THE KEYWORD MNEMONIC METHOD FOR TEACHING VOCABULARY: ITS USE BY LEARNING DISABLED CHILDREN WITH MEMORY DIFFICULTIES

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CHAPTER I

INTRODUCTION

Deficits in the learning disabled child's ability to retain, recognize, recall, associate, and sequence what he has experienced are often mentioned by parents, teachers, and writers in the field (Cruickshank, 1967; Cruickshank & Hallahan, 1975; Johnson & Myklebust, 1967; Lerner, 1976; Myklebust, 1971). Memory difficulties often have a pervasive impact on a child's life. In school, a child with memory difficulties is likely to have more trouble in such basic skills as learning to read, do arithmetic, and spell. He may also find it hard to retrieve what he has learned when he needs it and to even remember the teacher's instructions and assignments. The frustrations for the learning disabled child with memory difficulties are not limited to academic areas. They also influence remembering such aspects as activities, where he placed items, who people are, and even jokes to tell one's friends. Any deficit that severely impedes a child's functioning and progress in social, academic, and general living situations is likely to lead to great amounts of frustration. Frustration and failure frequently form a vicious cycle for many learning disabled youngsters (Cruickshank & Hallahan, 1975; Myklebust, 1971). The child finds he does not do as well at tasks as he and significant others in his life would like. At first he is likely to try harder. However, if his increased efforts do not bring improvement he may soon develop

strong feelings of frustration and become convinced that he is stupid or that something is wrong with him. When expected to perform, he is likely to become anxious and tense and thereby remember things even less well. The next step may be avoidance of the areas where he has a great deal of frustration, a lack of self-confidence, and an unwillingness to approach new unknown tasks.

It certainly seems important that every effort be made to precisely identify particular memory deficits that a learning disabled child has and to teach the child ways to try to compensate. This may help prevent or interrupt a frustration-failure cycle for the child and possible emotional overlays to the learning difficulty. In order to identify memory deficits precisely and to devise effective compensatory methods, thorough research in the area is clearly needed. This document will bring together and analyze the research that has been done on the memory abilities of the learning disabled child. Based on the trends that appear there, a technique for possibly helping learning disabled children compensate for their memory deficits will be devised and investigated.

Review of the Literature

The research that will be discussed covers three areas: memory abilities in learning disabled children, mnemonic strategies, and the keyword method--a particular mnemonic technique that has been developed for learning foreign language vocabulary.

Memory Abilities in Learning Disabled Children

This is a review of experimental studies concerned with the memory abilities of children diagnosed as learning disabled, dyslexic, or reading disabled. A framework of information processing views is utilized in describing and interpreting the various works. That is, the literature will be analyzed in terms of various aspects of mnemonic processing: a modality-specific sensory memory stage, attention as it has a role in the processing of information between the sensory registers and a short-term store, primary memory, and finally the characteristics and processes of secondary memory (long-term storage). Results from the literature will be analyzed in terms of what they suggest about the integrity or impairment in each of these stages, the transfer of information from one stage to the following one, and the registration and retrieval processes involved in each stage.

Sensory Memory

Sensory memory refers to the holding in memory of relatively "raw" copies of the impinging patterns for a brief time after the stimulus is turned off. The two main forms of sensory memory that have been investigated with normal adults are visual sensory memory (iconic) and audito auditory sensory memory (echoic). A primary characteristic of such sensory traces is their very rapid forgetting rate--from one-third second to one second, for iconic storage (Haber, 1970), and about two seconds for echoic memory (Crowder & Morton, 1969).

Research suggests that iconic memory persists at least equally long for both retarded readers and normal readers (Morrison, Giordiani &

Nagy, 1977). Two studies indicate that it may last longer for the poor readers (Stanley, 1975; Stanley & Hall, 1973). This implies that difficulties may occur not in iconic memory but in getting information out of iconic and into primary memory.

For information in sensory memory to be retained, it must be rapidly processed. One method of studying the processing of what is contained in auditory sensory memory is Broadbent's (1958) dichotic listening task. This involves the simultaneous presentation of two short series of digits, letters or words, one series to each ear. Subjects are then to recall this information. The researcher suggests that reading disabled children perform less well than normal children, on both a dichotic listening task and an audiovisual analogue of such a task (McKeever & Van Deventer, 1975; Senf, 1969; Senf & Feshback, 1970; Senf & Frendl, 1971).

The reading disabled subjects performed particularly poorly when they were instructed to recall the items by pairs, rather than modalities (Senf, 1969; Senf & Feshback, 1970). Several studies have tried to determine what factors may account for the poorer performance by the reading disabled subjects. After comparing the difficulty with pair recall for a long inter-pair input interval and a short interval, Senf (1969) concluded that the deficit could not be explained in terms of insufficient time to switch attention from one stimulus modality to another. In Senf and Frendl's (1971) study, the stimuli were alternated to see if sensory masking created by the simultaneous occurrence of the auditory and visual stimuli disrupted modality recall performance. Alternating the stimuli had negligible effects. The studies suggest that some higher-order processes, possibly of memory organization, seem

to be involved. Davis and Bray (1975) suggest, however, that the deficit may be due to output interference rather than memory factors. When they used a probe recall procedure, the normal and retarded readers did not differ in either modality or pair recall.

There is some evidence that the modality and pair recall proficiency of retarded readers, as compared to their normal peers, varies with age. Senf (1969) and Senf and Frendl (1971) found that elementary-age normal readers and poor readers differed on modality but not on pair recall. Older poor readers (in junior high and early high school) differed on pair recall but not on modality recall (Senf, 1969; Senf & Feshback, 1970). In comparing younger and older groups of normal and poor readers, it seems that normal children's ability to recall in pairs increases with age while poor readers' ability either increases more slowly or not at all (Senf & Feshback, 1970).

In terms of differences in auditory or visual input, Senf (1969) found that poor readers prefer recalling items presented in the auditory modality, while normal readers showed no modality preferences. In addition, poor readers, as well as normal readers, utilized redundancies in information in terms of color-object pairs to improve their recall performance.

Primary Memory

The information to which we are currently attending or to which we have very recently attended is said to constitute primary memory. Such activated information is readily accessible. However, there are severe limitations on the amount of information that can be activated at any one time.

Access. Little research has been done with a learning disabled population concerning speed of access to information in primary memory. The one study found that dyslexics were slower than control subjects in reporting a tachistoscopically presented letter; this effect was even larger when a greater memory load and serial constraints were incorporated (McKeever & Van Deventer, 1975).

Storage Limitations. Most of the primary memory studies in learning disabled children are concerned with storage limitations. The studies using a free recall procedure have generally found that learning disabled subjects recall fewer items than control subjects (Bryan, 1972; Engorova, 1972; Marshall, Anderson & Tate, 1976). Numerous serial recall tasks have been used in assessing the primary memory limits of this population. A number of studies have involved either an auditory or visual presentation of a digit span task (Corkin, 1974; Mason, 1975; Senf & Frendl, 1972; Spring, 1976; Stanley, Kaplan & Poole, 1975). Other serial recall experiments have utilized geometric shapes (Stanley, Kaplan & Poole, 1975); durational and patterns of rhythmic tones, phonemes, and words (Richie & Aten, 1976); taps on blocks (Corkin, 1974), pictures (Torgensen & Goldman, 1977); strings of consonants (Mason, 1975); and semantically and syntactically varied sentences (Wiig & Roach, 1975). The learning disabled groups performed less well than the normal groups on these tasks, except memory for a series of words. Several experiments employing either probed recall or probed recognition tasks with letters, geometric forms, abstract forms, or digits have found that the learning disabled subjects recall significantly fewer items than their normal controls (Morrison, Giordani & Nagy, 1971; Spring & Capps, 1974).

Nature of the Information in Primary Memory. It is important to know what kind of information individuals maintain in primary memory and the extent to which they can manipulate that information. Two studies suggest that retarded readers fail to maintain information concerning critical differences between stimuli (Cummings & Few, 1976; Goyen & Lyle, 1973). One important study examining dyslexic children's ability to manipulate spatial information in memory, found that dyslexic and normal children did equally well at the task (Stanley, Kaplan & Poole, 1975).

Generally, the researcher agrees that learning disabled children's primary memory difficulties include processing nonverbal, as well as verbal, information and stimuli presented either visually or in an auditory mode. Differences in primary memory abilities between learning disabled and normal children are readily apparent with verbal symbolic materials, but have not been found in the manipulation of spatial information.

Secondary Memory

Various forms of processing aid in maintaining information in primary memory or in transferring it to a more long-lasting form of storage. Two different general types of processes are involved in getting information from primary to secondary memory: (a) those that maintain information in primary memory (this allows the person time to use the second process) and (b) those that transform information so that it can be maintained over a period of time and retrieved easily when it is needed. The research involving serial position curves will be reviewed to determine if there are difficulties in one or both of those

types of processes. The results on specific control processes then will be reviewed.

Serial Position Curves. Research concerning normal children and learning disabled children suggests: normal children show a primacy effect, learning disabled children show less of a primacy effect, and both groups show recency effects (Bauer, 1977; Marshall, Anderson & Tate, 1976; Spring & Capps, 1974; Traver, Hallahan, Kauffman & Ball, 1976; Weber, 1975).

Several conclusions can be drawn from the serial position curve results. The fact that learning disabled subjects show less of a primacy effect than normal subjects on both immediate and delayed recall implies that the learning disabled youngsters are quite inefficient at utilizing the critical control processes involved in the transfer of information in primary memory to a more permanent form of storage. Two of those control processes are scanning and rehearsal.

The cognitive processes involved in the creation of recency effects do not seem to be strongly impaired since learning disabled children do show recency effects similar to those found with normal children. The processes involved in recency effects include the areas of: (a) attention, (b) retrieval, and (c) maintaining information in primary memory.

Control Processes. Control processes are the rules and strategies a person selects, constructs, and uses in processing information. Craik and Watkins (1973) have divided control processes into two general types: maintenance rehearsal and elaborative operations. Maintenance rehearsal is repeating the information to one's self. The form or organization of material is not changed. Elaborative operations

generally involve working with the material in some way. In doing so, the organization of the new information may be changed and associations between the new material and what the person already knows may be made. The research suggests that learning disabled children do not tend to spontaneously employ maintenance rehearsal (Bauer, 1977; Conaway, 1976; Spring & Capps, 1974; Torgenson & Goldman, 1977). Several studies have found that instructing learning disabled children to rehearse improved their performance on memory tasks (Bauer, 1977; Torgenson, 1977; Torgenson & Goldman, 1977; Traver et al., 1976). However, other studies have been done where maintenance rehearsal instructions have not improved significantly the performance of the learning disabled children on the experimental task. Two of these studies can be explained in terms of tasks requiring the use of secondary memory. For those studies maintenance rehearsal was not particularly appropriate (Weber, 1978; Bryan, 1972).

The elaborative operations that will be examined are: chunking, categorizing, and elaborative rehearsal. Chunking changes the nature of the information by the subject actively engaging in a process of grouping the items. Instructions to chunk the information have been found to increase the recall of learning disabled children (Traver et al., 1976; Weber, 1975).

Several studies have looked at the extent to which learning disabled subjects group items. There is mixed evidence in the area. Egorova (1975) found that the learning disabled children grouped a much smaller percentage of the remembered items than the control subjects. Parker, Freston, and Drew (1975) found that the learning disabled subjects failed to use implicit retrieval cues to aid in grouping items.

On the other hand, Ring (1976) found that learning disabled children do use organizational input, and Dummaresq (1976) found that they utilize implicit retrieval cues. Torgenson (1976) found that reading-disabled children with memory difficulties will cluster items during the recall process but not during the study period. He also found that poor readers make significantly less use of verbal labels for encoding purposes than do good readers.

One form of elaborative rehearsal that has been found quite helpful for normal adults is mnemonic strategies (Norman, 1976). Although several authors (Lerner, 1971; Ross, 1976; Shoemaker, 1971) suggest that mnemonic techniques be used with learning disabled children few studies seem to have been done in this area. Taylor (1978) compared a group of learning disabled boys that had been instructed to use a mnemonic technique for learning foreign language vocabulary (the keyword method) with a control group of learning disabled boys who did not know the method. She found that use of the mnemonic method made a significant difference ($p < .0001$) in the proportions of lists of meanings of Spanish vocabulary words that were recalled.

Mnemonics to Aid Memory

Over the centuries, humans concerned with the art of memory have devised a number of special techniques, mnemonic devices, for remembering material. In the past, psychologists have largely ignored these techniques, considering them mere tricks and sophistry. However, when one looks further, it is found that the techniques do aid memory and involve some basic principles of learning.

Several investigators have demonstrated that mnemonic processes and strategies facilitate memory (Delin, 1968; Luria, 1968; Senter & Hauser, 1968; Smith & Noble, 1965, Wood, 1967). Neisser (in Sheehan, 1972) has noted that particularly those mnemonic strategies that include the use of mental imagery seem to have very striking results. The two mnemonic-imagery strategies that psychologists appear to have studied the most are called the method of loci and the pegword system. The method of logi involves forming an image for the first item of an ordered list. The image is then imagined in the first distinctive location of a familiar room of a house or building. The image for the second item is placed in the second distinctive location of the room, etc. To recall the items in their correct order, one takes a mental walk through the room and "sees" each image in the successive locations. Dramatic results have been obtained from experiments comparing a control group using their normal means of learning a list of items versus subjects using the method of loci. Experimental subjects remembered two to seven times as much as control subjects (Bower, 1970). Experimenters verifying the effectiveness of the method of loci include Ross and Lawrence (1968) and Crovitz and his collaborators (Briggs, Hankins & Crovitz, 1970; Crovitz, 1964). In the pegword mnemonic technique, the words to be remembered are paired serially with a rhyming mediator (e.g., "one is a bun, two is a shoe, three is a tree"). Recall seems to be helped by the number evoking the mnemonic mediator which then elicits the word to be remembered (Bugelski, 1968; Bugelski, Kidd & Segmen, 1968). Paivio (1968) has shown that imagery is necessary for this mnemonic system. By itself, the mnemonic rhyme is insufficient to mediate retrieval.

What is it concerning mnemonic systems that improves one's ability to remember? After examining psychological research findings concerning memory as they relate to mnemonic systems, Norman (1969) concluded that the power of these systems appears to be the result of a very simple principle:

> they reduce long, unrelated strings of material into short, related lists. Mnemonic systems provide us with the rules and techniques for shortening the sequence that is to be learned and finding meaning, even where there appears to be none (p. 121).

They all have the user pay careful attention to the material, organize the items, and relate what is to be learned to things the individual already knows. If the new material cannot be easily related to known facts through visualizations and associations, the new information "must be transformed by the use of key words or analytic substitutions until images can be used" (Norman, 1969, p. 118).

The importance of these processes can be understood in terms of known properties of human memory. The emphasis on the structuring of stored material relates to the retrieval problems with a large capacity system. Slowly, psychologists have begun to realize that subjects in their experiments frequently group the items they are to learn. Bousfield (1975), Bousfield and Cohen (1955), and Bousfield and Sedgewick (1944) noted clustering when subjects recalled words. Tulving (1962, 1964) found that subjects organize the words they are to learn and recall them according to the same organization. After reviewing such studies, Norman (1969) concluded that it is not easy for humans to learn material unless it has structure. If structuring is not present, humans impose it. Moreover, the limitations of primary memory determine

the possible type of organization in secondary memory. This can be seen in the use of a limited number of small units (Miller, 1956).

Norman (1976) has formed four basic rules for efficient memorizing, based on what is known about human memory. The rules are:

1. Small basic units. The material to be learned must be divisible into small, self-contained sections, with no more than four or five individual items in any section.

2. Internal organization. The sections must be organized so that the various parts fit together in a logical, self-ordering structure.

3. External organization. Some relationship must be established between the material to be learned and material already learned.

4. Depth of processing. Any mental activity performed on the material, such as forming images or putting it into mental settings or stories, increases the depth of processing, thereby automatically helping to form the relevant connections that improve retrievability (pp. 154-155).

Mnemonic strategies clearly provide systematic techniques for working with material in a way that follows these rules.

Although several authors (Lerner, 1971; Pittman, 1977; Ross, 1976; Shoemaker, 1971) have suggested that mnemonic techniques be used with learning disabled children, little research has been done in this area (Taylor, 1978). However, a variety of research has shown mnemonic techniques to be helpful for other specialized populations. Mediational strategies, often clearly capitalizing on the use of imagery, have been effective with educable mentally retarded children (Burger & Blackman, 1976; Taylor, Josenberg & Knowlton, 1972; Wanschura & Borkowski, 1974; Yarmey & Brown, 1972) and retarded adults (Lebrato & Ellis, 1974; Zupnick & Meyer, 1975). Another study demonstrated that imagery instructions served to improve the memory of blind adults (Jonides, Kahn & Rozin, 1975). Finally, Pattern (1972) found that the pegword system

significantly helped four of seven patients with brain function impairment.

The Mnemonic Keyword Method

In conducting foreign language vocabulary learning experiments, Atkinson (1975) has been struck by the great variability in learning rate across subjects. He indicated that this may reflect differences in fundamental abilities, but

> it is easy to demonstrate that they also depend on the strategies that subjects bring to bear on the task. Good learners can introspect with ease about a 'bag of tricks' for learning vocabular items, whereas poor learners are incredibly inept when trying to describe what they are doing (p. 821).

