4.82	.76	51			

Materials

Two paired associate lists were employed in this study. Twenty disyllabic pairs were constructed to form the production list. The stimulus items were low $\frac{m}{-}$ paralogs. The response items were familiar words. Items composing these pairs were selected from Noble's list (1952) and Cieutat's association index (1963) or were specifically designed for the experiment. Seven of the stimulus items were selected from Noble's list. Their mean $\frac{m}{-}$ value was 1.57 (range 1.28 - 1.82). The remaining 13 stimulus items on the production list were drawn from Cieutat's index and had a mean association value ($\frac{a}{-}$) of .68 (range .49-.90). Ten of the response items were selected from Noble's list and had a mean $\frac{m}{-}$ value of 7.65 (range 5.94 - 9.61). The remaining ten response items were selected from Cieutat's list and had a mean ($\frac{a}{-}$) value of .99 (range .97-1.00).

Fifteen of the twenty paired associates composing the production list satisfied two criteria established in a pilot study. (Experiment I in Appendix A). These pairs had been found to elicit low level strategies (no reported strategy or repetition), strategies of intermediate complexity (letter cues and word formation), and more complex strategies (superordinate and syntactical) with equal probability. Secondly, the pairs had been shown to differentiate between Ss producing high strategies and those Ss producing low level strategies. Subjects identified as high strategy producers reported significantly more high level strategies for these pairs, while low strategy producers formulated more low level strategies.

The remaining five pairs differentiated between high and low producers; however, they elicited low, intermediate and high level strategies in unequal proportions. These pairs were added in order to lengthen the production list to twenty pairs. The complete list of twenty paired associates comprising the production list is presented in Table 6.

Table 6. Production list items

Pair		Pair	
Dragrope	-- Drumbeat	Zumap	-- Zebra
Cowwheat	-- Climber	Kaysen	-- Heaven
Wellat	-- Jewel	Nostaw	-- Nonsense
Incarn	-- Dinner	Tabret	-- Mallet
Mugweed	-- Deerskin	Myxlas	-- Party
Kupod	-- Kitchen	Davit	-- Village
Attar	-- Jelly	Fardel	-- Decoy
Caratch	-- Captain	Welkin	-- Wagon
Jointress	-- Journal	Endore	-- Empire
Perflate	-- Porpoise	Landgrave	-- Leader

The criterion list consisted of 14 paired associates which met both criteria. These pairs were also constructed from items selected from the Noble and Cieutat lists. Six of the stimulus items had a mean $\bar{m}$ value of 1.79 (range 1.05 - 2.41) on the Noble list, and five of the

stimulus items had a mean ($\underline{a}$) value of .69 (range .52 - .85) on Cieutat's index. The mean ($\underline{m}$) value for seven response items was 7.53 (range 5.98 - 9.43) and the Cieutat ($\underline{a}$) value was .99 (range .99 - 1.00) for four other response items. The criterion list of 14 paired associates and the experimenter-supplied mediators are presented in Table 7.

Table 7. Criterion list pairs and the experimenter-supplied mediators

Pair	High Strategy	Low Strategy
Carom - Income	"Cars come and go in"	O, M
Delpin O Insect	"Pin the insect"	I
Protan - Pencil	"A tan pencil"	P
Rompin - Return	"Romp up and return it"	R, N
Cotane - Custom	"Cot and custom"	T
Standage - Salute	"Stand up and salute"	S, A
Icon - Office	"I come to the office"	C
Meardon - Army	"Don is in the army"	A, R
Mugwam - Summer	"It's muggy in the summer"	U
Santon - Lion	"I sat on a lion"	N
Cannel - Money	"Can I have some money?"	N, E
Capstan - Youngster	"Cap of the youngster"	S, T
Lucarne - Lady	"Lucy is a lady"	L
Golder - Quarter	"Gold is worth a quarter"	E, R

Procedure

Measures on five separate tasks were obtained from all Ss. They were: (1) a production task, (2) a criterion task, (3) an associative strategy task, (4) a retention task, and (5) an associative strategy retention task.

Production task. The production task was administered to groups of Ss ranging in size from 20 to 25. The E first described the seven associative strategy categories by means of a sample paired associate presented on the blackboard. The different strategy categories were introduced as "tricks" and Ss were asked to tell which trick they would use if they had to learn what "new word" (the stimulus term) went with the "old word" (response term). The twenty production pairs were presented to Ss in booklet form, with one paired associate printed at the top of each page. Subjects were allowed sixty seconds to write down the trick they would use for each pair. The E read each pair once. The complete set of instructions for the production task follows:

> "This is going to be a word game in which I find out how you all learn new words. In the booklets I have just handed out are thirty pairs of words. One of the words is one you know, the word with it is a new word for you, but it means the same as the word you already know.
>
> Here is a pair of words, not in your booklet, that we can use as an example. (LENEAR - GARDEN placed on blackboard)
>
> One way to learn that LENEAR means GARDEN is to say it over and over again. Another way is to look for letters that are in both the new word and the old word, and then remember the letters. There is an AR in LENEAR and an AR in GARDEN. Can anyone see other letters in both words? (Children suggest similar letters)
>
> Another trick you can use to remember that the two words go together is to find a little word inside the new words, and then remember that the new little word goes with the

word you know. (NEAR in LENEAR shown) "Are there any other words?

Finally, you can make a little jingle or saying out of the two words like NEAR THE GARDEN. Can anybody think of any others?

All of these tricks can help you learn that these two words go together. For each of the pairs of words in these booklets, I want you to tell me which trick you would use if you had to learn that the two words go together. There are no right or wrong tricks, I just want to know how you would learn the new words. Are there any questions?

When I tell you to begin, I want you to turn to the first pair. I will give you sixty seconds to write down how you would learn each pair. At the end of that time please turn the page and I will say the next two words. If you can't think of any tricks, just write NONE. Do not go back in the booklet, after you have finished a pair forget it and think about the next one."

Subjects' responses were then rated and each S was assigned to a high strategy, low strategy or variable strategy production group. In order for an S to be assigned to the high strategy production group, he must have produced a combined total of 15 word formation, superordinate or syntactical strategies. Subjects assigned to the low strategy production group reported at least 15 single or multiple letter cues, repetition strategies or no associative strategy. Variable production Ss produced a wider range of associative strategies. A subject was defined as a variable producer if he reported fewer than 15 of either the low level strategies or high level strategies.

Criterion task. The criterion task was presented to each S seven days after the production task. Criterion pairs and stimulus items were presented on slides by means of a Kodak Carousel 750 projector with an automatic timer attachment. During the learning trials, each of the

14 paired associates was presented at a 5 sec. exposure rate, with a 10 sec. intertrial interval. On the first three learning trials, Ss were supplied the mediators listed in Table 7. The E repeated the pair, then supplied the strategy. For the control (no strategy) condition, E repeated the pair twice.

Learning and test trials were presented alternately. For the test trials, the timer was converted to manual control so that all Ss had sufficient time to respond. The exposure time for each test stimulus was approximately 10 secs. The E recorded Ss responses on a separate answer sheet. Subjects were tested until a criterion of two successive, errorless trials was attained.

Associative Strategy Task. After completion of the criterion task, Ss were reminded of the various strategy categories and were asked what associative strategies, if any, they used to learn the pairs. The 14 paired associates were presented again and Ss reported orally the strategies they employed. These oral reports were recorded on a tape recorder. Subjects were allowed as much time as they required to report a strategy.

Retention task. All subjects were administered the retention task seven days after the learning of the criterion list. A recall method was used, in which Ss were first presented the 14 stimulus terms and were asked to supply the correct response. Subjects were allowed 10 secs. in which to respond. After this recall trial, Ss were again presented the 14 paired associates at a 5 sec. exposure rate with a 10 sec. intertrial interval. Subjects were again tested until a

criterion of two successive, errorless trials was attained. No mediators were given to Ss during the retention trials.