As a result of these observations, Atkinson and Raugh have been developing and experimenting with the keyword method, a mnemonic procedure for learning foreign language vocabulary. Their studies have shown the method to be remarkably effective both with Spanish and Russian words, and both in the psychological laboratory and as a supplement to a college foreign language curriculum (Atkinson, 1975; Atkinson & Raugh, 1975; Raugh & Atkinson, 1975; Raugh, Schupbach & Atkinson, 1977). In presenting this method, the following areas will be covered: (a) a description covering how the method works and the criteria for the selection of the "keywords" used, (b) a presentation of the results of the psychological studies concerning its use, and (c) a discussion of the best ways to use the keyword method and why these conditions have been selected.

Description of the Method

The keyword method is a mnemonic procedure for associating a spoken foreign word and its English translation. The keyword method involves

forming two links: an acoustic link between the foreign word and a keyword (an English word sounding like part or all of the foreign word) and an imagery link (a mental picture combining the keyword and the English meaning). For example, the sound-alike keyword for lagartija (Spanish for lizard) is "log" and the image could be "a lizard on a log." When the person later sees "lagartija," he or she then generates the sound-alike "log," followed by the connecting image of what was on the log, namely the "lizard."

The procedure generally used is to present a series of foreign words to the subject by simultaneously pronouncing the foreign word and displaying its keyword and English translation. While each item is presented, the subject has to both (a) associate the sound of the foreign word with the keyword given and (b) generate a mental image that involves the interaction of the keyword and the English translation.

Results of Research on the Keyword Method

Atkinson and Rough have done a number of studies on the effectiveness of the keyword method. One experiment involved 120 Spanish vocabulary items including some that were judged to be difficult to image. The test vocabulary was divided into three comparable subvocabularies which were presented by computer on three consecutive days. A test covering all the items was given two days after the presentation of the last subvocabulary. A similar test was given one month later. For the keyword and control conditions, respectively, the results were 54 percent and 45 percent correct ($p < .001$). With the delayed comprehensive test, the results were 43 percent and 35 percent correct, respectively ($p < .01$) (Rough & Atkinson, 1975).

In another experiment all the subjects were first taught the keyword for each item in a 60-word Spanish vocabulary. The subjects were then divided into an experimental and control group. The experimental group was instructed to use imagery to associate each keyword with the English translation. The control group used a rehearsal method to associate each Spanish word directly to its English translation. With this test of the effectiveness of mental imagery, 88 percent and 28 percent of the words were recalled correctly by the experimental and control groups, respectively (Raugh & Atkinson, 1975). The difference in the percentage learned by the control groups in this and the study described in the preceding paragraph (28 percent vs. 45 percent) may be due to the difference in list length (60 vs. 40 words-pairs). The discrepancy in the percentage learned by the experimental groups in this study and the previous one (88 percent vs. 54 percent) is possibly due to the fact that the subjects had already learned the acoustic (keyword link) and just had to learn the imagery link in this study. For the previous experiment, the experimental group formed both links at once.

In a third study subjects were in one of three conditions. One group used the keyword method. A free-choice group could use whatever learning strategy they preferred, which included requesting a keyword when desired. The control group used a rehearsal method to learn the 120 items. The percentages of correct responses on a comprehension test were 59 percent, 57 percent, and 50 percent correct for the free-choice, keyword, and control conditions respectively ($p < .005$) (Raugh & Atkinson, 1975).

Next, the effectiveness of the keyword method was tested on a non-Romance language, Russian. Russian posed a special challenge since it

involves a number of frequently recurring phonemes that do not occur in English. A subvocabulary was presented by means of a computer on three consecutive days. On the fourth day a comprehensive test of the 120 item items was given. The percentages of correct items on this test were 72 percent and 46 percent correct for the experimental and control groups respectively ($p < .001$). When subjects were called back without warning six weeks later for a second comprehensive test, the keyword group recalled 43 percent of the words and the control group recalled 28 percent of the items. The average performance when an English phrase served as the keyword was the recall of .74 of the items for the keyword condition and .44 for the control condition on the comprehension test. The corresponding averages for items with the keyword consisting of only one English word were .71 and .45 respectively. Therefore, the possibilities were essentially equal for learning the keywrod-phrase items as the single-keyword items (Atkinson, 1975; Atkinson & Rough, 1975).

Raugh, Schupbach, and Atkinson (1977) evaluated the keyword method for teaching a large Russian vocabulary (675 words) over 8 to 10 weeks. A computer controlled keyword curriculum was a supplement to a second-year Russian language course at Stanford University. They found that the students frequently chose to use the keyword method and that it seemed quite effective.

Two studies have been conducted that involved the use of the keyword method by children. Pressley (1977) found that second- and fifth-grade children that were (a) instructed in keyword method use and (b) provided with interaction pictures for each vocabulary item remembered more English meanings for Spanish vocabulary than control subjects not instructed to use the keyword method. In one study-recall test trial

on a list of 12 Spanish words, the second-grade students using the keyword method recalled a mean of 8.22 (SD = 2.12) words while the control group recalled a mean of 2.84 (SD = 2.01) words. In one study-recall test trial over a list of 18 Spanish words, fifth-grade students using the keyword method recalled a mean of 11.52 (SD = 2.52) words while control subjects recalled a mean of 6.29 (SD = 2.86) words. Learning the acoustic links without instruction in the keyword method did not significantly improve the students' recall of the English meanings.

Taylor (1978) examined the effectiveness of the keyword method in helping learning disabled boys (mean age = 13.73, SD = 1.38) learn the English meanings for Spanish vocabulary items. The mean score on the Wechsler Intelligence Scale for Children--Revised was 93.20 (SD = 6.42). During two study-recall test trials boys using the keyword method recalled 85 percent of the English meanings while the control group recalled 16 percent of the meanings. In the tests for the mnemonic group they were shown both the Spanish words and their keywords. After the study-test trials the subjects were involved in short cognitive tasks for a five-minute period. They were then given another recall test in which only the Spanish word was presented. The boys that had been instructed in the keyword method still recalled 85 percent of the English meanings while the control group recalled 19 percent.

Utilization of the Keyword Method

Several procedural considerations and possible criticisms of the keyword method merit consideration. Based on their experience, Raugh and Atkinson (1975) have outlined four procedures that seem to facilitate learning foreign vocabulary when the keyword method is used. First, they

suggest that the experimenters provide the keywords rather than having the subject generate his own. This is especially important if the subjects are unfamiliar with the phonetics of the foreign language. Second, it is better to have the subject create his own imagery link rather than having the experimenter suggest one. This suggestion corresponds with Bower's (1973) observation that natural language mediators that are generated by the subject, rather than the experimenter, are more effective in the learning of paired associates. Third, the keyword selected needs to approximate enough of the sound of the foreign word to distinguish it from other words in the list. It is not necessary to approximate the full sound of the foreign word. Fourth, pilot work concerning the recall of a foreign word when given its English translation suggests that this type of recall is easier if the keyword approximates the first syllable of the foreign word.

In conclusion, the use of the keyword (as enabling an imagery link process) can be conceptualized as a temporary crutch utilized in the initial learning of a foreign vocabulary word-English translation pair. Based on his research using the keyword method with Russian vocabulary, Atkinson (1975) indicates that the early learning process consists of forming two independent links, one acoustic and the other imaginal. With continued practice a third link is formed that directly associates the foreign word and its English translation. At this point, the subject will only use the keyword under special circumstances, such as when he is consciously trying to do so or when he fails to retrieve the information by the third link process. The acoustic and imagery links are valuable in serving as a crutch in the subject's learning of the direct association. This view is supported by Atkinson's (1975) research which

found that once an item was thoroughly mastered, retrieval times did not differ for subjects that learned it by the keyword method or by rote rehearsal.

When subjects in a keyword group and a rote rehearsal group studied items to the same criterion level, it was found that learning by use of the crutch not only facilitates forward associations but also backward associations. On retrieval of a Spanish word given its English translation, Atkinson (1975) found that the keyword group had a score 19 percent above that of the rote-rehearsal subjects. This is despite the fact that the keyword group had fewer learning trials on the forward association than the rote-rehearsal group since the keyword group was faster at reaching the criterion.

From observation in a study entitled "The Effects of Interactive-Image Elaboration on the Acquisition of Foreign Language Vocabulary" (Ott, Butler, Blake & Ball, 1973), there is some evidence to suggest that students use mediating strategies similar to the keyword method as a crutch when learning foreign vocabulary, even if not instructed to do so. They report that subjects not given special instructions often employ English mediating words combined with imagery or other mnemonic aids. These observations suggest that the keyword method is not essentially different from techniques frequently used by subjects. The primary differences are (a) the systematic extent to which the method is applied and (b) that the experimenter supplies a carefully selected keyword.

Rationale for the Present Study

From the research that has been done, learning disabled children

clearly have memory difficulties. Compared to normal children, learning disabled youngsters show some small decrement in their abilities to process information at the sensory memory level and to transfer the information into primary memory. However, the substantially larger drop in performance occurs on tasks that require transferring information to and retrieving information from long-term storage.

Use of the Keyword Method by Learning Disabled Boys

Mnemonic techniques, such as they keyword method, have been shown to help normal adults remember materials for a period of time, and to allow easy retrieval of the information when it is needed. Furthermore, the keyword method has been shown to be quite effective in helping learning disabled boys learn Spanish vocabulary words and their English meanings (Taylor, 1978). This study will investigate whether the keyword method will also aid disabled boys in teaching them English vocabulary words with which they are not familiar. The hypotheses concerning the keyword method are:

H_1: Learning disabled boys who have been taught the keyword method will recall a significantly greater proportion of the meanings of a list of vocabulary words than control subjects. The control subjects are learning disabled boys who have not been taught the keyword method.

H_2: Learning disabled boys using the keyword method are expected to recall a significantly greater proportion of the meanings than the control subjects when the test followed by a short post-study delay period (five minutes long) during which the subjects did several quick cognitive tasks.

H_3: The learning disabled boys that used the keyword method and the control subjects are expected to recall essentially the same proportion of the meanings when they are tested a week after they participated in two study-test trials on a list of vocabulary items.

H_4: After two study-test trials on a list of vocabulary items, a week interval, and two more test-study trials on that list, the subjects that used the keyword method are expected to recall a significantly greater proportion of the meanings than the control group subjects.

H_5: When both groups learned a list of vocabulary words while using the keyword method, the number of meanings recalled by the groups is expected to be essentially the same.

Basic Process Measures Selected

A common trend in the literature of mnemonics is to demonstrate rather than to analyze (see critique by Higbee, 1977). Too often psychologists are so enthusiastic about memory enhancements produced by various mnemonic methods, that they tend to try out one method after another without really understanding the underlying basis of why a given method works and why it may be more helpful for some individuals than for others. To better understand the processes underlying the effectiveness of the keyword method, certain basic processes in the subjects were measured and related to their functioning on other tasks.

Seven basic process measures, and three additional process scores derived from them, were selected. The processes selected and their importance will now be described. Consider Table I. The first three tasks deal with speech representation; they would seem to have face validity because most mnemonic techniques involve at least some verbal coding and elaboration. Speak Aloud and Speak Silently are important since the rate of encoding verbal information for auditory memory should determine how much information enters primary memory and how much decays from a sensory store before it is verbally encoded. Previous studies have examined such speaking rates (Landauer, 1962; Weber & Bach, 1969; Weber & Castleman, 1970). However, there does not seem to be any

TABLE I

THE BASIC PROCESS TASKS

Task	Explanation
(1) Speak Aloud	When the experimenter said "start," the subject said the alphabet as quickly as possible. The subject finished by saying "stop." Subject says: "a, b, c, . . . x, y, z, stop" Dependent Variable: the number of seconds between the time when "start" and "stop" are said
(2) Speak Silently	When the experimenter said "start," the subject moved his mouth as if to say the letters of the alphabet but did not say them out loud. The subject finished by saying "stop" out loud. The mouthing response is as rapid as completely covert speech, yet allows a more objective indicator of processing. Subject says: "(a), (b), (c), . . . (x), (y), (z), stop" when the letters in parentheses indicate that they are mouthed Dependent Variable: the number of seconds between the time when "start" and "stop" are said
(3) Alternate Aloud/Silent	When the experimenter said "start," the subject went through the alphabet alternating between saying a letter and mouthing the next. The subject finished by saying "stop" out loud. Subject says: "a, (b), c, (d), e, (f), . . . (x), y, (z), stop" Dependent Variable: the number of seconds between the time when "start" and "stop" are said
(4) Percept	The subject was given a card with the alphabet typed in lower case letters on it. When the experimenter said "start," the subject went through the alphabet (while looking at the card) and said "yes" for each letter that was tall (took more than half a typed space) and "no" for each letter that fit in half of a typed space.

TABLE I (Continued)

Tasks	Explanation
(4) Percept (Continued)	Subject sees: a, b, c, d, . . . x, y, z Subject says: "no, yes, no, yes, . . . no, yes, no" Dependent Variables: the number of seconds between the time when the experimenter said "start" and when the subject finished classifying the letters the number of mistakes and omissions made by the subject
(5) Translate	The subject was given a card with the alphabet typed in capital letters on it. When the experimenter said "start," the subject went through the alphabet and classified the small letters as tall or not. The subject could look at the card to remind him of the letters. He was to say "yes" for tall letters and "no" for letters that were not tall. Subject sees: a, b, c, d, . . . x, y, z Subject says" "no, yes, no, yes, . . . no, yes, no" Dependent Variables: the number of seconds between the time when the experimenter said "start" and when the subject finished classifying the letters the number of mistakes and omissions made by the subject
(6) Image	The subject was told to imagine the small letters of the alphabet and classify them as tall, saying "yes," or not tall, saying "no." The subject does not have a card with the letters on it to look at. Subject says: "no, yes, no, yes, no, . . . no, yes, no" Dependent Variables: the number of seconds between the time when the experimenter said "start" and when the subject finished classifying the letters

TABLE I (Continued)

Tasks	Explanation
(6) Image (Continued)	the number of mistakes and omissions made by the subject
(7) Span	The subject was told that after the experimenter read a list of letters, the subject was to write down as many as he remembered in any order. The experimenter read a list of 12 consonants at the rate of one every two seconds. Dependent Variable: the number of consonants from the list written down by the subject

literature available correlating speech rates and memory performance. The third task, Alternate Aloud/Silent is concerned with the time it takes to alternate between speaking and speaking silently. Much of information processing seems to alternate between speaking aloud and thinking silently about what will be said next. Switching between overt and covert modes takes a surprisingly long time. Typical alternation times as revealed in pilot work are about four to six times longer than the amount of time it takes to say the same string of characters either exclusively aloud or exclusively silently. The individual differences for Alternate are quite large and may well implicate the working of memory control structures. (It should be known that, for reasons of objectivity, the Speak Silently condition will actually involve inaudible mouth and lip movement; this procedure yields results comparable to a completely silent, lips closed condition, with the exception that it is less variable in result.)

The fourth, fifth, and sixth tasks deal with visual representation of information; they would also seem to have face validity in that most mnemonic techniques require visual image coding. In Percept Representation (Weber & McManman, 1977) the rate at which subjects can extract visual form information from perceptually available visual letter strings is examined. In Translate (Weber & McManman, 1977) recoding translation time in going from a perceptual to a visual image representation is examined. Letter strings are presented graphically in upper case format, and subjects must translate these to a lower case image representation and respond on the basis of the properties of the imagined lower case letters. Since the mnemonic scheme to be studied makes extensive use of imagery and the translation from verbal to image format, this task seems appropriate. In Image Representation images of letters are generated without any supporting perceptual string. The subject is to imagine the successive lower case alphabetic letters as rapidly as possible and classify each letter for height. The final task, Span, is simply a memory span test for consonant letters. For completeness it is desirable to determine the correlation between a span measure and paired associate measures as used in the separate experiments. Preliminary evidence relating span to paired associate learning, however, tends to indicate little or no relation.

In addition to the above measures, it is potentially useful to examine various derived subtractive measures such as Switch, Change, and Imagine, as defined in Table II. These are generally self-explanatory; they involve "stripping off" the times for more peripheral components (perceptual and responding) to obtain a purer or less contaminated time measure for central processes. The logic and legitimacy of the

subtractive method is summarized in the work of Chase (1978) and R. Sternberg (1977).

TABLE II

SUBTRACTIVE MEASURES DERIVED FROM THE BASIC PROCESS TASKS

Measure	Definition
(1) Switch:	Switch = Alternate - (Speak Aloud + Speak Silently)/2
(2) Change:	Change = Translate - Percept
(3) Imagine:	Imagine = Image - Percept

Individual Differences in the Rate of Learning Paired Associates

A major emphasis is to not only demonstrate the efficacy of mnemonic methods to learning disabled children but also to gain a better understanding of individual differences in rate of learning paired associates, with or without the keyword method. To this end a number of exploratory regression analyses were employed to assess the "strength" of relationships among three sets of variables: (a) demographic variables such as age, scores on an intelligence test, and scores on an achievement test; (b) performance measures on various basic process tasks; and (c) measures on the various phases for learning the pairs of vocabulary items and their meanings. Figure 1 shows the general nature of the regression analyses involved.

Class

(1) Rote = f[Psychometric ability, Basic process performance]

(2) Mnemonic Memory Performance = g[Psychometric ability, Basic process performance, Rote memory]

(3) Psychometric Performance = h[Rote memory, Mnemonic memory, Basic process performance]

Each dependent variable is considered to be functionally related to other measurable variables.

Figure 1. Classes of Regression Equations

The regression analyses were done in an attempt to answer the important question of "How does mnemonic memory performance relate to other tasks?" Two hypotheses are possible answers to this question. The Memory Independence Hypothesis would state that mnemonic memory performance is relatively independent of performance on psychometric tasks, basic process tasks, and rote memory tasks. This is a somewhat unlikely result, but it is possible. An alternative, the Memory Dependence Hypothesis, is that mnemonic memory performance is linked or strongly related to some of the other task categories. Knowing the linkage among the different task categories is of obvious theoretical importance; if the linkage is substantial, we can then isolate components that contribute to aggregate memory performance. To the extent that basic process tasks are related to mnemonic memory (or psychometric performance), it may be possible to provide direct experience and training in basic process tasks to facilitate memory and psychometric performance.

Sentence Recall Measure

In order to get a measure of the subject's recall of linguistic material, five sentences were chosen from the Detroit Tests of Learning Aptitude. The sentences were chosen from the subtest titled Auditory Attention Span for Related Syllables. They were scored according to the procedure for that test. The sentences used in this study and the scoring procedure are presented in Appendix E.

Anxiety After Relative Failure or Success on a Vocabulary Learning Task

Learning disabled children are frequently characterised as having low self-esteem, lack self-reliance, and feeling unable to accomplish anything correctly (Wallace & McLoughlin, 1975). The repeated academic failures that learning disabled children experience are often pointed to as a factor contributing to their low self-esteem. This study investigated whether the experience of relative success (by learning vocabulary with the keyword method) as opposed to a sense of frustration and failure (when learning without special instructions) made a difference in the children's immediate level of tension and apprehension.

The State Anxiety (A-State) scale of the State-Trait Anxiety Inventory (STAI) (Speilberger, Grosuch & Lushene, 1970) was selected to measure the subject's feelings at different points in this study. This scale was chosen because (a) it was relatively easy to read (fifth or sixth grade level), (b) short, (c) had norms for high school students, and (d) seemed to have relatively good reliability and validity. The primary qualities evaluated by the A-State scale involve feelings of

tension, nervousness, worry, and apprehension. The A-State scale consists of 20 statements. The subjects mark a four-point scale as to what degree the statement fits how they feel at that moment. The scale is balanced for acquiescence set, with 10 items directly scored and 10 reversed items. The range of possible scores varies from a minimum score of 20 to a maximum score of 80. A copy of the scale is included in Appendix I.

Spielberger et al. (1970) presents normative data for high school students based on scores obtained when the instrument was given to 377 high school juniors at Long Beach Senior High School (New York). The instrument was administered in a structured group-testing session that was part of a special research project.

Spielberger et al. (1970) indicate that the work done concerning the reliability and validity of the STAI A-State scale suggests that the scale has a high degree of internal consistency. Then, too, test-retest correlation coefficients were relatively low, ranging from .16 to .54 with a median $\underline{r}$ of .32 for the groups tested. The low $\underline{r}$'s were anticipated since the A-State scale was developed to be sensitive to the influence of different circumstances at different times of testing. Evidence bearing on the construct validity of the A-State scale comes from studies where subjects' scores were compared under different experimental conditions. For example, the scale discriminated between a normal condition, a relaxation condition, an exam condition, and a stressful movie condition (Speilberger et al., 1970).

The two hypotheses concerning the subjects' level of anxiety, apprehension, and worry (as measured by the A-State scale) are:

H_6: Learning disabled boys that have used the keyword method in four study-recall test trials on a list of vocabulary items are expected to have significantly lower scores on the A-State scale than control subjects that have participated in similar study-test trials without the use of the keyword method.

H_7: When both groups have just used the keyword method to study a list of vocabulary items, their scores on the A-State scale are expected to be essentially the same.

CHAPTER II

METHOD

Subjects

Thirty-four boys served as subjects. They ranged in age from 11 through 17 (mean = 13.41, standard deviation = 1.58). The boys were in the sixth through eleventh grades (M = 7.36, SD = 1.37). All had been diagnosed as learning disabled according to the criteria used in the State of Oklahoma. To be identified as learning disabled in that state, the student must show below expectancy achievement in one or more curriculum areas, an IQ score of 75 or above, and the assumption of a neuropsychological factor as the basis of the learning disability. Many of the characteristics of the sample used in this study are port yed in Table VI (Appendix G). That table presents the means and standard deviations for the entire sample and separates the control and mnemonic groups on a number of measures of demographic factors. On the Wechsler Intelligence Scale for Children--Revised (WISC-R), the subject's Full Scale IQ scores had a range from 71 to 112 (M = 91.18, SD = 10.00). The average IQ score on the verbal section of the WISC-R was 87.06 (SD = 9.76). For the performance section of the WISC-R the average IQ score was 95.97 (SD = 12.67). The subjects were an average of 0.24 years (SD = .44) behind the usual grade level for their age. In academic achievement, the average grade level on the Wide Range Achievement Test

(WRAT) reading section was 4.85 (SD = 2.10). For the WRAT arithmetic test the mean grade level was 4.04 (SD = 0.75). The mean on the WRAT spelling test was 3.93 (SD = 1.37). Figures 3, 4, and 5 (Appendix A) are graphs which clearly show that most of the subjects performed below their grade level on each of the three WRAT tests. Subjects were randomly assigned to the control and experimental groups.

Stimulus Materials

Fifty-five relative unfamiliar and difficult English vocabulary items were utilized. Five criteria were used in selecting the words. First, they were chosen from Carroll, Davies, and Richman's (1971) Word Frequency Book, as words that occurred at a frequency of less than once for every million words in that sample. Secondly, all the vocabulary words were nouns. They all had meanings that consisted of a synonym that was a commonly known noun. Rodale and Fluck's (1961) The Synonym Finder was utilized in finding the synonyms. Next, only vocabulary words were used for which the experimenter could think of a one or two word keyword. The keywords had to sound like part or all of the vocabulary word, be common nouns that learning disabled children would know, and words that could be easily pictured in an image. Finally, only vocabulary words were used for which there was an easily formed image with the keyword and synonym interacting. Forty-two sets of vocabulary words, keywords, and definitions were randomly assigned to three lists. These three lists, each containing 14 of the vocabulary words, were used in the various phases of the experiment. The other 13 vocabulary words were employed in the instructions given at three points

in the experiment. The vocabulary items, keywords, images, and meanings used in this experiment are presented in Table V (Appendix C).

All the stimuli were typed in capital letters on an eight inch (20.2 cm) by five inch (12.7 cm) card. The vocabulary words were typed in the center of the card. Figure 6 (Appendix D) presents a typical front side of a card when a vocabulary word (but not its keyword) was given. When a keyword was given along with the vocabulary word, the keyword was typed in parentheses to the right and below the vocabulary word (Figure 7, Appendix D). The definition of the vocabulary word was placed in the center on the back of the card. Figure 8 (Appendix D) shows a typical back side of a card.

Procedure

Each subject participated in two 50-minute experimental sessions with approximately one week between the two sessions. During the first session each subject participated in the first four phases: a baseline rote learning procedure, learning the experimental list (mnemonic or control condition), a few minutes of interpolated basic process activities, and finally a delayed recall test over the experimental list. Table III presents the different phases of the first session in their order of sequence. During the second session the subject participated in five additional phases: another recall test over the first experimental list, additional study-test trials with the first experimental list, an assessment of the subjects' current state of anxiety, learning the second experimental list (both groups used the keyword method), and a second assessment of their state of anxiety. Table IV presents the

TABLE III

FIRST SESSION: PHASES ONE THROUGH FIVE

Group	Phase 1--Baseline	First Teaching Period	Phase 2--Treatment	Phase 3--Basic Process Tasks	Phase 4--First Delayed Recall Test
Mnemonic	List A: Baseline Performance--Learn new English vocabulary without a mnemonic link. Example: Stimulus → Response Study: "Hod" → "Bucket" Test: "Hod" → ?	Taught the keyword method while using five vocabulary items and their mnemonic links.	List B: Study a new vocabulary while using the mnemonic method. Stimulus → Link → Response Study: "Palfrey" → "Pole" → "Horse" (Image: a horse on top of a telephone pole.) Test: "Palfrey" → "Pole" → ?	See Table I.	List B: Present stimulus word and test for retention. Stimulus → Link → Response Test: "Palfrey" → ? → ?
Control	List A: Baseline Performance--Learn new English vocabulary without a mnemonic link. Example: Stimulus → Response Study: "Hod" → "Bucket" Test: "Hod" → ?	Practice learning five vocabulary items without the use of the mnemonic links.	List B: Study a new vocabulary list without the use of a mnemonic link. Stimulus → Response Study: "Palfrey" → "Horse" Test: "Palfrey" → ?	See Table I.	List B: Present stimulus word and test for retention. Stimulus → Response Test: "Palfrey" → ?

TABLE IV

SECOND SESSION: PHASES FIVE THROUGH NINE

Group	Phase 5--Second Delayed Recall Test	Phase 6--Additional Study	Phase 7--Anxiety Measurement	Second Teaching Period	Phase 8--Mnemonic Learning	Phase 9--Anxiety Measurement
Mnemonic	List B: Present stimulus word and test for retention. Stimulus Link Response Test: "Palfrey" → ? → ?	List B: Continue to study the second list while using the linking mnemonic. Stimulus Link Response Study: "Palfrey"→"Pole" →"Horse" Test: "Palfrey"→ ? → ?	Complete the A-State scale.	Practice five vocabulary items with the use of their mnemonic links.	List C: Study a third vocabulary list while using the mnemonic method. Stimulus Link Response Study: "Whelp" →"Well" →"Puppy" (Image: a puppy about to fall in a well.) Test: "Whelp" → ? → ?	Complete the A-State scale.
Control	List B: Present stimulus word and test for retention. Stimulus Response Test: "Palfrey" → ?	List B: Continue to study the second list without the use of the mnemonic link. Stimulus Response Study: "Palfrey" → "Horse" Test: "Palfrey" → ?	Complete the A-State scale.	Taught the keyword method while using five vocabulary items and their mnemonic links.	List C: Study a third vocabulary list while using the mnemonic method. Stimulus Link Response Study: "Whelp" → "Well"→"Puppy" (Image: a puppy about to fall in a well.) Test: "Whelp" → ? → ?	Complete the A-State scale.

phases of the experiment that occurred during the second session. (The instructions for all the phases are given in Appendix B.)

For each study trial (baseline phase, treatment phase, additional study phase, and mnemonic phase) the experimenter started a stopwatch when the first vocabulary items were presented to the subject. The experimenter watched the stopwatch to pace the items so that all the subjects spent a similar amount of time studying the list for each particular trial. When the experimenter finished removing the card with the last item in a list, the time that the subject spent on that trial was recorded. Later the amount of study time in a phase was calculated by adding each subject's two trial times for that phase.

The subjects were offered material rewards for their effort. At the beginning of the first session the subjects were told that they could pick one piece of candy from a bag when they finished that session. The boys were informed that if they worked hard they could have three pieces of candy. At the end of the session they were told that they could get three pieces of candy if they felt they had worked hard. When the second session started the boys were told that they could chose one item from a bag (with candy bars, special pencils, decals, comic books, and baseball trading cards) at the end of the session.

First Session

Phase 1: Baseline. In the instructions for the baseline phase, each subject was told that (a) he would be shown a series of vocabulary words and their meanings and (b) after seeing the series he would be given a recall test where the vocabulary word would be shown and pronounced and he would be asked to give the meaning. Three items were

used to illustrate both the study and the test aspects. With these example items, the subject was shown a vocabulary word typed on a card and the word was pronounced twice in a three second period. Two more seconds passed while the card was turned over revealing the meaning. The meaning was also pronounced twice in another three second period. Approximately five more seconds passed as the card was removed and another card was introduced. This procedure was used for the study aspect of the baseline trials. Therefore, the subjects spent approximately three minutes studying the entire list. After a subject had studied the 14 items of the baseline list (List A), the cards were shuffled and the recall test occurred where the vocabulary item was presented and pronounced. The subject was then allowed approximately 15 seconds to give the meaning of the item. As soon as the first study-test trial was finished the stimulus cards were shuffled again and the second study-test trial was started. Both trials were presented in the same manner.

Teaching Period. The next section, the teaching period, occurred between Phase 1 and Phase 2. It differed for the control and mnemonic groups. For the control group five vocabulary items and their meanings were presented as a practice list. One study-test trial similar to the baseline procedure was given. In this instance the items were presented for the study period and the test in the same order.

It was at this time that the mnemonic group was taught the keyword method. This method was presented as a memory aid involving a "linking word," a word that sounds like part or all of the vocabulary item. As illustrations, the subject was shown two vocabulary items, their keywords, and the meanings. A mental picture for one to form involving the

keyword and the meaning was described for each item. The subject was asked to create and describe his mental picture for each of the two items. Three more items and their keywords were used as a practice list. For each of these, a picture was described to the subject. They were asked to make the picture in their minds and to describe it to the experimenter when they saw the picture clearly. After forming pictures for the practice list the subject was tested over the list. If he had difficulty with the method further coaching was given. The five items used as the illustrations and practice words were the same as those used as a practice list by the control group.

Phase 2: Treatment. For the treatment part of the study the subjects were given two study-test trials over another list of 14 items (List B). The order of the items was randomized for each trial. For the control group a similar procedure to that used in the baseline phase was utilized. The one difference occurred on the study part of the first trial. The subjects were given approximately nine seconds (instead of the three seconds used on the baseline phase) to look at the meanings of the vocabulary items. This was done to be consistent with the mnemonic group, where the additional time was needed to form the mental image. This meant that approximately four and one-half minutes were spent studying the entire list during the first trial of this phase. Three minutes were spent studying the list during the second trial. In the treatment phase the subjects in the mnemonic group were instructed to use the memory aid in learning the items. The cards for their study-test trials had the keywords typed below the vocabulary items. In the presentation of the items the vocabulary word was pronounced twice (as in the baseline phase) and then the keyword was pronounced once. In the

study part this was followed by the presentation and pronouncing of the meaning. An image linking the keyword and the meaning was described next. The subject was instructed to nod his head when he had formed the picture in his mind. The images were given, rather than having the subjects form their own, in order to keep the time spent in forming the images short and equivalent for the various subjects. In the test trials the subject was expected to recall the meaning of each vocabulary word after the item and its keyword had been presented and pronounced.

Phase 3: Basic Process Tasks. A delay then followed for about five minutes during which time the subjects were tested on the basic process tasks to measure the processes which seem to serve as the building blocks for what Atkinson and Shiffrin (1969) have called control processes in memory. Table I presented the names and explanation of the seven tasks. Table II explained three other measures that were derived from the subject's time scores on the basic process tasks.

Phase 4: First Delayed Recall Test. The first delayed recall test was then given. The procedure differed slightly between the control and mnemonic groups. For both groups, each vocabulary item from the list for the treatment phase (List B) was presented and pronounced. The control subjects were to give each English meaning. The subjects in the mnemonic group were asked to give both the keyword and the meaning; this helped to ensure use of the mnemonic link and also indicated if the link was still available. The order of the vocabulary items was randomized for each subject.

This phase ended the first session of the experiment. Each subject was thanked for his effort and allowed to pick his pieces of candy.

Second Session

Phase 5: Second Delayed Recall Test. The second session started with another recall test over the list utilized in Phases 2 and 4 (List B). The procedure followed was the same as that employed in Phase 4.

Phase 6: Additional Study-Test Trials. Two additional study-test trials were given with the list utilized in Phases 2, 4, and 5 (List B). The procedure for the trials was generally the same as that used in Phase 2. The one difference in the procedure was involved in the test aspect for the mnemonic group. In this phase subjects in that group were presented with only the vocabulary word (not the keyword) and asked to recall both the keyword and the meaning.

Phase 7: First Assessment of Subject's Current Level of Anxiety. All of the subjects were asked to complete the A-State scale of the State-Trait Anxiety Inventory.

Second Teaching Period. At this point five new vocabulary words were utilized in teaching the control group how to learn vocabulary items and their meaning utilizing the keyword method. The instructions followed the same steps that were used in teaching the keyword method to the mnemonic group during the first teaching period. For the second teaching period the mnemonic group practiced learning the five new vocabulary items with the keyword method.

Phase 8: Mnemonic Learning. The groups were given two study-test

trials over another list (List C) of 14 vocabulary items. Both groups were instructed to learn the items by using the keyword method, were given keywords, and were told what images to form. The procedure was generally the same as that employed by the mnemonic group in Phase 2. The one difference was in the test aspect. There the subjects were presented with only the vocabulary word and asked to recall the keyword as well as the meaning.

Phase 9: Second Assessment of Subject's Current Level of Anxiety. All of the subjects were again asked to complete the A-State scale of the State-Trait Anxiety Inventory.

The experiment ended with a short time to debrief each subject. At this point it was explained to each subject that the experiment concerned different ways for boys his age to learn new vocabulary. The subject was thanked for his help in investigating this area and allowed to pick his reward.

Data Analyses

For the vocabulary list learning data, the number of correct responses for each subject within a trial was converted to a proportion. The proportion was then used in the analyses. An inverse sine transformation of the proportional data was not considered necessary. It was felt that the analysis of variance and *t*-test statistical procedures were sufficiently robust to use with proportional data. Furthermore, since the inverse sine transformation would spread out the tails of the distribution, in not doing such the experimenter was accepting conservative *p*-values.