Associative strategy retention task. All Ss were asked to report the associative strategies they employed during the retention task. The Ss reported orally the strategies they used for each of the 14 pairs. Their strategies were recorded on a tape recorder, and Ss were allowed as much time to respond as they required.

RESULTS

The mean ages, IQs, grade achievement levels and reading achievement levels for Ss in the nine sub-groups were compared by means of a 1 x 9 analysis of variance. The data revealed no significant differences among the nine groups in age ($F=1.48$, $df=8/153$), IQ ($F=.30$, $df=8/150$), grade achievement ($F=1.13$, $df=8/145$), and reading achievement ($F=.56$, $df=8/145$).

The number of trials required to reach a criterion of two perfect anticipations served as the major measure of learning. The means and standard deviations of trials to criterion on the acquisition task for the nine sub-groups are presented in Table 8. A 3 x 3 Treatments by Levels analysis of variance design (Lindquist, 1956) was performed on these data. Table 9 presents the summary of this analysis. The Treatments effect was found to be highly significant ($p<.01$). Multiple comparisons of the complex, control and simple treatment conditions using the Tukey (a) test (Winer, 1962) revealed all three means to be significantly different from each other. The strategy production variable was also found to be significant ($p<.01$). The only significant difference among the Level means was between the high and low strategy producers as determined by the Tukey test. The Treatments x Levels interaction was not found to be statistically significant. These results indicate that the introduction of complex mediators leads to more rapid acquisition of a paired associate list than does a non-aided control condition. The control condition itself

Table 8. Means and standard deviations of the number of trials to criterion on the acquisition task.

Strategy Style		Treatment Condition			Style (N=54)
		Complex	Simple	Control	
High Producers	$\bar{X}$	5.28	7.56	6.33	6.39
	S.D.	1.70	1.65	1.93	1.41
Variable Producers	$\bar{X}$	5.61	7.11	7.00	6.57
	S.D.	.98	1.84	1.68	1.67
Low Producers	$\bar{X}$	6.17	8.72	7.17	7.35
	S.D.	1.20	1.56	.88	1.62
Treatment (N=54)	$\bar{X}$	5.68	7.80	6.85	
	S.D.	1.36	1.15	1.57	

Table 9. Summary of analysis of variance of number of trials to criterion on the acquisition task.

Source		df	SS	MS	F
A:	Treatments	2	120.78	60.39	35.32**
B:	Levels (Strategy Style)	2	27.43	13.72	8.02**
A x B:	Treatments x Levels	4	10.76	2.69	1.57
	Error	153	261.03	1.71	
	Total	161			

** $p<.01$

resulted in faster acquisition than did a simple mediation condition. Moreover, high level strategy producers reached criterion on the acquisition task significantly faster than Ss producing low level strategies.

The hypothesis that Ss who are supplied mediators congruent with those they habitually report will perform more efficiently than Ss receiving incongruent mediators was examined by means of a 2 x 2 analysis of variance. The performance scores of high strategy producers receiving complex mediators and low strategy producers receiving simple mediators constituted the congruent condition, while low strategy producers receiving complex mediators and high strategy producers receiving simple mediators composed the incongruent condition. Table 10 presents the means and standard deviations for these groups.

Table 10. Means and standard deviations of the number of trials to criterion on the acquisition task for the congruent and incongruent conditions.

Strategy Style		Treatment Condition		Style (N=36)
		Complex	Simple	
High Producers	$\bar{X}$	5.28	7.56	6.42
	S.D.	1.70	1.65	1.52
Low Producers	$\bar{X}$	6.17	8.72	7.45
	S.D.	1.20	1.56	1.18
Treatment (N=36)	$\bar{X}$	5.72	8.14	
	S.D.	1.16	1.43	

A summary of the analysis of variance is presented in Table 11. The results of the analysis revealed a consistency with the previous analysis of variance in that the Treatment and Levels effects were both highly significant. ($p<.01$). Of importance in this analysis however, was the fact that there was no significant interaction between the two main effects. It does not appear that incongruency between Ss' mediational style and experimenter-supplied mediators adversely affects acquisition of a paired associate list.

Table 11. Summary of analysis of variance of the number of trials to criterion on the acquisition task for congruent and incongruent conditions.

Source		df	Ss	MS	F
A:	Treatments	1	105.16	105.16	44.00**
B:	Levels	1	19.02	19.02	7.96**
A x B:	Treatments x Levels	1	.35	.35	.15
	Error	68	162.20	2.39	
	Total	71			

** $p<.01$

Two basic measures were utilized in analyzing the retention task results. The number of pairs correctly recalled on the first test trial served as a measure of recall while the number of trials required for Ss to attain the criterion of two errorless trials was used as a relearning measure. Table 12 presents the mean number of pairs recalled on the recall test trial. A Treatments x Levels

Table 12. Means and standard deviations of the number of items recalled on the recall task.

Strategy Style		Treatment Condition			Style (N=54)
		Complex	Simple	Control	
High Producers	$\bar{X}$	12.06	8.06	9.56	9.89
	S.D.	1.76	3.20	.68	2.69
Variable Producers	$\bar{X}$	10.50	7.89	9.06	9.15
	S.D.	3.00	3.45	2.03	3.01
Low Producers	$\bar{X}$	9.00	6.83	8.44	8.09
	S.D.	1.93	2.30	2.41	2.34
Treatment (N=54)	$\bar{X}$	10.52	7.59	9.02	
	S.D.	2.20	2.93	1.97	

Table 13. Summary of analysis of variance of the number of items recalled on the recall session.

Source		df	SS	MS	F
A:	Treatments	2	231.18	115.59	19.66**
B:	Levels (Strategy Style)	2	88.00	44.00	7.48**
A x B:	Treatments x Levels	4	22.99	5.75	.98
	Error	153	899.53	5.88	
	Total	161			

** $p<.01$

analysis of variance of these data revealed a highly significant treatment effect ($p<.01$). The Tukey test revealed that the complex mediation treatment group recalled significantly more items than did the simple mediation group ($p<.01$). There were no significant differences between the complex mediation and control conditions, although the control group mean was in the expected direction. The Levels effect was also significant ($p<.01$). The only significant difference between the groups was between high and low strategy producers. Low strategy producers recalled significantly fewer pairs, across all treatments, than did high strategy producers ($p<.05$). There was no significant interaction between Treatments and Levels. These results indicate that Ss receiving complex mediators during learning were able to recall significantly more pairs than did Ss receiving simple mediators. Moreover, low strategy producers recalled fewer pairs on the recall task than did high strategy producers. Table 13 presents the summary of this analysis.

The number of trials required to relearn the criterion list is presented in Table 14. A 3 x 3 analysis of variance revealed significant Treatment and Level effects. ($p<.01$ and $p<.05$, respectively). Table 15 presents the summary of this analysis. In analyzing the treatment means, the Tukey test revealed that Ss receiving complex mediators during learning were able to relearn the list more rapidly than Ss receiving simple mediators ($p<.01$). Although the over-all Level effect was significant, the Tukey test revealed no significant differences among the three Level means. The differences between high and low producers and variable and low producers both approached significance. The means were in the expected direction; high producers were superior to variable producers and variable producers were superior to low producers.

Table 14. Means and standard deviations of the number of trials to criterion on the relearning task.

Strategy Style		Treatment Condition			Style (N=54)
		Complex	Simple	Control	
High Producers	$\bar{X}$	3.11	4.78	4.00	3.96
	S.D.	.97	2.25	1.41	1.50
Variable Producers	$\bar{X}$	3.39	4.67	4.06	4.04
	S.D.	.84	1.37	.87	.98
Low Producers	$\bar{X}$	4.28	5.44	4.33	4.68
	S.D.	1.19	1.24	1.33	1.25
Treatment (N=54)	$\bar{X}$	3.59	4.96	4.13	
	S.D.	1.06	1.76	1.29	

Table 15. Summary of analysis of variance of the number of trials to criterion on the relearning task.