The data for this experiment were analyzed by the use of analyses of variance, t-tests, stepwise regression analyses, and correlations. Phases 1 and 2 together comprise a split-plot design with one between-subjects treatment (control versus mnemonic group) and two within-subjects treatments. One of the within-subjects treatments was the phase of the experiment (baseline or treatment). The other within-subjects treatment was the trial within each phase (trial one or trial two). Two analyses of variance were done comparing Phases 1 and 2. The first was on the proportions of the lists of meanings recalled by the groups in these phases. The other was on the amount of study time spent by each group during these phases.

Two additional analyses of variance were done where there was one between-subjects factor (group) and one within-subjects factor (phase). One of these analyses compared the proportions of meanings recalled in the first delayed recall test (Phase 4) and the second delayed recall test (Phase 5). The other analysis compared the groups' scores on the two times when they took the anxiety inventory (Phases 7 and 9).

A number of t-tests were used to assess the differences between the groups on (a) various demographic variables; (b) the amount of study time spent in Phases 1, 2, 6, and 8; and (c) the proportions of the meanings recalled in Phase 4, in Phase 5, in Phase 6, and in Phase 8.

Three sets of stepwise regression analyses were done; one with all the data, one with control group data; and a third with mnemonic group data. For each of these sets of data six analyses with different groups of variables predicted and predictor variables were done. For one of these, all the demographic variables were used to predict scores on the vocabulary learning tasks. In another, just the subtests on the

WISC-R were used to predict scores on the vocabulary learning tasks. In another, scores for the basic process tasks and the measures derived from basic process task sources were used to predict the scores on the vocabulary learning tasks. Next, the basic process derived scores were used in predicting demographic scores and vocabulary learning task scores. The fifth group of analyses involved predicting demographic scores with basic process scores. The last group of regression analyses involved the prediction of the scores on the A-State scale by use of the vocabulary learning scores as predictors. The specific measures used in the the regression analyses are listed in Appendix F.

Two sets of three correlation matrices were calculated. Within each set one matrix utilized the data from all the subjects. Another used the data only from the control subjects. A third used the mnemonic group subject data. For the first set the matrices consisted of correlations between (a) the scores on the vocabulary learning tasks and A-State scale with (b) the demographic data and basic process task scores. The other set involved (a) the basic process task scores and their derived measures correlated with (b) the demographic variables. Appendix F lists the specific variables in each matrix.

CHAPTER III

RESULTS

The data analyzed consists of demographic/subject factors (such as age), test scores (such as on the WISC-R), and performance scores from the various tasks involved in this study. The demographic data for the mnemonic and control groups are compared to determine their similarities and differences. Next, the results of the subjects' performance on the vocabulary learning parts of the experiment (Phases 1, 2, 4, 5, 6, and 8) are presented. Study time factors for the vocabulary learning trials are described to see if they account for the differences in recall performance. This is followed by a section on the data from the anxiety measure. The results of the various regression analyses done are presented next. Finally, there is a description of the patterns of variables, both demographic and performance, that appear to vary together.

Demographic Characteristics

A comparison of the control group and the mnemonic group on a number of demographic variables indicated that the groups were quite similar. Table VI (Appendix G) presents the means, standard deviations, *t*-scores, and probability levels for the major variables that were compared: age, grade, full scale intelligence score on the WISC-R, verbal and performance intelligence scores on the WISC-R, and the subject's performance on the WRAT reading, spelling, and arithmetic tests. On the three variables

where there was a significantly large difference (at the .05 level) between the groups, the control group was superior. The verbal intelligence score on the WISC-R was significantly different, t (32) = 2.23, $p < .05$, with the control group having a mean of 90.59 and the mnemonic group a mean of 83.53. The groups also differed significantly on the Similarities subtest of the WISC-R, t (32) = 3.78, $p < .01$, with the means for both groups being 9.7 (control group) and 7.2 (mnemonic group). The final significant difference was on the WISC-R Vocabulary subtest, t (32) = 2.28, $p < .05$. There the control group's mean was 9.0 and the mnemonic group's mean was 7.2. Clearly, if the demographic differences provided an advantage in learning the vocabulary in this experiment, the enhancement should have been in the control group's performance.

Recall Data

The analyses based on the proportions of the vocabulary lists recalled by the two groups in Phases 1, 2, 4, 5, 6, and 8 of the experiment are presented in this section. Table VII (Appendix G) shows the means and standard deviations of the proportions of vocabulary words and keywords recalled by the groups in each of these phases. As the results are presented, frequent references are made to Figure 2, a graph of the proportions of the lists recalled in the vocabulary phases of this study. In evaluating the proportions, the amount of time spent by the two groups on the study-test trials is examined to see if this might account for the differences in the proportions of the words recalled. Table VIII (Appendix G) presents the means, standard deviations, t-scores, and probability levels for the amount of time spent by each of the groups during the study aspect of the study-test trials.

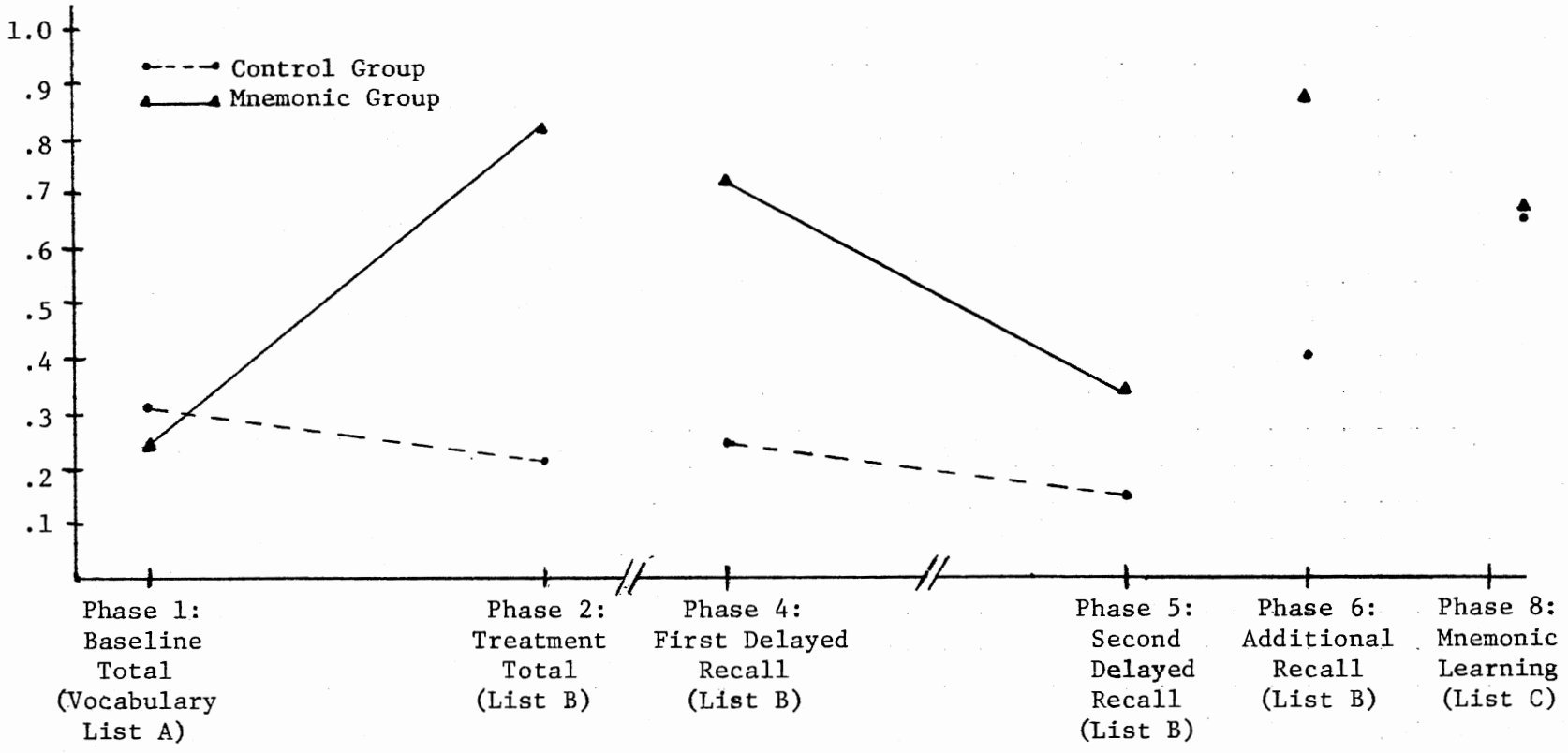

Figure 2. Proportions of Lists Recalled in Various Phases of the Experiment

The utilization of the keyword method by the mnemonic group in the treatment phase appears to have led to a large increase in the proportion of vocabulary meanings recalled as compared to study without use of this method. In the baseline phase the average proportions of the meanings recalled by the groups did not differ significantly at the .05 level. As can be seen in Figure 2, the control group recalled a slightly smaller proportion of the words in the treatment phase ($\underline{M}$ = 0.212) than they did in the baseline phase ($\underline{M}$ = 0.307). However, for the mnemonic group there was a dramatic increase over the baseline phase ($\underline{M}$ = 0.242) with their use of the keyword method in the treatment phase ($\underline{M}$ = 0.821). An analysis of variance between Phase 1 and Phase 2 indicated that there was a significant groups by phase interaction, $\underline{F}$ (1,32) = 206.81, $\underline{p}$ < .0001. Table IX (Appendix G) shows the complete results of this analysis of variance. The groups did not differ significantly in the amount of study time during the baseline period. However, there was a significant difference in the amount of study time during the treatment phase in favor of the control group, $\underline{t}$ (29) = 3.5087, $\underline{p}$ < .01, and a significant groups by phase interaction, $\underline{F}$ (1,32) = 19.31, $\underline{p}$ < .0001 (Table X, Appendix G). The mean for the control group was 463.57 seconds of study-trial time while the mean for the mnemonic group was 437.88 seconds. This indicated that the superior performance of the mnemonic group in Phase 2 could not be accounted for in terms of study time.

In Phase 4 of the experiment, after a short delay of approximately five minutes spent on the basic process tasks, the mnemonic group ($\underline{M}$ = 0.723) continued to recall a significantly higher proportion of the list studied in Phase 2, $\underline{t}$ (32) = -6.0716, $\underline{p}$ < .0001, than the control group ($\underline{M}$ = 0.239). This difference occurred despite the fact that there was

a drop in the proportion of meanings recalled by the mnemonic group after the delay while the control group recalled approximately the same proportion of the list as they had in Phase 2 (Figure 2).

The mnemonic group ($\underline{M}$ = 0.353) also recalled a significantly greater proportion of List B (the list utilized in the treatment phase) than the control group ($\underline{M}$ = 0.147) when the subjects were tested approximately a week after they had participated in the two study-test trials on List B, $\underline{t}$ (32) = -2.7730, $\underline{p} < .01$. The number of days between the first and second sessions was not significantly different (at the .05 level) for the two groups. The mean number of days between the sessions for the control group was 7.06 ($\underline{SD}$ = 0.966) while the mean was 7.24 ($\underline{SD}$ = 1.300) for the mnemonic group.

An analysis of variance between the groups on the delayed recall test at the end of the first session (Phase 4 of the experiment) and the delayed recall test at the beginning of the second session (Phase 5) resulted in a significant group difference, $\underline{F}$ (1,32) = 23.20, $\underline{p} < .0001$; phase difference, $\underline{F}$ (1,32) = 66.21, $\underline{p} < .0001$; and groups by phase interaction, $\underline{F}$ (1,32) = 23.84, $\underline{p} < .0001$ (Table XI, Appendix G). As can be seen in Figure 2, there was a slight drop in the proportion of meanings recalled by the control group between Phase 4 and Phase 5. There was a fairly large drop in the proportion recalled by the mnemonic group between those phases.

In Phase 6, the period when two additional study-test trials were given on List B, both groups recalled greater proportions of the lists than they had before. The mnemonic group continued to recall a significantly greater proportion of the meanings, $\underline{t}$ (32) = -6.7769, $\underline{p} < .0001$, than the control group with the mean proportion for the control group

being 0.399 and the mean for the mnemonic group being 0.884. The study time for the two groups was not significantly different at the .05 level (Table VIII, Appendix G).

In Phase 8, where both groups utilized the keyword method to study a third list of vocabulary words, the proportions of the list recalled did not differ significantly at the .05 level between the groups. The control group recalled an average proportion of 0.649 while the mnemonic group's mean was 0.655 (Table VII, Appendix G). Neither the study time spent (Table VIII, Appendix G) or the proportion of the keywords recalled were significantly different between the groups.

To look at the relative ease with which the subjects utilizing the keyword method remembered one but not both of the lists (acoustic and image), a comparison was made of the proportion of the total responses that (a) the keyword and not its associated meaning or (b) the meaning and not its associated keyword were recalled. Table XII (Appendix G) presents these proportions for Phases 4, 5, 6, and 8 of the study. To remember the keyword and not its meaning was a far more frequent occurrence than the other pattern. This pattern is particularly evident for the second delayed recall test (Phase 5).

Affect Data

An analysis of variance on the groups' scores from Phase 7 and Phase 9 on the State-Trait Anxiety Inventory found no significant difference (.05 level) between the groups, phases, or on the groups by phase interaction (Table XIII, Appendix G). In Phase 7 the mean score for the control group was 40.47 ($\underline{SD}$ = 6.62) while the mean for the mnemonic group was 41.42 ($\underline{SD}$ = 11.32). In Phase 9 the respective means

for the control and mnemonic group were 40.17 (SD = 8.03) and 39.82 (SD = 7.73).

Regression Analyses

One pattern of regression equations was found where a fair amount of the variance was accounted for by the predicting variable. When the WISC-R subtests were utilized to predict the data on the vocabulary tasks of the experiment, Picture Arrangement frequently met the .05 significance level for entry into the models for both groups. It appeared as a significant factor regardless of whether the keyword method was being utilized to learn the vocabulary list or not. Table XV (Appendix G) presents the regression equations where Picture Arrangement is a predictor of vocabulary learning.

Patterns of Correlations

From the correlational analyses, four patterns of highly correlated items emerged. These correlations are presented in Table XVI (Appendix G). As would be expected, one of these patterns is similar to the pattern found when the regression analyses were examined. That is, the subjects' scores on the Picture Arrangement subtest of the WISC-R were highly correlated with their performance in the vocabulary learning phases of the experiment. These significant correlations appeared when the scores for the groups were analyzed separately and when they were analyzed together.

Secondly, when the correlational analyses were done between the basic process measures and the WISC-R scores, a number of significant correlations were found between (a) Alternate and the derived score of

Switch with (b) the Full Scale IQ score, Performance IQ score, Picture Completion, and Picture Arrangement.

A third pattern that emerged was a number of high correlations between the control group's performance scores in the baseline, treatment, first delayed recall, second delayed recall, additional study, and mnemonic learning phases of the experiment and their WISC-R scores (particularly in verbal areas). The WISC-R scores involved in these high correlations were: Full Scale IQ score, Verbal IQ score, Information subtest, Similarities subtest, and the Vocabulary subtest. The vocabulary learning data also correlated highly with the WRAT Reading score. This pattern of correlations was not evident for the mnemonic group, even in the baseline phase. This suggests that it was due to the particular sample of subjects in the control group.

The fourth pattern noted consisted of high correlations between the measure based on the recall of sentences and WISC-R scores, particularly in verbal areas. The sentence recall measure for the whole sample correlated highly with the Full Scale IQ score, Verbal IQ score, Information subtest, Similarities subtest, and the Digit Span subtest. In a related way, it correlated with the verbal factors (called Verbal Comprehension, Conceptual, and Acquired Knowledge) found in two factor analytic studies of the WISC-R subtests (Appendix H).

CHAPTER IV

DISCUSSION AND SUMMARY

Discussion

The general pattern of results was a significant difference in the proportions of meanings recalled whenever one group used the keyword method and one did not. A significant difference was not found when both groups either did not use the keyword method (baseline phase) or did use it (mnemonic learning phase). It follows that five of the seven hypotheses were supported. The first hypothesis, that subjects who had been taught the keyword method would learn a significantly greater proportion of a list of vocabulary items and their meanings than control subjects, was strongly supported. The second hypothesis, that subjects utilizing the keyword method would recall a significantly greater proportion of the meanings than the control subjects when the test followed a short post-study delay period, was also strongly supported. The third hypothesis was not supported. It suggested that the groups would recall essentially the same proportion of the meanings when the subjects were tested a week after they had participated in two study-test trials on a list of vocabulary items. A significant difference was found when this comparison was made with the mnemonic group continuing to recall more of the meanings than the control group. The fourth hypothesis was strongly supported. It stated that after two study-test trials on a list of

vocabulary items, a week interval, and two additional study-test trials on that list, the subjects using the keyword method would recall a greater proportion of the meanings than the control group. The final hypothesis stated that the groups would recall essentially the same number of meanings when both groups used the keyword method. This hypothesis was also supported.

Two hypotheses concerned the subject's scores on the State-Trait Anxiety Inventory. The first suggested that the levels of state anxiety indicated by the subjects would differ significantly after one group had been utilizing the keyword method and one had not. For the second hypothesis it was proposed that after both groups had utilized the keyword method in studying a vocabulary list, their anxiety scores would be essentially the same. A significant difference was not found in either situation so the first of these hypotheses was not supported while the second was.