Source		df	SS	MS	F
A:	Treatments	2	51.48	25.74	14.38**
B:	Levels	2	17.04	8.52	4.76*
A x B:	Treatments x Levels	4	3.83	.96	.54
	Error	153	274.20	1.79	
	Total	161			

** $p<.01$
* $p<.05$

The congruency - incongruency hypotheses were again compared on the retention task by means of a 2 x 2 analysis of variance. Table 16 presents the means and standard deviations for the congruent and incongruent groups.

Table 16. Means and standard deviations of the number of trials to criterion on the relearning task for the congruent and incongruent conditions.

Strategy Style		Treatment Condition		Style (N=36)
		Complex	Simple	
High Producers	$\bar{X}$	3.11	4.78	3.94
	S.D.	.97	2.25	1.02
Low Producers	$\bar{X}$	4.28	5.44	4.86
	S.D.	1.19	1.24	1.27
Treatment (N=36)	$\bar{X}$	3.69	5.11	
	S.D.	1.20	2.16	

Table 17 presents the summary of this analysis of variance. The Treatments and Levels effects were again highly significant ($p<.01$ for both main effects). The lack of a significant interaction again fails to support the congruency hypothesis.

Table 17. Summary of analysis of variance of the number of trials to criterion on the retention task for congruent and incongruent conditions.

Source		df	SS	MS	F
A:	Treatments	1	36.12	36.12	16.19**
B:	Levels	1	15.12	15.12	6.78**
A x B:	Interaction	1	1.13	1.13	.54
	Error	68	151.75	2.23	
	Total	71			

** $p<.01$

The strategies reported by Ss for each pair on the associative strategy task were independently rated by two judges. Each S was assigned a total strategy score based on the sum of the strategy ranks for all 14 pairs. For example, if S's reported strategies for four pairs had been categorized as word formations, he would receive a score of twenty (four pairs categorized at strategy level five). If the verbal reports for three other pairs had been classified as repetition strategies he would have received a score of six for these three pairs (three pairs categorized at strategy level two). Thus, an individual's total strategy score would be the sum of the ranks assigned to each of

his reported strategies.

The reliability of the judges' ratings of the strategies reported by 18 Ss on the associative strategy task and the retention strategy task were assessed by means of rank order correlations. The obtained correlations for the two judges was .98 on the associative strategy task and .99 for the retention strategy task. Since interjudge reliability was high, only one judge was selected to rate the remaining associative strategies.

The relationship between the number of trials to criterion and the total strategy score reported by Ss on the associative strategy task was examined by means of a rank order correlation. For all 162 Ss, the resulting rho was -.66 ($p<.01$), indicating that Ss with high strategy level scores required fewer trials to reach criterion.

The consistency of Ss' reported strategies across production tasks had been substantiated in Experiment Ia (See Appendix A). The effect of an intervening learning task upon Ss' reported strategies had not been determined. The strategy levels reported by Ss in the control treatment condition should indicate the effect of a learning task on strategy formation. These Ss had not been exposed to experimenter-supplied mediators during the learning task, and their verbal reports should more accurately reflect their own mediational style.

The median total strategy scores for the high, variable and low strategy producers assigned to the control treatment were 72, 56 and 52.5, respectively. A Kruskal-Wallis one-way analysis of variance on the total strategy scores for these groups yielded a significant $\underline{H}$

value (H=22.59, df=2, $p<.001$). Individual comparisons by means of the Mann-Whitney U test revealed that the high strategy producers were significantly different from both the variable and low producers (p .01 for both comparisons), but that the variable and low strategy groups were not different from each other.

The median strategy level reported by the high, variable and low producers was also computed for the retention task. The median strategy scores for the high, variable and low strategy Ss assigned to the control condition were 70, 58 and 51.5, respectively. The Kruskal-Wallis analysis of these median strategy scores yielded a significant H value (H=16.28, df=2, $p<.001$). The Mann-Whitney U test again revealed high strategy producers to be significantly different from the variable and low producers ($p<.01$), but the variable and low strategy groups were not significantly different from each other.

During the associative strategy task, Ss were presented each pair and were asked to report the strategies they had employed. The elapsed time from when E said the pair and presented it on the screen to when S began to verbalize his strategy was computed from the tape recorded sessions. A measure known as the total latency to strategy emission was obtained from the total number of seconds elapsed between presentation and verbalization for all 14 pairs. Latency to strategy emission was found to correlate -.51 ($p<.05$) with strategy level when all nine sub-groups were combined. The correlation suggests that as higher strategies were produced, Ss required less time to begin reporting them.

In order to determine whether the three treatment conditions differentially affected mean emission latencies, and whether latency is a function of the mediational style of the learner, the mean latencies for all Ss were computed. Table 18 presents the means and standard deviations for the mean latencies on the acquisition task.

Table 18. Means and standard deviations of the latency to strategy emission on the acquisition task.

Strategy Style		Treatment Condition			Style (N=54)
		Complex	Simple	Control	
High Producers	$\bar{X}$	1.83	2.54	2.75	2.37
	S.D.	.96	1.13	1.20	.89
Variable Producers	$\bar{X}$	1.77	2.58	3.01	2.45
	S.D.	.99	1.09	1.31	.96
Low Producers	$\bar{X}$	2.93	3.36	3.14	3.14
	S.D.	1.14	1.27	1.28	1.13
Treatment (N=54)	$\bar{X}$	2.18	2.83	2.97	
	S.D.	.91	1.02	.99	

A 3 x 3 Treatments x Levels analysis of variance was computed for these data. Table 19 presents the summary of this analysis. The Treatments main effect was found to be highly significant ($p<.01$). The only significant individual comparison was between the complex mediation treatment and the control treatment. Control Ss had a significantly longer latency than did Ss receiving complex mediators.

A significant Levels effect was also obtained ($p<.01$). The Tukey test revealed the only significant individual comparison to be between high and low strategy producers ($p<.05$). Low strategy producers exhibited significantly longer latencies than did Ss producing high level strategies.

Table 19. Summary of analysis of variance of latency to strategy emission on the acquisition task.

Source		df	SS	MS	F
A:	Treatments	2	20.42	10.21	10.01**
B:	Levels	2	18.98	9.49	9.30**
A x B:	Treatments x Levels	4	3.71	.93	.91
	Error	153	156.72	1.02	
	Total	161			

** $p<.01$

Mean latencies were also computed for the retention strategy task. Table 20 presents the means and standard deviations for these latencies.

Table 20. Means and standard deviations of the latency to strategy emission on the retention strategy task. (N=18 for all groups)

Strategy Style		Treatment Condition			Style
		Complex	Simple	Control	
High Producers	$\bar{X}$	1.69	2.52	2.41	2.21
	S.D.	1.15	1.03	1.08	1.01
Variable Producers	$\bar{X}$	1.87	2.61	3.11	2.53
	S.D.	.98	1.06	1.09	.92
Low Producers	$\bar{X}$	2.82	3.47	3.04	3.11
	S.D.	1.06	1.30	1.16	1.02
Treatments (N=54)	$\bar{X}$	2.13	2.87	2.85	
	S.D.	.97	.99	1.03	

A 3 x 3 analysis of variance of these data revealed significant Treatment and Levels effects. Control Ss again had significantly longer latencies than did Ss receiving complex mediators according to the Tukey test ($p<.05$). Moreover, low strategy producers again had significantly longer latencies than did Ss producing high level strategies ($p<.05$).

The latency to strategy emission for control Ss was again of special interest, because these Ss had not received any mediational aid during learning. The mean total latency scores in seconds were 38.3 for high strategy producers, 41.6 for variable producers and 43.2 for

low producers. A Kruskal-Wallis one-way analysis of variance of these data revealed a significant H value ($H=8.77$, $p<.02$). High strategy Ss had significantly shorter latencies than did low strategy producers as determined by the Mann-Whitney U test ($p<.05$).