The vocabulary learning results will be examined, interpreted, and evaluated in terms of (a) their implications, (b) how they fit with previous research, and (c) suggestions for further explorations of the area. Next, a discussion of the State-Trait Anxiety Inventory data will be included. This will be followed by an examination of the patterns in the exploratory work involving regression analyses and correlations.

Use of the Keyword Method

Utilizing the keyword method seems to help learning disabled boys to learn and retain difficult English vocabulary items and their meanings. Large differences were found between the proportions of meanings recalled by the groups in the treatment, first delayed recall, second

delayed recall, and additional study phases of the experiment. These differences could not be accounted for in terms of demographic differences in the groups or the amount of time they spent studying the pairs. In fact, the control group seemed to have greater verbal abilities, as measured by the WISC-R, and received significantly more time to study the items in the treatment phase. Both of these factors would seem to have given the control group an advantage in the vocabulary learning tasks. Furthermore, the differences found for the treatment and additional study phases of the experiment may be an under estimation of what the differences could be. There seemed to be a ceiling effect for a number of the mnemonic group subjects knew all but one or two of the items on the first trial of each of these phases and recalled all of the items correctly on the second trials.

For the subjects using the keyword method, the test in the treatment phase differed from the tests in the first and second delayed recall phases, the additional study period, and the mnemonic learning period. In the tests in the treatment phase, the mnemonic group subjects were presented with the vocabulary word and the keyword and asked to recall the meaning. In the other phases the subjects were presented with only the vocabulary word. They were asked to recall both the keyword and the meaning. This difference in the testing procedures might be partially responsible for the drop in the proportion recalled by the mnemonic group between the treatment phase and the first delayed recall test. The different test procedures may also explain why the mnemonic group learned an average proportion of 0.821 in the treatment phase while both groups recalled a proportion of approximately 0.666 in the mnemonic learning phase.

The data for Phases 4, 5, 6, and 8 suggested that most subjects when utilizing the keyword method remembered either both the keyword and the meaning or neither of them. When either the keyword or its associated meaning was remembered, but not both, it was much more common for the keyword to be the one recalled. This was particularly true of the test that took place after the delay period of a week. This may suggest that the acoustic link was more strongly established by the subjects than the imagery link.

The differences between the proportion of words learned by the mnemonic and control groups were even more drastic than those described by Atkinson (1975), Atkinson and Raugh (1975), Raugh and Atkinson (1975), and Raugh, Schupbach, and Atkinson (1977) with college students. This may reflect a lack of any method of memorizing the material, even rote rehearsal, by many of the learning disabled boys in the control group. It would be much more likely for Atkinson and Raugh's control groups of college students to use some methods to memorize the material, as Ott, Butler, Butler, and Ball (1973) found their subjects doing.

The results for the vocabulary learning in the first session closely paralleled those reported by Taylor (1978) in the study that utilized the same design as the first session in the present study, a similar population, and involved the teaching of Spanish vocabulary and their English meanings with the keyword method. The interaction effects between the first two phases in the present study and the Taylor (1978) study are quite similar. This is also true of the differences in the proportions recalled in the first delayed recall test. In both studies, if the subjects remembered only a keyword or the meaning of the vocabulary word but not both, it was much more common for the keyword (the acoustic link)

to be the one remembered. These parallels suggest that the keyword method is utilized by learning disabled boys in a similar way to learn Spanish vocabulary-English meaning pairs and difficult English vocabulary-simpler meaning pairs.

Future research concerning the use of the keyword method and other mnemonic techniques by learning disabled children certainly seems to be warranted. The fact that (a) the vocabulary words were nouns, (b) they had noun keywords, and (c) there were one or two word synonyms for meanings probably maximized the usefulness of the keyword method. To see how useful it would be in a typical classroom situation, the use of the keyword method needs to be tested with a random sampling of difficult vocabulary words. In such a way, one could test its usefulness for learning general vocabulary where (a) many words are not nouns, (b) it is sometimes difficult to think of a keyword that can be incorporated in an image, (c) the definition may be more than one word, and (d) it may be difficult to make an image with the definition.

In addition, further research might investigate how effective the keyword method is for these children when they select their own keywords or images. There might be a gain in learning because a greater depth of processing occurs as the individual selects his own keyword or image. On the other hand, some confusion may result. Telling the subjects what keyword and image they are to use has the advantage of enabling one to specify an image that fits with the meaning of the vocabulary item. For example, for "duct" one might use the keyword "duck" and give an image of "a duck stuck in a concrete pipe" rather than "a duck smoking a pipe." Another important topic that needs to be investigated is the relative effectiveness of keywords that sound like the first syllable

and/or begin with the same letter as the vocabulary item as opposed to those that do not. It would also be interesting to see if a third direct vocabulary-item-to-meaning link is formed by the children as Atkinson (1975) suggests will happen with continued practice. Further investigations might concern how the keyword method could best be taught to a group or class of learning disabled children rather than having individualized instruction in the method. Finally, one of the most useful extensions of the work presented here would be to see how effective the keyword method is for learning disabled children when they are learning pairs of items involved in their typical school work or everyday lives. Possible types of pairs might be: (a) historical information such as leaders and what war they were involved in, (b) scientific facts such as the organs of the body and their basic function, and (c) individual's names and faces.

Data from the State-Trait Anxiety Inventory

Two possible interpretations can be made based on the STAI in Phases 7 and 9. First, it may be possible that use of the keyword method does not affect the feelings of learning disabled boys. Secondly, it may be that the use of the keyword method does affect their feelings but this difference was not detected due to either the instrument used or the placement of the measure in Phases 7 and 9 (rather than at other points in the experiment). There seemed to be a difference in the subjects' interest in participating in the second session. The control group subjects had usually had a very frustrating first session and frequently were quite reticent to participate in another session. On the other hand, mnemonic group subjects were generally quite willing and

at times eager to participate in the second session. When the mnemonic group was taught the keyword method after the baseline phase they often seemed excited that they could now do a task (learning a list of meanings) that had just been very difficult for them. There seemed to be some realization that their struggles in the baseline phase may have been largely due to the teaching method rather than their lack of abilities.

If the observations above are indicative of a change in the boys' feelings with the use of the keyword method, several aspects of the study may have contributed to the lack of difference in the affect measurements. First, a more ideal time to give the first anxiety measure would be at the end of the first session (Phase 4 just completed). This is a time of failure for the control group and a time of success for the mnemonic group. By the time a subject had participated in the additional study-test trials, even the control subjects were recalling a number of the meanings. Therefore, their sense of frustration and failure had diminished since the end of the first session. Secondly, utilizing an inventory that was too difficult for many of the subjects to read led to deviations from the standardized procedure of presentation. The experimenter had to read parts and explain numerous terms. This procedure may have modified the reliability and validity of the measure. For instance, the subjects may have been less likely to indicate their true feelings when the experimenter was watching them as opposed to leaving a person on their own to complete the inventory.

The Regression Analyses and Patterns of Correlations

A major emphasis of this study was to not only evaluate the usefulness of the keyword method for learning disabled boys but to also gain a better understanding of individual differences in rate of learning paired associates, with or without the keyword method. To this end, exploratory regression analyses and correlations were done to assess the "strength" of the relationships between three sets of variables: (a) demographic variables, (b) basic process task variables, and (c) vocabulary list learning variables. If the linkage is substantial between either or both mnemonic memory performance or vocabulary learning without the keyword and other memory tasks (Memory Dependence Hypothesis), it would be possible to specify and provide experience and training in basic process tasks to facilitate vocabulary learning. Discussion of the four patterns found in these analyses follows.

The significant correlations and regression analyses involving Picture Arrangement and both groups' performance scores on the vocabulary learning tasks may suggest that skills in the area of anticipation and planning are important in the vocabulary learning tasks. Picture Arrangement and Vocabulary learning may both involve selecting out of all the available memory material that which is most appropriate in the situation. Also possibly involved are processes of storing form information so that it can be retrieved in a sequential form.

The second pattern is the relationship between the basic process measures of Alternate and Switch and the Full Scale, Verbal, and Performance IQ scores as well as the Picture Completion and Picture Arrangement

subtest scores. These correlations may imply that the ability to switch one's attention between different modes is highly related to intelligence and particularly intellectual tasks requiring one to examine pictures for details.

A third pattern of correlations occurs between the control group's (a) performance scores in the vocabulary learning tasks with (b) their Verbal IQ scores and Reading scores on the WRAT. This pattern suggests that the performance on the vocabulary tasks of the control group subjects varied with their verbal intelligence skills. It is important to remember that a significant difference was found between the control and mnemonic groups on the Verbal IQ score, the Similarities subtest, and the Vocabulary subtest (three of the items involved in this correlation). This seems to imply that the control group had an advantage over the mnemonic group in the vocabulary learning tasks. Hence, the results favoring the mnemonic group over the control group are probably conservative.

The correlations between the sentence recall scores and the Full Scale and Verbal IQ scores, Similarities subtest, Vocabulary subtest, and Digit Span subtest imply that similar abilities are utilized in these different kinds of verbal tasks.

Taylor (1978) conducted similar exploratory regression analyses and correlations between: (a) demographic variables, (b) basic process task variables, and (c) Spanish vocabulary list learning variables. When she compared the regression equations found for control group data with those found for mnemonic group data, quite different factors appeared in the regression equations for predicting the baseline data of the two groups. Taylor interprets this finding (plus the general lack of

patterns in the results for the regression analyses) as indicative of the questionable reliability of the regression equations found.

There is little similarity in the patterns of highly correlated items found in the present study and the one conducted by Taylor (1978). This could be seen as indicative of questionable reliability in the analyses. Another possible explanation of the lack of consistent patterns in the regression and correlational analyses of these two studies is to see them as lending some support for the Memory Independence Hypothesis. That is, the results may suggest that mnemonic memory performance is relatively independent of performance on psychometric tasks, basic process tasks, and rote memory tasks.

Summary

This study has shown the effectiveness of a mnemonic technique, the keyword method, in helping learning disabled boys to both learn and recall (as much as a week later) pairs of carefully selected difficult English vocabulary items and their simplier meanings. This adds further support to the usefulness of the mnemonic, since it was also effective in helping learning disabled boys to learn pairs of selected Spanish words and their English meanings (Taylor, 1978). Further research involving a random sampling of difficult vocabulary words is needed to establish the degree of usefulness of the keyword method when the vocabulary words are not carefully selected. Nontheless, these two studies seem to suggest that the general processes underlying the keyword method are extremely helpful for learning disabled boys. The important underlying processes appear to be: (a) replacing difficult associations with smaller easier ones, (b) organizing the associations in a logical order,

(c) utilizing present knowledge (the keyword) in learning new material, and (d) actively utilizing visual-spatial abilities (often a strength for learning disabled children) in learning verbal material (often a weak area for such children). To facilitate the use of the keyword method and the processes that it involves, a pamphlet describing how teachers could use the method and processes is included in Appendix J.

Further research concerning the learning disabled children's use of the keyword method and other mnemonic methods, the process of having learning disabled children utilize their visual-spatial abilities to learn verbal material, the impact of learning method on the children's feelings, the relative independence or dependence of mnemonic learning and other memory tasks is clearly warranted. When the memory deficits of learning disabled children frequently affect many areas of their academic and social lives, effective mnemonic techniques may have strong positive implications for remediation.