Mean latencies were also computed for control Ss on the strategy retention task. The Kruskal-Wallis test revealed a significant H value ($H=13.27$, $p<.01$). High strategy Ss had significantly shorter latencies than both variable and low strategy producers ($p<.01$), according to the Mann-Whitney U test.

In order to examine further the relationship between latency to strategy emission and performance on the acquisition task, the latencies for pairs attained early in acquisition were compared to those attained on later trials. It was hypothesized that control Ss who had learned a pair early in acquisition may have developed their own strategy on these early trials and rehearsed it throughout the later learning trials. This covert rehearsal should enable them to report the strategies they formulated with a shorter latency during the associative strategy task. Subjects learning pairs on later trials during acquisition should have less time to rehearse these newly formed strategies and may need more time to emit them during the associative strategy task. This hypothesis was examined by comparing the latencies to strategy emission of strategies reported for pairs learned on the first two trials with the latencies of pairs learned only on the last two trials. Correlated t tests of the differences between the mean latencies of the early and late pairs

reported by Ss in the three control groups were computed. Although the differences were all in the expected direction, none of the mean differences were significant. The mean difference in seconds between early and late pairs for the high strategy Ss was 1.35 (S.D.=2.25). The t value for this difference was 1.26 ($p>.05$). The mean difference in seconds was .24 (S.D.=1.40) for variable producers ($t=.60$, $p>.05$). Low strategy producers had a mean difference of 1.10 seconds (S.D.=2.08) with a t value of 1.72 ($p>.05$). The hypothesis that longer latencies would be reported for pairs learned later in acquisition was not supported.

DISCUSSION AND IMPLICATIONS

The results confirm hypothesis (1); complex mediators do seem to serve as better storage devices than do simple mediators. The complex mediation treatment resulted in more rapid learning of a paired associate list than did a simple mediation treatment. Moreover, high strategy producers acquired the list more rapidly than did low strategy producers. It appears that Ss who are supplied complex mediators or are permitted to utilize their own high level strategies are at an advantage in learning new associations. The highly significant correlation obtained between strategy level and speed of learning lends additional support to this interpretation.

Hypothesis (1b) received only partial support; high strategy producers did not learn the list significantly faster than did variable producers, although their performance was in the expected direction. The reason for this lack of superiority is not clear. It had been hypothesized that variable producers are able to produce high level strategies if the mediators provided by E do not prove effective. However, analysis of the strategy levels of the control Ss revealed that high strategy producers reported significantly higher strategy levels than did variable producers. Apparently, variable producers did not produce more high level strategies as they learned the list. An alternative explanation may be that the criterion list was not difficult enough to permit high strategy producers to take advantage of their superiority in strategy production.

The superior performance on the acquisition task of control Ss when compared to Ss receiving simple mediators supports hypothesis (2). Subjects receiving no mediational aid from E learned the list more rapidly than did Ss who were supplied simple mediators composed of letter cues. This finding further attests to the relatively minor facilitative effect that mediators of this type have upon learning. It also supports the notion that children free to develop their own strategies during acquisition can surpass the performance of learners instructed to employ mediators that are only mildly effective learning devices.

The hypothesis that variable strategy producers would learn at a faster rate than low strategy producers was not confirmed. There was no significant difference in learning rate between these two groups on the acquisition task. Moreover, the lack of a significant difference in strategy level between the variable and low strategy control groups suggests that variable producers did not make greater use of higher levels as hypothesized. The failure of unaided variable producers to utilize high level strategies during acquisition may account for the similarity in performance of all variable and low production Ss.

The findings support the facilitation view of mediational aid. The lack of a significant interaction between type of mediation provided and S's mediational style refutes the congruency hypothesis. The effect of various mediational aids does not appear to be dependent upon Ss' predominant mediational style. Complex mediational aids

appear most conducive to efficient learning, regardless of the type of strategies an individual generally produces. The retention data indicated that congruency was not a factor in relearning.

Further analysis of the retention task results supports the view that complex mediators permit better storage and retrieval of learned associations. Subjects receiving complex mediational aid not only recalled significantly more pairs on the recall task than did Ss receiving simple mediators, but they also relearned the list more rapidly. Furthermore, low strategy producers recalled fewer pairs correctly on recall than did high strategy producers. Since all Ss attained the same degree of original learning, these retention differences would not be predicted from the traditional view of forgetting. The position that the utilization of complex mediators during acquisition allows the recoding of new associations and thus ensures better retention seems supported by these findings.

The hypothesis that complex mediators directly facilitate learning and retention is further supported by the results of the latency to strategy emission analyses. Subjects who receive complex mediators not only learn new associations significantly faster than control Ss, but begin to report the strategies they employed more rapidly. Control Ss take a longer time before beginning to report their strategies. Since control Ss were forced to rely on their own strategy productions during acquisition, more trials may have been required before they developed strategies which could be useful in learning. There would have been less time for control Ss to practice

the strategies they finally produced. On this basis, it seems likely that it would require more time for them to emit their strategies when asked. Experimental Ss, on the other hand, would have had adequate time to rehearse the strategies provided them, and would be expected to emit them more rapidly. The fact that control Ss did not possess readily available mediators at the beginning of acquisition may have adversely affected their learning rate.

In summary, the results of this study indicate that complex, experimenter-supplied mediators served as better storage devices than did simpler mediators. It was demonstrated that Ss differ in the complexity of their mediational styles, and that Ss generally producing high level strategies surpass low strategy producers' in rate of learning. Congruency between the complexity of mediators supplied and the mediational style of the learner was found not to be a factor. It was also noted that complex mediators permitted significantly better retention of the list and that Ss exhibiting high strategy mediational styles performed better than low strategy producers on retention. These differences were obtained despite the fact that all Ss attained a high degree of original learning.

It should be pointed out that this study has successfully validated the strong facilitative effect of complex mediators through the direct comparison of simple and complex strategies. Prior to this research, the relationship between efficient learning and high level strategies had been largely demonstrated through correlational techniques. Although syntactical strategies had been found to facilitate learning

in the Martin et.al. (1967) study, complex mediational aid had never been compared directly with the facilitative effect of low level strategies. Moreover, no previous attempt to determine stable individual differences in the type of plans learners employ in associative learning had been made. Through experimental manipulations, this study has confirmed hypotheses formed from correlational data; complex mediators are most effective in facilitating learning. Also of importance is the fact that this study has demonstrated that stable individual differences in the type of mediator utilized in learning do exist.

The fact that hypotheses derived from Ss' verbal reports of how they attempted to learn new associations can be confirmed experimentally has important methodological implications. Too many past research attempts have ignored Ss' verbal reports, perhaps for fear of adding an uncontrolled, "introspective" element to the investigation. The traditional approach to verbal learning has been that experimental conditions should attempt to minimize the contribution made by Ss to their own performance. This approach is thought to allow a more precise view of the variables under examination. The results of this study however, have called attention to the important role Ss actually can play in the formation of testable hypotheses relevant to human learning. There may be much to recommend a general research methodology which systematically attends to the verbalizations of naive Ss, and then experimentally examines hypotheses generated from these reports.

The results strongly suggest the existence of mediational styles among learners, and imply that their utilization is a determining factor in how well children learn new associations. Although this study has demonstrated only one of several "styles" of cognitive behavior, the fact remains that it is a powerful one. Individuals exhibiting a complex style of mediation are at a decided advantage in learning and recalling associations because of their apparent increased ability to store larger chunks of information.

Although large individual differences in mediational styles were noted, the consistency with which these styles were expressed must also be considered. The children included in the mediational style groups defined within the framework of this study produced similar strategies across a wide variety of tasks. Subjects' reported strategy levels remained consistent from a relatively open-ended production task, through a more structured learning situation to a final memory task.

In a recent article, Jensen (1968) has called attention to "basic learning abilities" which can be measured by laboratory learning tasks. Examples of learning abilities derived from laboratory tasks are digit span, numerical aptitude and spatial relations. These basic abilities involve little transfer from past experience. Intelligence, on the other hand, consists of transferable knowledge and cognitive skills previously acquired. In a stimulating environment, intelligence and basic learning ability may be highly correlated, but they often correlate negligibly on measures obtained

from children of a less stimulating environment. Jensen feels that it is the "lack of cognitive skills tapped by intelligence tests and required for educability, rather than the basic learning abilities" that differentiates culturally disadvantaged children from middle-class children on school achievement. What must be determined through research is how basic learning abilities can best be changed into the kind of intelligence needed for school achievement, for children from non-stimulating environments. One way may be to allow the learner himself to act on the instructional input in order to master it. This approach would assume that the learner possesses and can utilize many already existing skills. Another approach would be to bring the learner's behavior under the direct control of the instructor or instructional medium by the application of operant training procedures. This approach would not require the learner to bring as many developed skills to the learning situation and would appear to be more applicable to children from less stimulating environments.

The consistency with which mediational style appears indicates that it may be related to these basic learning abilities. In order to examine the relationship between mediational style and basic learning ability, a series of correlations were computed. The correlation between IQ and strategy level on the production task for the 159 Ss for whom data were available was .14 ($p>.05$). The low magnitude of this correlation suggests that intellectual ability is only slightly related to Ss' production of associative strategies. The relationship between the number of trials to criterion on acquisition and IQ was

also examined. The obtained r was -.26 ($p<.05$) revealing a small but significant relationship between IQ and performance. Grade achievement level was also correlated with number of trials to criterion. The obtained correlation was -.36 ($p<.05$) indicating that achievement and performance are significantly related. The magnitude of these correlations indicates that only a small portion of the variance in the production and acquisition tasks can be accounted for on the basis of Ss' IQ scores and grade achievement levels. A larger relationship was obtained between strategy level and acquisition ($r=-.66$, $p<.01$), suggesting that one could predict an individual's learning score more reliably from knowledge of his strategy level than from his IQ or achievement level. It appears that mediational style, as represented by strategy level scores, contributes to our knowledge of Ss' potential performance somewhat independently of more traditional measures. The relative independence of mediational style suggests that it is a variable to be considered in further study of associative learning.

If mediational style as well as other possible styles of behavior exist, then there may be some important implications. One implication is that new curriculums could be designed which would permit the utilization of these styles, and secondly, one could attempt to remediate styles that were not particularly effective in attaining certain desirable behaviors.

In terms of curricular change, it may be valuable to begin to specify the component parts of learned skills and materials, rather

than emphasize the terminal behavior themselves. This approach of proceeding backwards by analyzing an already existing task would be useful in understanding the learning of school subject matter. This task analysis approach, as outlined by Gagné (1965) assumes that verbal associations are fundamental to most complex forms of human learning. If we can identify the basic associations which compose a specific behavior and introduce mediators designed to facilitate these associations, the learning of school tasks could be facilitated.

An attempt at remediating or altering Ss' mediational styles has already been made. Martin et.al. (1967) have succeeded in conditioning educable mental retardates to search for high or low level associative strategies. The conditioned "sets" to form high or low strategies affected the later learning of a paired associate list. Subjects conditioned to look for high level strategies made significantly more correct responses on the test than Ss conditioned to look for low level strategies. Verbal approval constituted the reinforcement and conditioning was accomplished in one brief session. Although it would probably require more sessions to condition children to adopt a relatively permanent mediational "set", these results are certainly encouraging.

The fact that mediational styles can be identified and perhaps modified has meaning for educators involved in the diagnosis of learning disabilities. The intelligence quotient as an aid to the understanding of learning problems has long been criticized. The trend now is to go beyond the IQ; to examine specific linguistic

skills, perceptual and motor functioning or conceptual abilities. Perhaps the diagnostician should also be concerned with the learner's mediational style, as another meaningful index to how the child most adequately learns. As has been demonstrated, mediational style appears to be somewhat independent of IQ and its effect on learning probably escapes detection with traditional diagnostic instruments. Conceivably, diagnostic efforts could benefit from the inclusion of a production task or a facsimile of a paired associate learning task in the battery of instruments regularly employed by psychologists.

The findings dealing with retention in this study are most provocative. The fact that original learning was ensured for all Ss makes the differences found in retention somewhat in conflict with existing research. All learners were supplied enough trials to learn the criterion associations, yet those who were provided complex mediators or who generated their own high level strategies recalled the associations more rapidly. Current conceptualizations, as exemplified by Underwood's position, would have predicted no differences in retention.

It may be that individuals differ in their ability to remember as a function of what plan they employ in original learning. Underwood's statement that there are no differences in recall between slow and fast learners if they both have enough time to learn the material to a high degree, may apply to slow and fast learners who learn in the same manner. The experimental Ss in this study did not all learn in the same manner, although they did learn to the same criterion. The style

of learning employed may be the significant factor. Corroboration for this view is present in Underwood's statement (1964) that the "retention of some things is fortified by the circumstances under which we learn them". He mentions distributed practice as an important task variable; one might also suggest mediational style as an individual difference variable.

Researchers have often ignored long term retention measures and have too often concentrated on the rate of acquisition of new material. It appears likely that retention effects are of greater relevance to educational theory. It might be that differences in rate of learning are relatively unimportant; of prime importance is how well one can retain what was originally acquired. In fact, differences in level of learning may only be validly assessed through a retention task. If this is the case, then the provision of complex mediators and other aids which enhance retention should be employed for a wide variety of school material.

A final implication arises from the experimental findings. Language experts and curriculum designers have recently begun to emphasize the internal construction of the words in our vocabulary. Attention is being paid to the internal aspects of words in many of the new language skills programs developed for our elementary schools. Many words contain smaller, self-contained words within them; these embedded words often give important clues to the meaning, pronunciation, or spelling of the larger word. The phrase "There's a rat in separate", may prove valuable in attempting to spell 'separate'. Many words also

contain lexical clues within them; the morphological root "spect" meaning to "see or look" may prove useful in determining the meaning of "retrospect", "circumspect", etc. If one were to conceive of vocabulary learning as a process similar to associative learning in which the new vocabulary word is a stimulus to which one must attach an appropriate response, then the results of this study support an approach to language development based on word construction. Identifying an embedded word or root is comparable to a word formation strategy in which a novel stimulus is differentiated into a more meaningful element. The analysis of a stimulus term into a meaningful element is the basis for the formation of complex strategies. Children able to form these types of strategies have been shown to be more efficient learners.

SUMMARY

The purpose of this study was to analyze individual differences in the verbal learning ability of fifth grade children. In addition, the effects of experimenter-supplied complex and simple mediators upon the learning rates of three specific groups of children were examined. The three groups of children typically reported simple, complex or a combination of simple and complex mediators.

One hundred and sixty-two Ss were asked to report what associative strategies they would employ in learning each item of a twenty item paired associate list. Their verbal reports were classified according to the complexity of each mediator produced. Subjects producing at least 15 word formation, superordinate or syntactical strategies were defined as high strategy producers, and Ss producing 15 or more letter cues, repetition strategies or no strategies were categorized as low strategy producers. A subject was defined as a variable producer if he reported fewer than 15 of either the low or high level strategies.

All Ss in each group then learned a new 14 item list to a criterion of two consecutive errorless trials. During acquisition, Ss in each group were administered one of three different treatments. Subjects were supplied either complex mediators in the form of syntactical strategies, simple mediators such as letter cues, or no strategies on the first three learning trials. A retention task in which no mediators were provided was administered one week after original learning.

Analysis of the results revealed a significant difference among the three groups on the mediational complexity variable. Complex mediators resulted in more rapid learning than no mediators, which in turn, produced faster learning than did simple mediators. There was also a significant difference on the mediational style variable. High strategy producers and variable strategy producers learned more rapidly than did low strategy producers. No significant interaction between type of mediational treatment and mediational style was obtained, indicating that congruency of these factors is not an important variable.