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APPENDIXES

APPENDIX A

GRAPHS OF WRAT SCORES AND GRADE LEVEL

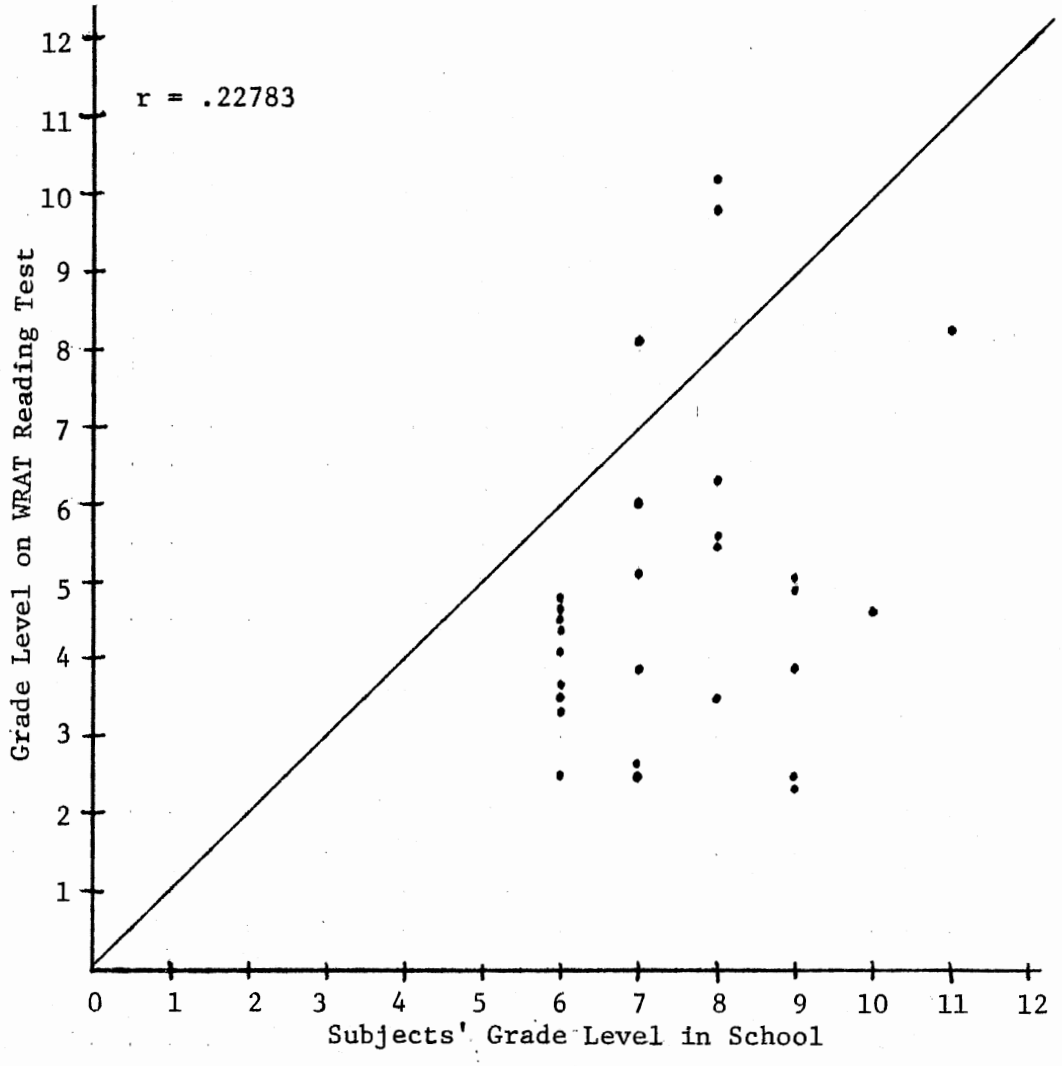


Figure 3. Graph of Subjects' WRAT Reading Level with Their School Grade Level

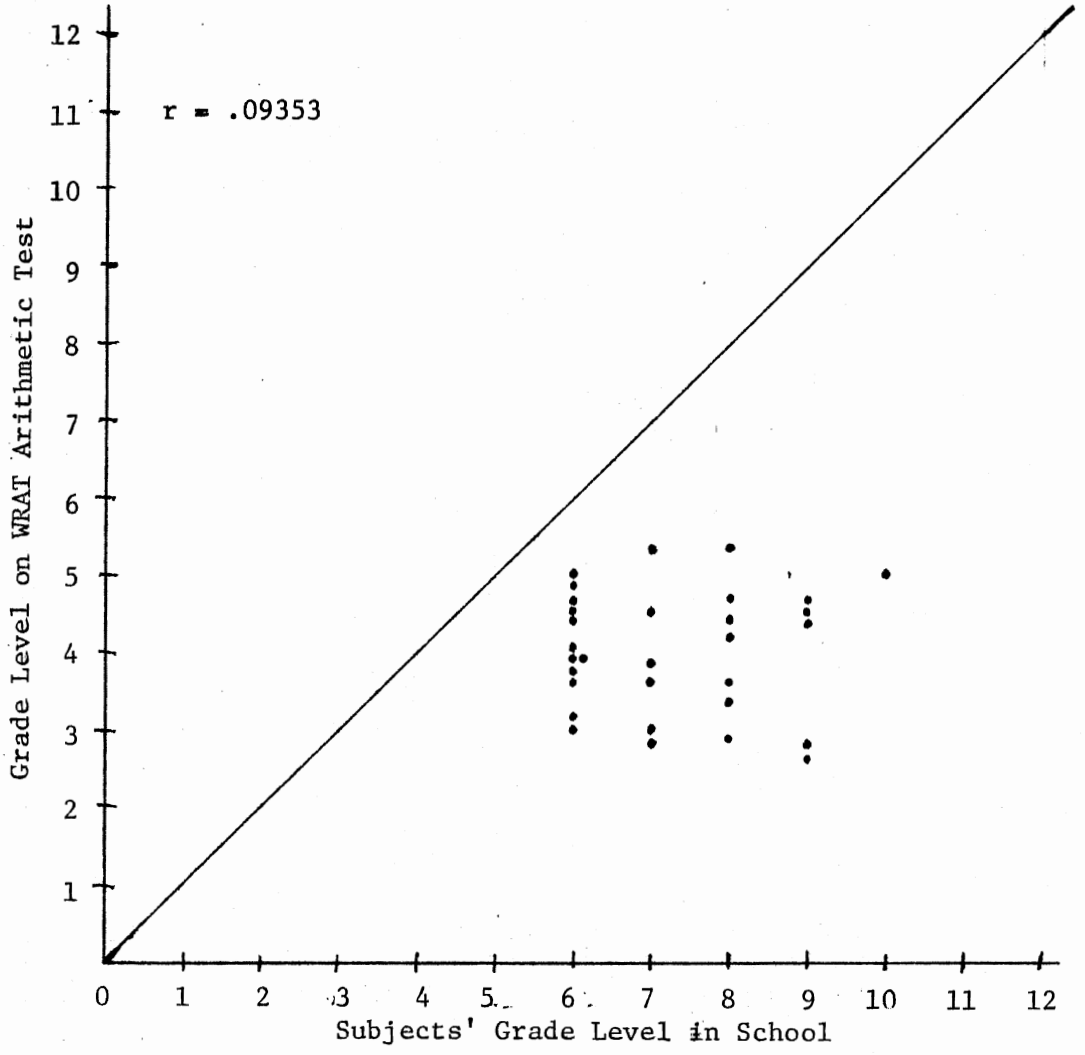


Figure 4. Graph of Subjects' WRAT Arithmetic Level with Their School Grade Level

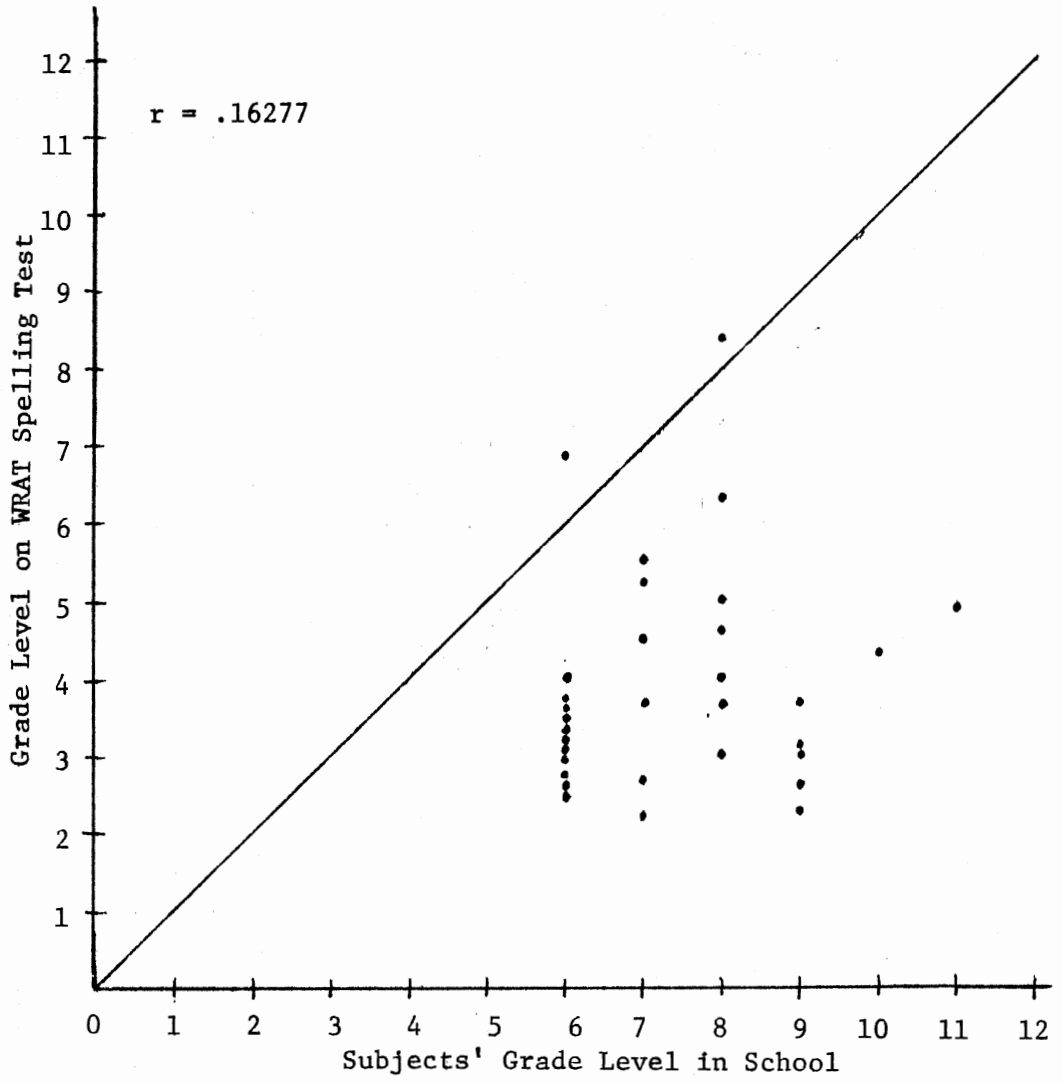


Figure 5. Graph of Subjects' WRAT Spelling Level with Their School Grade Level

APPENDIX B

INSTRUCTIONS

Baseline Phase (Both Groups)

I am trying to find out the best way for young people your age to learn vocabulary words and their meanings. I will show you and pronounce each vocabulary word. I will both tell and show you the meaning of each word. Here is a short example list:

Hector, hector is a word meaning bully, bully.
Muck, muck is a word meaning mud, mud.
Nebula, nebula is a word that means fog, fog.

After I have shown you a series of words and their meanings, you will be given a recall test. I will present a word from the list and you will be asked to give the correct meaning associated with that word. For example:

If I say muck, then you would say _____. That is right.
And if I say nebula, you would say _____. Right.
And for hector, _____. Fine.

Here is the list you will be given the recall test over. I will present the words like I did for the example. It is just a longer list. Do you have any questions? (List A, trial 1.)

Now I will show you each of the vocabulary words and you are to tell me their meanings. (List A, recall test 1.)

Now I will show you these words for you to study again. Then I will give you another recall test. Lets see if you can know more of them this time. (List A, trial 2.)

Here is the recall test. (List A, recall test 2.)

First Teaching Period (Control Group)

Here is a short list on which to practice. I will present the items in the list to you once. For each vocabulary word, I will show it to you and pronounce it. Then I will show you its meaning. After we have completed the list I will give you a recall test. List for First Teaching Period.)

Here is the recall test. (List for First Teaching Period, recall test.)

First Teaching Period (Mnemonic Group)

In this part, I will teach you a memory aid to help you learn vocabulary words and their meanings. For this memory aid you will use

what is called a linking word (like a link in a chain). A linking word is a common word that sounds like part or all of a vocabulary word. For example:

For the vocabulary word flagon, the linking word is flag.
For the vocabulary word derelict, the linking word is dairy.

When you use the memory aid, I will give you a vocabulary word, a linking word, and the meaning of the vocabulary word. For example:

The vocabulary word is flagon. The linking word is flag.
And the meaning of flagon is canteen.
The vocabulary word is derelict. The linking word is dairy.
And the meaning of derelict is tramp.

As the aid to remembering, you are to make a picture in your mind of the linking word doing something with the meaning. Here are some examples:

If the vocabulary word is flagon, the linking word is flag, and the meaning is canteen, you would make a picture in your mind involving a flag and a canteen. Picture your school flagpole. Pretend someone has played a trick on the principal and put a canteen on the flagpole instead of the flag. Can you see the canteen up there. Describe your picture to me. For instance, what colors are involved and is the canteen blowing in the wind or still?

If the vocabulary word is derelict, the linking word is dairy, and the meaning is tramp, you would make a picture in your mind involving a dairy and a tramp. Picture a spotlessly clean dairy. A tramp has gone in there and is creating a ruckus. He is jumping on some cows and sliding under other cows. Can you see that picture? Describe it to me.

Make the picture as funny or unusual as possible, then it will be easier to remember. When you see the vocabulary word, the linking word and the picture will help you remember the meaning.

Do you understand the memory aid? Do you have any questions about it? Here are three vocabulary words on which to practice this memory aid. (Last three items of the list for the First Teaching Period.)

Let us see how many of these you know. (List for First Teaching Period, recall test.)

Treatment Phase (Control Group)

Now I will show you another series of vocabulary words and their meanings. You are to learn these as we go through the list. After you have studied all of the words, I will give you another recall test.

For that test I will show you the vocabulary words. You are to tell me their meanings. (List B, treatment phase, trial 1.)

Here is the recall test. (List B, treatment phase, recall test 1.)

Now I will show you the words for you to study again. Then I will see how many you know. Lets see if you can know more of them this time. (List B, treatment phase, trial 2.)

Here is the second recall test. Lets see how many you know now. (List B, treatment phase, recall test 2.)

Treatment Phase (Mnemonic Group)

Now I will show you a series of vocabulary words, their linking words, and their meanings. Learn these using the memory aid. I will tell you a picture to make in your mind. Nod your head "yes" when you see the picture clearly. After I have shown you all the words, I will give you a recall test. For this test, I will show you the vocabulary word and the linking word. You are to tell me the meaning of the vocabulary word. (List B, treatment phase, trial 1.)

Here is the recall test. Think of the linking word. That will tell you the picture and the picture will tell you the meaning. (List B, treatment phase, recall test 1.)

Next, I will show you the words for you to study again. In studying them, think of the linking word and what was in the picture with the linking word. See the picture clearly again. If you cannot remember the picture, tell me so. I will then remind you of the picture. Lets see if you can know more of them this time. (List B, treatment phase, trial 2.)

Here is the second recall test. Lets see how many you know now. (List B, treatment phase, recall test 2.)

Basic Process Tasks (Both Groups)

Here are some different things to do. They use the alphabet. First, say the alphabet to me. (The subject says the alphabet.) Fine. (If the subject does not know the alphabet well, the experimenter and the subject say it together several times.)

Now, when I tell you to begin, you are to say the alphabet as quickly as you can. When you come to the end of it say "stop." So I will say "begin" and you will say "a, b, c . . . x, y, z, stop." Do you have any questions? Say them as quickly as you can.

Next, I want you to mouth the alphabet as quickly as you can. So after I say "begin," I want you to go through the alphabet like this "(a), (b), (c) . . . (x), (y), (z) stop." Be sure to say "stop" when you get to the end. Do you understand? Mouth the alphabet as quickly as you can.

Now, I want you to alternate between saying and mouthing the alphabet. So after I say "begin," I want you to go through the alphabet like this "a, (b), c, (d), e, (f) . . . (x), y, (z), stop." Do you understand? Do you have any questions? Go through the alphabet like that once for practice. (The subject practices the task.) Now, go through it as quickly as you can. If you make a mistake, keep going.

This time I want you to read through the alphabet saying if letters are either tall or not tall. This is half a typed space. Letters which are larger than half a typed space are tall. So b is tall because of this part. T is tall because of this part. Y is tall because of its tail. Letters like a and z are not tall because they fit in half a typed space. For each tall letter you are to say "yes" and for each letter that is not tall you are to say "no." So with b you would say "yes." With t, "yes." With y, "yes." With a, "no." With z, "no." As an example, I will start from the end of the alphabet, "no, yes, no . . . ." Do you understand? You are to start from the beginning of the alphabet and go as fast as you can.

Now I have a card with all the letters in capitals. You are to do the same thing, saying "yes" for tall letters and "no" for letters that are not tall. You will have to look at the capital letters and think if their small letters are tall or not. Do you understand? Remember to go as quickly as possible.

This time I want you to do the same thing, only I will not show you a card. You will have a picture in your mind what the letters look like. Do you have any questions?

Now, I will read a list of letters. When I am through reading all of them you are to write down as many as you remember in any order. Do you understand? Do not write down any until I have read all of them. (The following letters are read at a rate of one every two seconds.) "C, H, L, M. R, J, X, G, Q, K, S, V."

First Delayed Recall Test

(Control Group)

Now I will give you one more recall test over the last list of vocabulary words that you studied. I will show you and pronounce each vocabulary word and you are to tell me the meaning of the vocabulary word. (List B, first delayed recall test.)

First Delayed Recall Test

(Mnemonic Group)

Now I will give you one more recall test over the last list of vocabulary words that you studied. I will show you and pronounce each vocabulary word and you are to tell me both the linking word and the meaning of the vocabulary word. (List B, first delayed recall test.)

Second Delayed Recall Test

(Control Group)

(The instructions were the same as those utilized with the control group in the first delayed recall test.)

Second Delayed Recall Test

(Mnemonic Group)

(The instructions were the same as those utilized with the mnemonic group in the first delayed recall test.)

Additional Study Phase (Control Group)

Next, I will show you the words for you to study again. After this there will be a recall test where I will present the vocabulary words. You will be asked to recall the meanings. Lets see if you can know more of them this time. (List B, additional study phase, trial 1.)

Here is the recall test. Tell me the meanings. (List B, additional study phase, recall test 1.)

This is the last time to study this list. Lets see if you can know all the words this time. (List B, additional study phase, trial 2.)

Here is the last test on this list. Tell me the meanings of the vocabulary words. (List B, additional study phase, recall test 2.)

Additional Study Phase (Mnemonic Group)

Next, I will show you the words for you to study again. In studying them, think of the linking word and what was in the picture with the linking word. See the picture clearly again. If you cannot remember the

picture, tell me so. I will then remind you of the picture. After this there will be a recall test where I will only present the vocabulary word. You will be asked to recall both the linking words and the meanings. Lets see if you can know more of them this time. (List B, additional phase study, trial 1.)

Here is the recall test. Tell me both the linking words and the meanings. (List B, additional study phase, recall test 1.)

This is the last time to study this list. As we go through the words, think of each linking word and see each picture clearly. Then you will be able to remember the meanings. Lets see if you can know all of the words this time. (List B, additional study phase, trial 2.)

Here is the last test on this list. Tell me both the linking words and the meanings. (List B, additional study phase, recall test 2.)

First Measure of Self-Esteem--Phase 7

(Both Groups)

(The experimenter read the directions at the top of the Self-Evaluation Questionnaire out loud to the subject. After that the experimenter added: "Some of the words in this questionnaire are rather unusual. If you are not sure of what they mean or how to read them, let me know. I will be glad to explain them.")

Second Teaching Period (Control Group)

(The instructions were the same as those used in the first teaching period for the mnemonic group. The only difference in the procedure was the use of the vocabulary word list for the second teaching period. As a result, the words used as examples in the instructions were barrister and nosegay.)

Second Teaching Period (Mnemonic Group)

Here is a short list on which to practice. I will present the items in the list to you once. For each vocabulary word, I will show it to you, pronounce it, and pronounce the linking word. Then I will show you the meaning of the vocabulary word and give you a picture to form in your mind. Nod your head "yes" when you see the picture clearly. After we have completed the list I will give you a recall test. (List for the Second Teaching Period.)

Here is the recall test. (List for the Second Teaching Period, recall test.)

Mnemonic Learning Phase (Both Groups)

Now I will show you a series of vocabulary words, their linking words, and their meanings. Learn these using the memory aid. I will tell you a picture to make in your mind for each one. Nod your head "yes" when you see the picture clearly. After I have shown you all the words, I will give you a recall test. For this test, I will show you the vocabulary word. You are to tell me both the linking word and the meaning of the vocabulary word. (List C, mnemonic learning phase, trial 1.)

Here is the recall test. Think of the linking word. That will tell you the picture and the picture will tell you the meaning. Then tell me the linking word and the meaning. (List C, mnemonic learning phase, recall test 1.)

Next, I will show you the words for you to study again. In studying them, think of the linking word and what was in the picture with the linking word. See the picture clearly again. If you cannot remember the picture, tell me so. I will then remind you of the picture. Lets see if you can know more of them this time. Again, in the recall test, you will have to recall the linking word and the meaning. List C, mnemonic learning phase, trial 2.)

Here is the second recall test on this list. Lets see how many you know now. Tell me the linking words and the meanings of the vocabulary words. (List C, mnemonic learning phase, recall test 2.)

Second Measure of Self-Esteem--Phase 9

(Both Groups)

Fill this questionnaire out according to how you feel right now. You may feel the same or you may feel differently compared to when you filled it out before. Again if you are not sure of any of the words or what they mean, feel free to ask me. I will be glad to explain them.

Sentence Recall Task (Both Groups)

I am going to say something to you. When I get all through, you say just what I said.

APPENDIX C

THE VOCABULARY WORDS, KEYWORDS, IMAGES, AND MEANINGS USED IN THE STUDY

TABLE V

THE VOCABULARY WORDS, KEYWORDS, IMAGES, AND MEANINGS USED IN THE STUDY

Phase	Vocabulary Word	Keyword	Image	Meaning
Introduction	Hector			Bully
	Muck			Mud
	Nebula			Fog
Phase 1: Baseline (List A)	Amulet			Charm
	Apparel			Clothing
	Balm			Lotion
	Bard			Fight
	Chevalier			Knight
	Dale			Valley
	Harpy			Monster
	Hod			Bucket
	Latrine			Toilet
	Litany			Prayer
	Mete			Boundary
	Neophyte			Student
	Pannier			Basket
	Toxin			Poison
First Teaching Period	Flagon	Flag	A canteen on a flagpole instead of a flag.	Canteen
	Derelict	Dairy	A tramp creating a ruckous in a dairy.	Tramp

TABLE V (Continued)

Phase	Vocabulary Word	Keyword	Image	Meaning
	Oculist	Octopus	An octopus acting like an eye doctor.	Eye Doctor
	Eddy	Teddy Bear	A teddy bear caught in a whirlpool.	Whirlpool
	Fife	Five	A flute with little fives coming out of it.	Flute
Phase 2: Treatment, Phase 4: First Delayed Recall, Phase 5: Second Delayed Recall, Phase 6: Additional Study (List B)	Apex	Ape	An ape sitting on two boards that make a point.	Point
	Ague	Egg	An egg with a thermometer in its mouth.	Fever
	Duct	Duck	A duck stuck in a concrete pipe.	Pipe
	Frock	Rock	A girl trying to put on a dress made of rock.	Dress
	Garb	Garbage	You are taking out the garbage and find that someone has put your favorite piece of clothing in the garbage.	Clothing
	Horde	Horn	A crowd of people with everyone blowing a horn.	Crowd
	Lacuna	Racoon	A racoon stuck at the bottom of a pit.	Pit
	Lexicon	Mexican	A Mexican with a dictionary in his sombrero.	Dictionary
	Magenta	Magician	A magician that is red from head to foot--clothes, skin, hair.	Red

Table V (Continued)

Phase	Vocabulary Word	Keyword	Image	Meaning
	Maul	Ball	A child using your favorite ball as a hammer.	Hammer
	Nub	Tub	A bathtub full of apple cores.	Core
	Palfrey	Pole	A horse on top of a telephone pole.	Horse
	Petard	Petal	You light some fireworks and petals shoot out instead of sparks.	Fireworks
	Scion	Sky	A branch breaks off a tree and floats up towards the blue sky.	Branch
Second Teaching Period	Barrister	Bear	A bear acting like a lawyer.	Lawyer
	Nosegay	Nose	A great big nose sniffing a bunch of flowers.	Flowers
	Eidolon	Eye	You see two eyes in the dark and then you see that they belong to a ghost.	Ghost
	Gulch	Sea Gull	A sea gull flying back and forth in a canyon trying to find its way out.	Canyon
	Citadel	City Bell	An army attacks a fortress when the city bell rings.	Fortress
Phase 8: Mnemonic Learning (List C)	Electorate	Electricity	Voters lined up at the voting booth get an electric shock.	Voters
	Kist	Kiss	Someone kissing a box.	Box

TABLE V (Continued)

Phase	Vocabulary Word	Keyword	Image	Meaning
	Chameleon	Camel	A lizard getting a free ride on the hump of a camel.	Lizard
	Desperado	Desk	An outlaw carrying a school desk down the street.	Outlaw
	Edifice	Face	A building crashing on the face of someone you do not like.	Building
	Grotto	Auto	A cartoon character zipping out of a cave in an auto.	Cave
	Macula	Dracula	Dracula getting upset because of this growing freckle on his arm.	Freckle
	Maggot	Magnet	A magnet that pulls flies to it--great at a barbecue.	Fly
	Mentor	Menu	At breakfast a waiter gives you a menu and you get to order your teachers for the day.	Teacher
	Nib	Nibble	At the zoo you have your hands on the fence. You feel a nibble on your finger and see a beak.	Beak
	Hovel	Shovel	A shack made of shovels.	Shack
	Palisade	Palace	A palace with a great big tall fence around it.	Fence
	Signet	Signature	You have to write your signature a hundred times, so you use a stamp with your signature on it.	Stamp

TABLE V (Continued)

Phase	Vocabulary Word	Keyword	Image	Meaning
	Whelp	Well	A puppy about to fall in a well.	Puppy

APPENDIX D

EXAMPLES OF CARDS USED IN STUDY

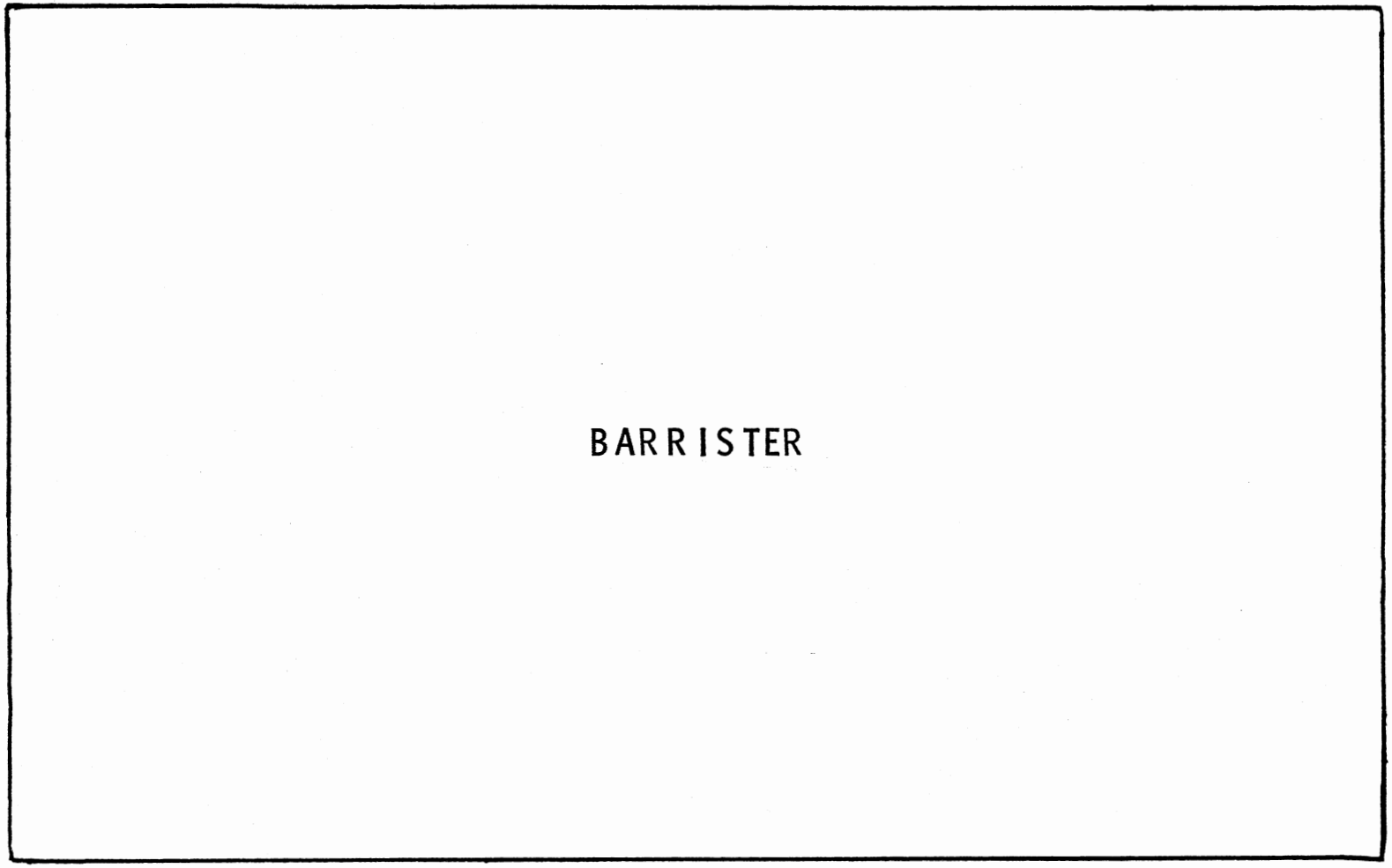


Figure 6. Typical Front Side of Card When Only the Vocabulary Word Was Presented

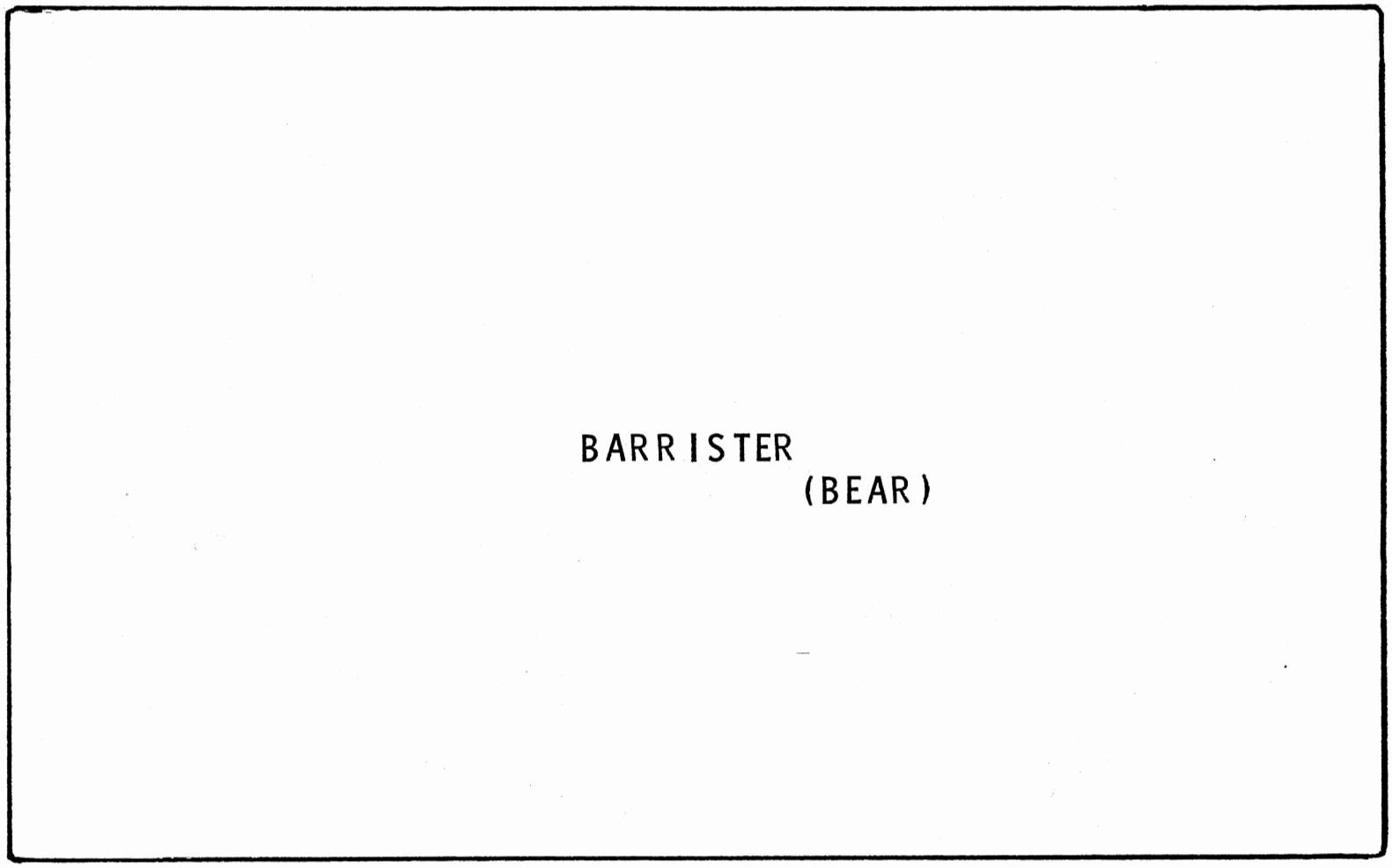


Figure 7. Typical Front Side of Card When Both the Vocabulary Word and the Keyword Were Presented

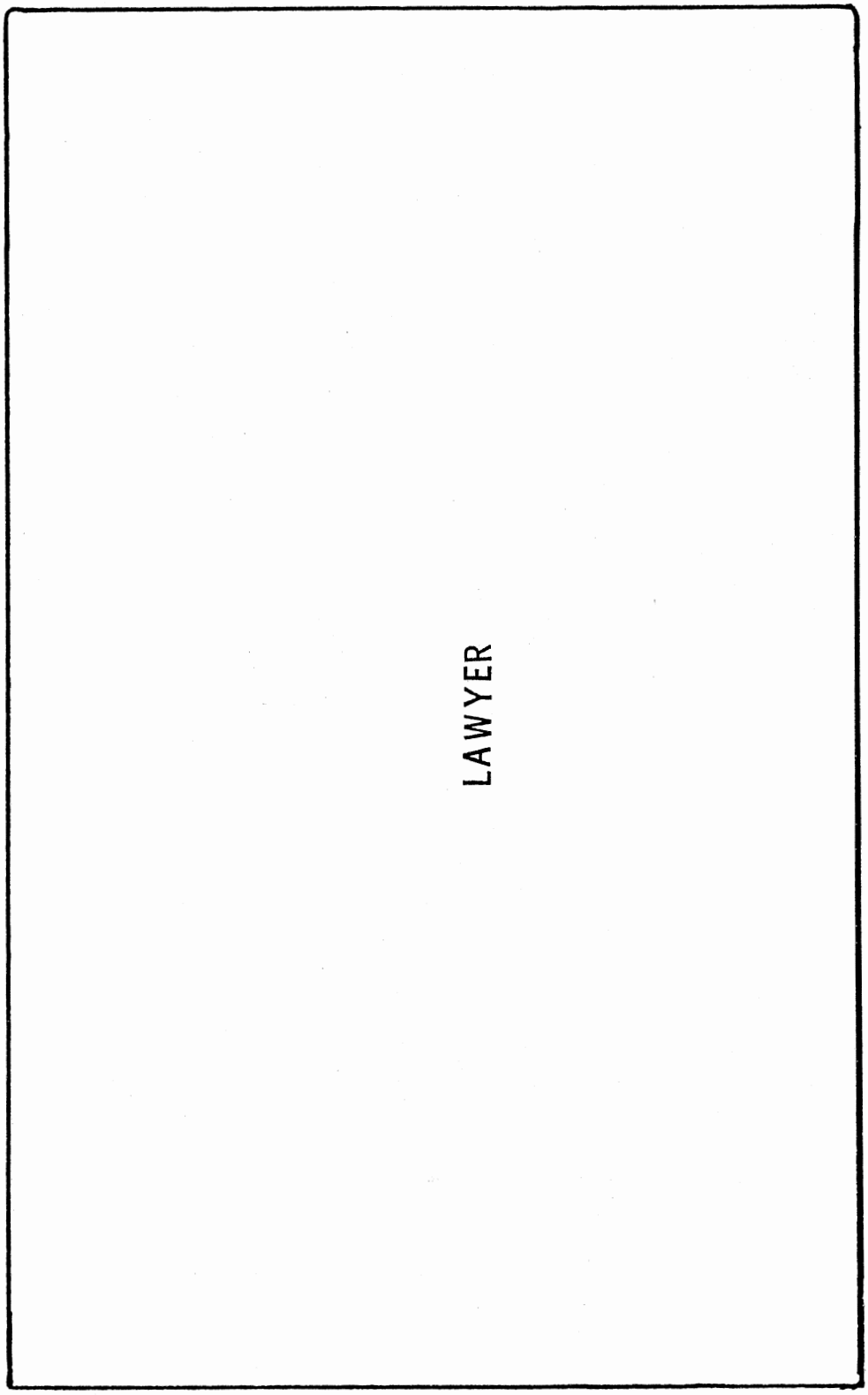


Figure 8. Typical Back Side of a Card

APPENDIX E

ITEMS USED IN SENTENCE RECALL TASK

Items Used in Sentence Recall Task

1. We will go for a walk.
2. Bring the broom and sweep the front room.
3. We saw a little fire on the way to school.
4. Three boys spent a happy day last week on a fishing trip.
5. Each year when the circus comes to town father takes the whole family.

Scoring Procedure

The sentences were scored according to the number of errors made. A maximum of three errors were counted for any one sentence. An error could be one of three kinds: (a) a word omitted, (b) a word added, or (c) an unsuitable word substituted.

APPENDIX F

THE REGRESSION AND CORRELATIONAL ANALYSES

Regression Analyses

Three sets of regression analyses, one with all the data, one with control group data, and a third with mnemonic group data, were done for each of the following groups of variables:

(a) Variables Predicted: Baseline Total, Treatment Total, Delayed Recall 1 Total, Delayed Recall 2 Total, Additional Study Total, Mnemonic Learning--Total Number of Keywords Recalled, Mnemonic Learning--Total Number of Meanings Recalled, Sentence Recall Score, State-Trait Anxiety Inventory--first administration, State-Trait Anxiety Inventory--second administration.

Predictor Variables: age, grade, Full Scale IQ score, Verbal IQ score, Performance IQ score, Information, Similarities, Arithmetic, Vocabulary, Comprehension, Digit Span, Picture Completion, Picture Arrangement, Block Design, Object Assembly, Coding, Reading Grade Level (WRAT), Arithmetic Grade Level (WRAT), Spelling Grade Level (WRAT).

(b) Variables Predicted: (The same variables were predicted as in analysis "a.")

Predictor Variables: Information, Similarities, Vocabulary, Comprehension, Digit Span, Picture Completion, Picture Arrangement, Block Design, Object Assembly, Coding.

(c) Variables Predicted: (The same variables were predicted as in analysis "a.")

Predictor Variables: Speak Aloud, Speak Silently, Alternate, Percept, Percept Mistakes, Translate, Translate Mistakes, Image, Image Mistakes, Span, Switch, Change, Imagine.