The significant differences observed on acquisition were again obtained in the retention task analysis, despite the fact that the degree of original learning was the same for all groups. Differences in retention would not have been predicted from traditional views of memory.

The results indicated that complex, experimenter-supplied mediators facilitated learning and retention and that differences in Ss' mediational style also contributed to their performance. It was suggested that mediational style could be a factor basic to learning ability in school, and that the identification of such styles could aid in the diagnosis and remediation of learning problems. The fact that complex mediators prove to be effective learning aids further implies that curriculum designers should attend more to the associations involved in the body of knowledge to be learned. Finally, it was suggested that the retention of learned associations can be enhanced through the employment of a plan utilizing complex mediators during original learning.

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APPENDIX A

Experiment Ia

Reliability of Strategy Production

Problem

Experiment Ia was conducted in order to answer two basic questions. The first was concerned with the consistency of Ss' reported strategies. Although the work of Kagan, Moss and Sigel (1963) and Holzman and Gardner (1960) attests to the fact that many cognitive behaviors are relatively stable, the reliability of an individual's associative strategy level over time had not previously been assessed.

One factor which can affect the consistency of Ss' strategy productions is the composition of the material to be learned, i.e. the paired associates themselves. The second question to be considered in Experiment Ia was whether paired associates could adversely influence individual differences in strategy formation. In order to maximize the possibility of an individual's style of strategy formation being expressed, the paired associates to which an individual is responding should elicit with equal frequency the various associative strategies.

Method

Forty-one fifth grade children served as Ss in this experiment. The mean chronological age of these Ss was 10.8 and the mean IQ was 108.7. All Ss were supplied with a printed booklet containing 30 paired associates, with one pair to a page. The stimulus words employed were disyllables selected from Noble's list (1952) and Cieutat's association

index (1963). The mean association value (a) for the 16 Cieutat words was .70 and the meaningfulness value (M) for the 14 Noble words was 1.64. Response words were also chosen from the Cieutat and Noble lists and had mean values of .98 (10 words) and 7.37 (20 words), respectively. Each of the stimulus terms had at least one embedded word within it and the stimulus and response terms of each paired associate contained at least two common letters. These procedures ensured the availability of single and multiple letter cues and word formation strategies. The complete list of paired associates utilized in Experiment Ia is presented in Table 21.

The task was administered to the 41 Ss as a group. The experimenter first described the seven possible associative strategies by means of a sample pair. The different strategy categories were introduced as "tricks" and Ss were asked to tell which trick they would use if they had to learn which "new word" (the stimulus term) went with the "old word" (response term). Subjects were allotted 60 secs. to write down the trick they would use for each pair. The experimenter read each pair once.

All 41 children were retested one and two weeks later. On retest I, Ss were administered a new 30 item list (List B), and were again instructed to report how they would learn each pair. The new pairs were constructed with the same specifications as List A, so that they would be also amenable to the formation of all seven strategy categories. Nine of the stimulus terms were taken from Cieutat's list and had a mean association value (a) of .62. Six of the response words

Table 21. Chi-square analysis of the distribution of high, intermediate and low strategy levels on 60 pairs.

Pair	χ^2	p	Pair	χ^2	p
Meardon-Army	.06	(.98>p>.95)	Attar-Jelly	6.26	(.05>p>.02)
Carom-Income	.20	(.95>p>.90)	Cowwheat-Climber	6.32	(.05>p>.02)
Kupod-Kitchen	.26	(.90>p>.80)	Myxlas-Party	7.30	(.05>p>.02)
Capstan-Youngster	.31	(.90>p>.80)	Zumap-Zebra	8.91	(.02>p>.01)
Icon-Office	.45	(.80>p>.70)	Magent-Father	9.46	(p<.01)
Lucarne-Lady	.87	(.70>p>.50)	Goken-Keeper	11.09	(p<.01)
Cotane-Custom	.93	(.70>p>.50)	Gossin-Circus	11.20	(p<.01)
Rompin-Return	1.16	(.70>p>.50)	Avast-Advice	11.25	(p<.01)
Delpin-Insect	1.27	(.70>p>.50)	Diplex-Divide	13.62	(p<.01)
Cannel-Money	1.35	(.70>p>.50)	Unrary-Uncle	13.80	(p<.01)
Caratch-Captain	1.45	(.50>p>.30)	Markaz-Zero	14.10	(p<.01)
Tabret-Mallet	1.61	(.50>p>.30)	Earest-Brother	16.91	(p<.01)
Incarn-Dinner	2.14	(.50>p>.30)	Halbut-Farmer	17.10	(p<.01)
Endore-Empire	2.31	(.50>p>.30)	Trisac-Candy	18.99	(p<.01)
Perflate-Porpoise	2.40	(.50>p>.30)	Armer-Airship	19.68	(p<.01)
Welkin-Wagon	2.97	(.30>p>.20)	Babizz-Asleep	20.67	(p<.01)
Wellat-Jewel	3.07	(.30>p>.20)	Binest-Outside	21.59	(p<.01)
Jointress-Journal	3.45	(.20>p>.10)	Nimbus-Children	22.78	(p<.01)
Mugweed-Deerskin	3.56	(.20>p>.10)	Telman-Indian	26.33	(p<.01)
Golder-Quarter	3.72	(.20>p>.10)	Sogmud-Bottom	31.85	(p<.01)
Davit-Village	3.81	(.20>p>.10)	Olpret-Balloon	32.57	(p<.01)
Mugwam-Summer	3.82	(.20>p>.10)	Steelen-Silver	33.96	(p<.01)
Dragrope-Drumbeat	4.46	(.20>p>.10)	Cabbig-Cities	34.31	(p<.01)
Kaysen-Heaven	4.62	(.10>p>.05)	Botsand-Water	36.55	(p<.01)
Standage-Salute	4.92	(.10>p>.05)	Salick-Peanuts	38.98	(p<.01)
Nostaw-Nonsense	5.15	(.10>p>.05)	Herred-Flowers	39.83	(p<.01)
Fardel-Decoy	5.22	(.10>p>.05)	Rawtem-Chicken	40.56	(p<.01)
Santon-Lion	5.57	(.10>p>.05)	Gilsum-Morning	47.17	(p<.01)
Proton-Pencil	5.69	(.10>p>.05)	Notold-Story	66.46	(p<.01)
Landgrave-Leader	6.22	(.05>p>.02)	Enbit-Apple	68.18	(p<.01)

had a mean (a) value of .99. The remaining stimulus items were constructed specifically for the task and the other response items were chosen from second grade reading texts.

Retest session II, given two weeks after the original task, consisted of the readministration of List A. The instructions given to Ss and the procedure followed was identical to that of the preceding two sessions.

Results

The reliability of the strategy classification scheme was determined by having two judges independently rate the reported strategies of 20 randomly chosen Ss. A Spearman rank order correlation coefficient was computed for the separate total strategy scores obtained for each individual. The obtained coefficient of .97 indicated high agreement in the judges' ability to rank Ss according to strategy level. Of the 600 strategies judged, perfect agreement occurred on 517, or 86.2%. Most disagreement in judging specific strategies occurred in differentiating between superordinate and syntactical strategies.

The percentage of each strategy classification level reported for all three production sessions is presented in Figure 1. Inspection of the figure reveals a general increase in the level of strategies reported on the retest sessions. Analysis of the data by sign tests Siegel, (1956) suggest that Ss' strategy levels do in fact significantly increase on the retest sessions. Of 41 Ss, 34 increased their total strategy score from List A to List B ($p<.001$) and 27 increased their scores on the List A retest ($p=.03$). The increases are particularly

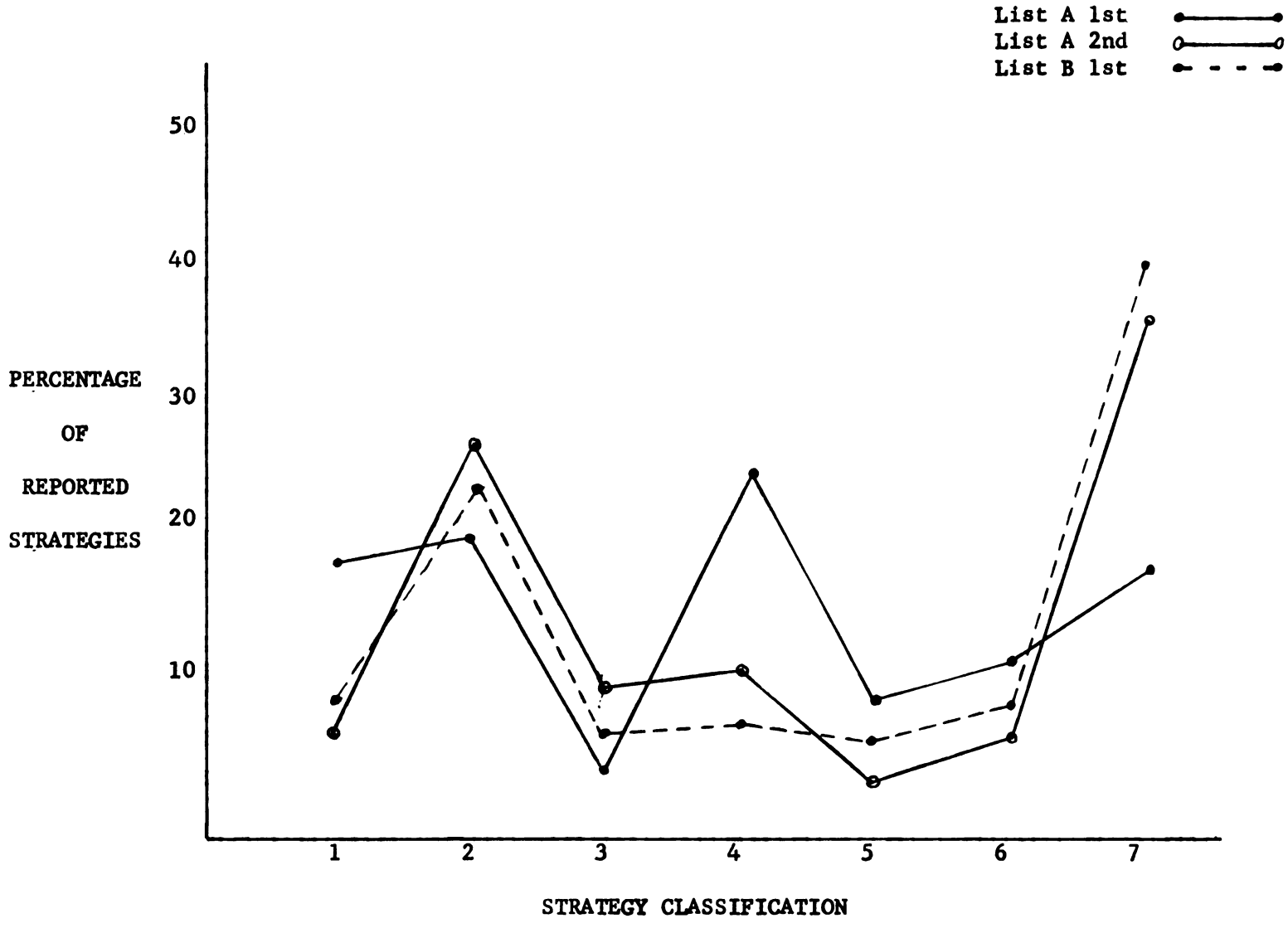

Figure 1. Percentages of each of the seven strategy classification levels reported for three testing sessions in Experiment Ia.

marked by the large proportion of syntactical strategies produced on List B (Retest I). There also appears to be a trend toward a decline in the number of level one strategies (no reported association) and an increase in repetition strategies (level two) with each strategy production session.

The consistency of Ss' reported strategy levels was analyzed by means of Spearman rank correlations. The rank correlation of Ss' strategy levels on List A and List B was .66 ($p<.01$). When Ss were retested on List A the resulting rank correlation was .73 ($p<.01$). These correlations indicate that Ss' overall rankings with respect to strategy level remain quite stable, although there is a significant tendency for total strategy scores to increase with repeated testing.

The strategy levels attained on List A pairs on the original testing session and the retest session were compared by means of rank correlation. The resulting coefficient was .40 ($p<.05$). There appears to be some indication that the pairs of List A generate strategies in a statistically reliable fashion.

APPENDIX B

Experiment Ib

Subject and List Differences in Strategy Production

Problem

Experiment Ib was undertaken in order to obtain reliability data on List B pairs and to determine whether comparable percentages of each strategy category would be reported with a new group of Ss. It had been noted that List B pairs produced a large percentage of syntactical strategies. One hypothesis explaining this fact is that Ss' strategy levels rise as repeated opportunities to produce associations are supplied. The increase in strategy level noted for Ss responding to List A serves as evidence for this view. An alternative hypothesis would be that List B is actually more amenable to the production of syntactical strategies than is List A.

Method

Thirty-one fifth grade children, enrolled in the same school as the previous Ss, were utilized in this experiment. The mean chronological age of the group was 11.1 and the mean IQ was 107.1. The materials utilized and the procedure followed were identical to that of Experiment Ia, with List B serving as the production list.

Results

The percentage of each strategy classification level reported for List B is presented in Figure 2. The frequency curve for each strategy level reported for List B in Experiment Ia is also included

in the figure.

The frequency curves appear quite comparable, with the percentage of syntactical strategies produced by Ss in Experiment Ia (43.3%) similar to the percentage produced by the new Ss (47.4%). This percentage of syntactical strategies is more than twice as high as that of Ss who responded to List A for the first time (17.2%) and is comparable to the percentages reported for Ss who had already practiced strategy production on another list. This evidence suggests that the rise in strategy level from List A to List B noted in Experiment Ia may be due to the amenability of the List B pairs to the production of syntactical strategies as well as to a practice effect.

The ranking of List B pairs on total strategy level remained highly stable from Experiment Ia to Experiment Ib. A rank correlation coefficient of .87 ($p<.01$) was obtained.

Discussion

The results of Experiment Ia and Ib seem to support the notion that individual Ss maintain their relative rank in the level of strategy production over time. The rank order correlation coefficients of .73 obtained between the first and second administration of List A and .66 between List A and List B substantiate the hypothesis that there is consistency in Ss' strategy productions. Moreover, independent judges appear to be highly reliable in ranking Ss on this dimension.

The pairs employed in both parts of Experiment I seem reasonably reliable as demonstrated by the rank correlations of .40 for List A and .87 for List B. It should be pointed out that List B produced a high

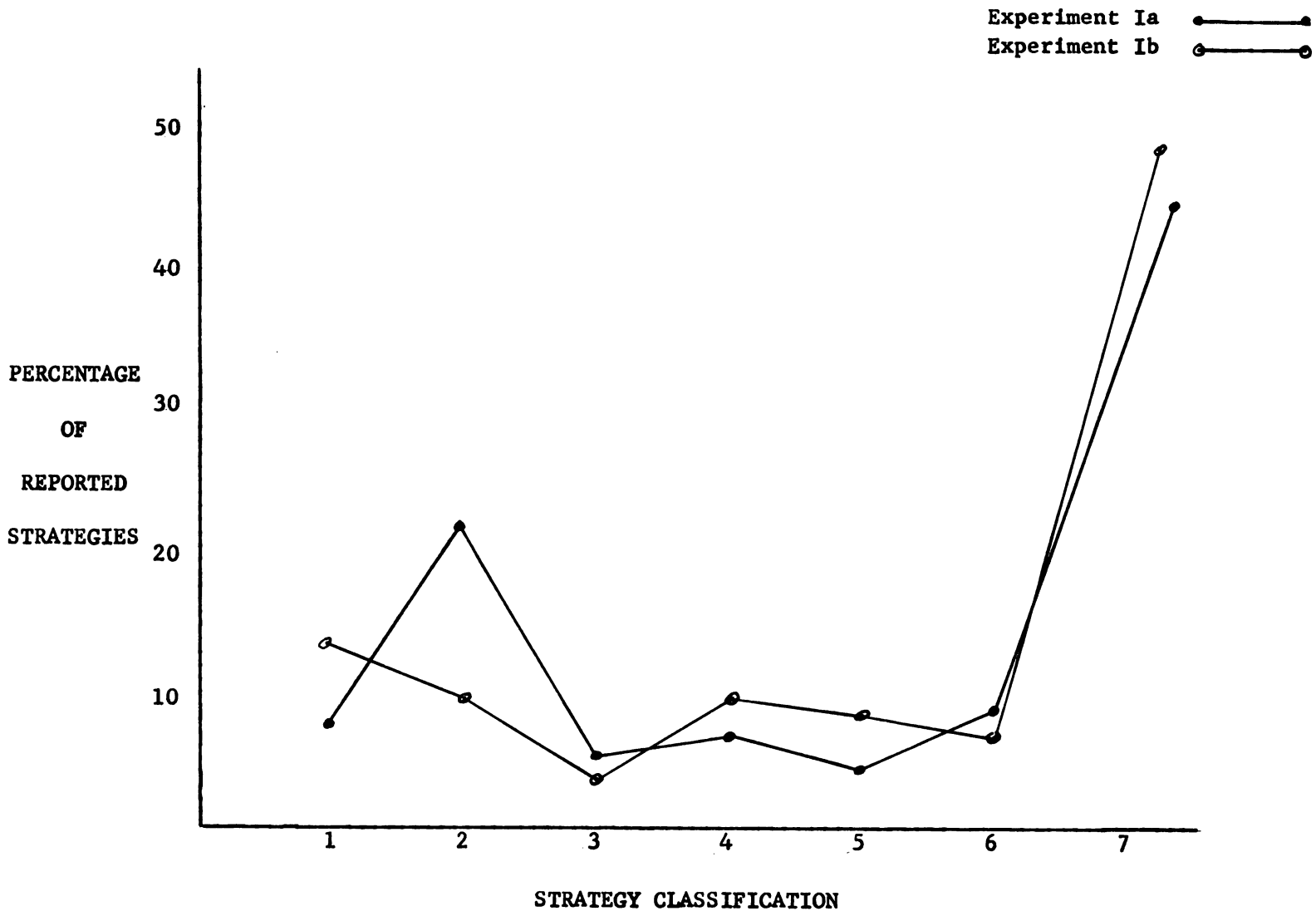

Figure 2. Percentages of each of the seven strategy classification levels reported for List B in Experiments Ia and Ib.

percentage of syntactical strategies which apparently contributed to the upward shift of Ss' strategy levels. Shifts in strategy level appear to be a function of the pairs themselves as well as the effect of practice in formulating mediating associations. It may be that the paired associates employed in a descriptive analysis of associative strategies should be so constructed that they elicit lower level strategies (no reported association and repetition strategies), intermediate level strategies (letter cues and word formation) and high level strategies (superordinate and syntactical) with equal probability. Evidently, reliable individual differences in strategy formation are more likely to emerge if paired associate materials are standardized on this kind of a criterion.

APPENDIX C

Construction of the Production List

The findings of Experiment I suggested that the pairs employed in a study of this nature should be analyzed in terms of how amenable each paired associate is to the various strategy classifications. For a pair to be considered adequate it should elicit low level strategies, strategies of intermediate complexity and more complex strategies with equal probability.

Analysis of each of the 60 pairs on Lists A and B was accomplished through use of the chi-square ($\underline{X}^2$) technique. The observed frequency of the three types of strategy level was compared to the frequency of each type expected by chance alone. An acceptable pair should show no statistically significant difference between the expected and the observed frequencies obtained. Table 21 lists the 60 pairs in order of the probability of the computed $\underline{X}^2$s occurring by chance. The data upon which Table 21 is based was obtained from the first administration of Lists A and B to the 41 Ss of Experiment Ia.

Table 21 reveals that the distribution of high, intermediate and low level strategies on twenty-nine of the pairs was not significantly different from what would be expected by chance ($p>.05$). Five more pairs were significantly different from chance at the .05 level. The remaining twenty-six pairs were significantly different from chance ($p<.01$). Twenty-one of these significant pairs were from List B. These 26 significant pairs were thus eliminated from further

analyses.

For a pair to be judged adequate for experimental purposes, it should meet one more criterion. If Ss are going to be characterized as high strategy producers and low strategy producers, the paired associates for which they produced associative strategies should reflect this differentiation. That is, high strategy Ss should produce high level strategies on a particular pair, and low strategy Ss should formulate low strategies on that same pair. The situation is comparable to item analysis of an achievement test. In such an analysis, specific items are judged on the basis of how well they discriminate among high and low scorers on the test. Most high scorers would be expected to answer the item correctly; low scorers would be expected to respond incorrectly.

In order to analyze the experimental paired associates in this manner, the 41 Ss were divided into a high and a low strategy level group, based on their total strategy level scores. The middle Sswas eliminated and 20 Ss thus composed each group. The strategy classification system was divided into high level and low level strategies (categories 5, 6 and 7; and categories 1, 2, 3 and 4, respectively). A 2 x 2 chi-square classification table was established for the top 34 pairs as ranked in Table 22. The $\underline{X}^2$ value and probability level for each pair is also presented in this table.

Table 22 reveals that all 34 pairs significantly discriminate between high and low strategy producers. One can assume from these two analyses that 29 of the pairs from List A and B not only differentiate between high and low strategy producers, but are capable of

Table 22. Chi-square analysis of the discriminating power of 34 paired associates.

Pair	χ^2	p	Pair	χ^2	p
Meardon-Army	6.94	<.01	Jointress-Journal	13.13	<.01
Carom-Income	3.96	<.05	Mugweed-Deerskin	10.12	<.01
Kupod-Kitchen	6.94	<.01	Golder-Quarter	6.73	<.01
Capstan-Youngster	9.11	<.01	Davit-Village	7.87	<.01
Icon-Office	5.55	<.02	Mugwam-Summer	8.07	<.01
Lucarne-Lady	13.73	<.01	Dragrope-Drumbeat	5.71	<.05
Cotane-Custom	24.65	<.01	Kaysen-Heaven	6.69	<.01
Rompin-Return	15.34	<.01	Standage-Salute	9.24	<.01
Delpin-Insect	5.21	<.05	Nostaw-Nonsense	4.52	<.05
Cannel-Money	5.55	<.02	Fardel-Decoy	23.43	<.01
Caratch-Captain	18.44	<.01	Santon-Lion	13.13	<.01
Tabret-Mallet	9.09	<.01	Protan-Pencil	4.02	<.05
Incarn-Dinner	3.89	<.05	Landgrove-Leader	6.73	<.01
Endore-Empire	7.87	<.01	Attar-Jelly	11.83	<.01
Perflate-Porpoise	13.13	<.01	Cowwheat-Climber	20.19	<.01
Welkin-Wagon	15.34	<.01	Myxlas-Party	4.14	<.01
Wellat-Jewel	6.85	<.01	Zumap-Zebra	9.24	<.01

eliciting low, intermediate and high level strategies with equal probability. Five of the pairs differentiate between high and low strategy producers, but elicit strategy distributions that are significantly different from chance. The first 29 pairs were considered to be the most adequate for use in a paired associate experiment investigating the formation of associative strategies.