(d) Variables Predicted: (The same variables were predicted as in analysis "a." In addition, the variables used as predictor variables in analysis "a" were predicted in this analysis.)

Predictor Variables: Span, Switch, Change, Imagine.

(e) Variables Predicted: (The predictor variables for analysis "a" were predicted in this analysis.)

Predictor Variables: (The predictor variables used in analysis "c" were also used here.)

(f) Variables Predicted: State-Trait Anxiety Inventory--first administration, State-Trait Anxiety Inventory--second administration.

Predictor Variables: Baseline Total, Treatment Total, Delayed Recall 1 Total, Delayed Recall 2 Total, Additional Study Total, Mnemonic Learning--Total Number of Meanings Recalled.

Correlation Matrices

Two sets of correlation matrices were calculated. Within each set one matrix utilized all the data. Another used the data only from the control subjects. A third used the mnemonic subject data.

(a) Performance Scores Correlated with Demographic Data and Basic Process Scores

Performance Scores: Baseline Total, Treatment Total, Delayed Recall 1 Total, Delayed Recall 2 Total, Additional Study Total, Mnemonic Learning--Total Number of Keywords Recalled, Mnemonic Learning--Total Number of Meanings Recalled, Sentence Recall Score, State-Trait Anxiety Inventory--first administration, State-Trait Anxiety Inventory--second administration.

Demographic Data and Basic Process Scores: age, grade, Full Scale IQ score, Verbal IQ score, Performance IQ score, Information, Similarities, Arithmetic, Vocabulary, Comprehension, Digit Span, Picture Completion, Picture Arrangement, Block Design, Object Assembly, Coding, Reading (WRAT), Arithmetic (WRAT), Spelling (WRAT). (The next items are factors from factor analytic studies of the WISC-R.) Verbal Comprehension, Perceptual Organization, Freedom from Distractibility, Conceptual, Spatial, Sequential, Acquired Knowledge. (The following variables are basic process task scores.) Speak Aloud, Speak Silently, Alternate, Percept, Percept Mistakes, Translate, Translate Mistakes, Image, Image Mistakes, Span, Switch, Change, Imagine.

(b) Basic Process Scores Correlated with Demographic Data

Basic Process Scores: Speak Aloud, Speak Silently, Alternate, Percept, Mistakes on Percept, Translate, Mistakes on Translate, Image, Mistakes on Image, Span, Switch, Change, Imagine.

Demographic Data: age, grade, Full Scale IQ score, Verbal IQ score, Performance IQ score, Information, Similarities, Arithmetic, Vocabulary, Comprehension, Digit Span, Picture Completion, Picture Arrangement, Block Design, Object Assembly, Coding, Reading (WRAT), Arithmetic (WRAT), Spelling (WRAT), Verbal Comprehension, Perceptual Organization, Freedom from Distractibility, Conceptual, Spatial, Sequential, Acquired Knowledge.

APPENDIX G

DATA ANALYSES

TABLE VI

A COMPARISON OF THE GROUPS ON THE DEMOGRAPHIC VARIABLES

Variable	Total Sample		Control Group		Mnemonic Group		Control Versus Mnemonic	Control Versus Mnemonic
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	t	p
Age	13.41	(1.58)	13.06	(1.56)	13.76	(1.56)	-1.3182	0.1968
Grade	7.36	(1.37)	7.06	(1.52)	7.69	(1.14)	-1.3384	0.1905
Full Scale IQ	91.18	(10.00)	93.82	(11.13)	88.53	(8.22)	1.5772	0.1246
Verbal IQ	87.06	(9.76)	90.59	(11.35)	83.53	(6.42)	2.2321	0.0327
Performance IQ	95.97	(12.67)	95.29	(13.30)	96.65	(12.37)	-0.3071	0.7608
Reading Grade Level	4.85	(2.10)	5.18	(2.51)	4.51	(1.61)	0.8329	0.4125
Arithmetic Grade Level	4.04	(0.75)	4.13	(0.70)	3.93	(0.82)	0.7251	0.4742
Spelling Grade Level	3.93	(1.37)	4.11	(1.63)	3.72	(1.02)	0.7884	0.4367

TABLE VII

PROPORTIONS OF WORDS RECALLED

Phase of the Experiment	Aspect of the Phase	Control Group		Mnemonic Group	
		Mean	Standard Deviation	Mean	Standard Deviation
Phase 1: Baseline	Trial 1	.256	(.245)	.164	(.103)
	Trial 2	.357	(.267)	.319	(.156)
	Total	.307	(.250)	.242	(.121)
Phase 2: Treatment	Trial 1	.160	(.238)	.731	(.206)
	Trial 2	.265	(.271)	.912	(.093)
	Total	.212	(.247)	.821	(.145)
Phase 4: First Delayed Recall	Keyword Trial 1	---	---	.798	(.146)
	Meaning Trial 1	.239	(.282)	.723	(.167)
Phase 5: Second Delayed Recall	Keyword Trial 1	---	---	.597	(.223)
	Meaning Trial 1	.147	(.212)	.353	(.221)
Phase 6: Additional Study	Keyword Trial 1	---	---	.878	(.079)
	Meaning Trial 1	.332	(.289)	.828	(.110)
	Keyword Trial 2	---	---	.950	(.066)
	Meaning Trial 2	.466	(.288)	.941	(.063)
	Keyword Total	---	---	.914	(.059)
	Meaning Total	.399	(.285)	.884	(.077)
Phase 8: Mnemonic Learning	Keyword Trial 1	.609	(.210)	.634	(.131)
	Meaning Trial 1	.550	(.223)	.534	(.166)
	Keyword Trial 2	.790	(.213)	.832	(.147)
	Meaning Trial 2	.748	(.238)	.798	(.162)
	Keyword Total	.700	(.188)	.733	(.126)
	Meaning Total	.649	(.225)	.666	(.154)

TABLE VIII

AVERAGE AMOUNT OF STUDY TIME (SECONDS) ON THE VOCABULARY LEARNING TASKS

Phase of the Experiment	Aspect of the Phase	Control Group		Mnemonic Group		Control Versus Mnemonic	Control Versus Mnemonic
		Mean	Standard Deviation	Mean	Standard Deviation	t	p
Phase 1: Baseline	Trial 1	185.29	(5.99)	186.18	(7.40)		
	Trial 2	177.65	(9.03)	180.00	(7.29)		
	Total	362.94	(11.33)	366.18	(9.28)	-0.9111	0.3690
Phase 2: Treatment	Trial 1	253.82	(17.28)	252.53	(15.85)		
	Trial 2	207.50	(13.29)	165.35	(12.51)		
	Total	463.57	(19.59)	437.88	(20.84)	3.5087	0.0015
Phase 6: Additional Study	Trial 1	177.94	(8.67)	190.44	(13.92)		
	Trial 2	178.82	(8.39)	169.60	(6.88)		
	Total	356.74	(10.30)	358.64	(13.94)	-0.4313	0.6695
Phase 8: Mnemonic Learning	Trial 1	278.41	(11.64)	274.76	(12.59)		
	Trial 2	177.94	(19.45)	179.06	(26.90)		
	Total	456.35	(25.49)	454.13	(25.73)	0.2498	0.8044

TABLE IX

ANALYSIS OF VARIANCE FOR THE PROPORTIONS OF MEANINGS RECALLED IN PHASE ONE (BASELINE) AND PHASE TWO (TREATMENT)

Source	df	SS	F	p
Between Subjects				
Group	1	2.517	17.90	.0002
Within Subjects				
Phase	1	2.002	107.10	.0001
Groups by Phase	1	3.866	206.81	.0001
Trials Within Phase	2	0.626	43.86	.0001
Groups by Trials Within Phase	2	0.037	2.59	N.S.

TABLE X

ANALYSIS OF VARIANCE FOR THE TIME SPENT IN THE STUDY ASPECT OF THE TRIALS IN PHASE ONE (BASELINE) AND PHASE TWO (TREATMENT)

Source	df	SS	F	p
Between Subjects				
Group	1	825.947	6.34	.0170
Within Subjects				
Phase	1	62367.641	506.23	.0001
Groups by Phase	1	2379.546	19.31	.0001
Trials Within Phase	2	101473.436	340.34	.0001
Groups by Trials Within Phase	2	13460.391	45.15	.0001

TABLE XI

ANALYSIS OF VARIANCE FOR THE PROPORTIONS OF MEANINGS RECALLED IN PHASE FOUR (FIRST DELAYED RECALL) AND PHASE FIVE (SECOND DELAYED RECALL)

Source	df	SS	F	p
Between Subjects				
Group	1	2.018	23.20	.0001
Within Subjects				
Phase	1	0.908	66.21	.0001
Groups by Phase	1	0.327	23.84	.0001

TABLE XII

PERCENTAGE OF RESPONSES IN WHICH ONLY THE KEYWORD OR ITS ASSOCIATED MEANING, BUT NOT BOTH, WERE RECALLED

	Mnemonic Group						Control Group	
			Additional Study		Mnemonic Learning		Mnemonic Learning	
	Delay 1	Delay 2	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2
Keywords	8.4	27.3	7.6	2.1	12.6	5.0	12.6	6.3
Meanings	0.8	2.9	2.5	1.3	2.5	2.1	7.1	2.1

TABLE XIII

ANALYSIS OF VARIANCE FOR SCORES ON THE STATE-TRAIT ANXIETY INVENTORY IN PHASE SEVEN AND PHASE NINE

Source	df	SS	F	p
Between Subjects				
Group	1	4.250	0.03	N.S.
Within Subjects				
Phase	1	22.368	0.72	N.S.
Groups by Phase	1	12.368	0.40	N.S.

TABLE XIV

MEANS AND STANDARD DEVIATIONS ON
THE BASIC PROCESS TASKS

	Total Sample		Control Group		Mnemonic Group	
Measurement	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Speak	5.79	(2.72)	5.35	(1.32)	6.24	(2.91)
Mouth	6.12	(1.68)	6.00	(1.66)	6.24	(1.75)
Alter	29.91	(11.86)	29.76	(11.01)	30.06	(13.07)
Percept	17.71	(3.95)	17.18	(3.43)	18.24	(4.45)
Translate	28.21	(6.89)	27.41	(6.81)	29.00	(7.09)
Image	40.91	(18.56)	39.53	(17.04)	42.29	(20.40)
Span (Items)	5.38	(1.71)	5.71	(1.69)	5.06	(1.71)
Percept (Mistakes)	0.50	(0.83)	0.53	(0.80)	0.47	(0.87)
Translate (Mistakes)	2.06	(1.67)	2.00	(1.77)	2.12	(1.62)
Image (Mistakes)	3.79	(2.11)	3.59	(1.77)	4.00	(2.45)
Switch	23.94	(10.80)	24.09	(10.46)	23.78	(11.50)
Change	10.50	(6.37)	10.24	(6.90)	10.76	(6.01)
Imagine	23.21	(17.68)	22.35	(16.72)	24.06	(19.07)

Note: The units are seconds unless otherwise indicated by parentheses.

TABLE XV

REGRESSION EQUATIONS

Data Involved	R Square	Predicted Variable	Y Intercept	Weight	Predictor Variable	Weight	Predictor Variable
Both Groups	0.6710	Keywords (Phase 8)	0.4552	0.0373	Picture Arrangement	-0.0152	Coding
Both Groups	0.6668	Meanings (Phase 8)	0.3205	0.0460	Picture Arrangement	-0.0170	Coding
Control Group	0.4168	Meanings (Phase 2)	-0.3222	0.0475	Picture Arrangement		
Control Group	0.4083	Meanings (Phase 4)	-0.3704	0.0521	Picture Arrangement		
Control Group	0.4744	Meanings (Phase 5)	-0.2144	0.0309	Picture Arrangement		
Control Group	0.7409	Meanings (Phase 6)	-0.4663	0.0806	Picture Arrangement		
Control Group	0.5819	Keywords (Phase 8)	0.4019	0.0304	Picture Arrangement		
Control Group	0.5375	Meanings (Phase 8)	0.2880	0.0362	Picture Arrangement		
Mnemonic Group	0.5258	Meanings (Phase 5)	-0.5723	0.0924	Picture Arrangement		

TABLE XV (Continued)

Data Involved	R Square	Predicted Variable	Y Intercept	Weight	Predictor Variable	Weight	Predictor Variable
Mnemonic Group	0.6300	Meanings (Phase 6)	0.5338	0.0335	Picture Arrangement		
Mnemonic Group	0.5443	Meanings (Phase 8)	0.0043	0.0654	Picture Arrangement		

Note: The form of the regression equations is:
Predicted Variable = Y Intercept + (Weight)(Predictor Variable) + (Weight)(Predictor Variable).

TABLE XVI

PATTERNS OF HIGHLY CORRELATED VARIABLES

Main Item	Data Involved	Patterns of Other Variables with Main Item		
Picture Arrangement r p	Both Groups	Baseline Phase 0.38975 0.0227	Treatment Phase 0.34440 0.0461	First Delayed Recall 0.36552 0.0335
	Both Groups	Second Delayed Recall 0.48956 0.0033	Additional Study Phase 0.44383 0.0086	Mnemonic Learning Phase 0.67277 0.0001
Alternate	Both Groups	Full Scale IQ -0.48644 0.0041	Performance IQ -0.51560 0.0021	Picture Completion -0.50523 0.0028
	Both Groups	Picture Arrangement -0.55302 0.0008		
Switch	Both Groups	Full Scale IQ -0.47632 0.0051	Performance IQ -0.50268 0.0029	Picture Completion -0.47089 0.0057
	Both Groups	Picture Arrangement -0.54540 0.0010		
Baseline Phase	Control Group	Full Scale IQ 0.52757 0.0295	Verbal IQ 0.55715 0.0202	Information 0.72291 0.0010
	Control Group	Similarities 0.67479 0.0030	Vocabulary 0.70742 0.0015	WRAT Reading 0.74803 0.0021
Treatment Phase	Control Group	Full Scale IQ 0.49537 0.0432	Verbal IQ 0.52713 0.0297	Information 0.59479 0.0118
	Control Group	Similarities 0.51783 0.0332	Vocabulary 0.55708 0.0202	WRAT Reading 0.65475 0.0111

TABLE XVI (Continued)

Main Item	Data Involved	Patterns of Other Variables with Main Item		
First Delayed Recall	Control Group	Full Scale IQ 0.50588 0.0383	Information 0.58055 0.0145	Similarities 0.49881 0.0415
	Control Group	Vocabulary 0.48509 0.0484	WRAT Reading 0.56610 0.0348	
Second Delayed Recall	Control Group	Full Scale IQ 0.51869 0.0329	Verbal IQ 0.63545 0.0061	Information 0.59881 0.0111
	Control Group	Similarities 0.51414 0.0347	Vocabulary 0.62284 0.0076	WRAT Reading 0.62248 0.0174
Additional Study Phase	Control Group	Full Scale IQ 0.60983 0.0093	Verbal IQ 0.59112 0.0125	Information 0.57261 0.0163
		Similarities 0.58889 0.0129	Vocabulary 0.52918 0.0289	WRAT Reading 0.64468 0.0128
Mnemonic Learning Phase	Control Group	Full Scale IQ 0.69595 0.0019	Information 0.63772 0.0059	Similarities 0.60063 0.0108
		WRAT Reading 0.57237 0.0324		
Sentence Recall	Both Groups	Full Scale IQ -0.40570 0.0173	Verbal IQ -0.43843 0.0095	Information -0.36261 0.0351
	Both Groups	Similarities -0.55965 0.0006	Digit Span -0.60617 0.0046	
	Both Groups	Verbal Comprehension -0.47445 0.0053	Conceptual -0.46630 0.0062	Acquired Knowledge -0.42157 0.0130

APPENDIX H

FACTORS FOUND IN FACTOR ANALYTIC RESEARCH WITH THE WISC-R

Kaufman's (1975) Factors (from research with a normal population of children):

Verbal Comprehension: Information, Similarities, Comprehension, Vocabulary

Perceptual Organization: Picture Completion, Picture Arrangement, Block Design, Object Assembly

Freedom from Distractibility: Arithmetic, Digit Span, Coding

Smith, Coleman, Kokecki, and Davis' (1977) Factors (from research with a population of learning disabled children):

Conceptual: Similarities, Comprehension, Vocabulary

Spatial: Picture Completion, Block Design, Object Assembly

Sequential: Arithmetic, Digit Span, Coding

Acquired Knowledge: Information, Arithmetic, Vocabulary

APPENDIX I

STATE-TRAIT ANXIETY INVENTORY, A-STATE SCALE

Self-Evaluation Questionnaire

Developed by C. D. Spielberger, R. L. Gorsuch
and R. Lushene

STAI Form X-1

Name_____ Date_____

Directions: A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you feel right now, that is, at this moment. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

		Not At All	Somewhat	Moderately So	Very Much So
1.	I feel calm	1	2	3	4
2.	I feel secure	1	2	3	4
3.	I am tense	1	2	3	4
4.	I am regretful	1	2	3	4
5.	I feel at ease	1	2	3	4
6.	I feel upset	1	2	3	4
7.	I am presently worrying over possible misfortunes	1	2	3	4
8.	I feel rested	1	2	3	4
9.	I feel anxious	1	2	3	4
10.	I feel comfortable	1	2	3	4
11.	I feel self-confident	1	2	3	4
12.	I feel nervous	1	2	3	4
13.	I am jittery	1	2	3	4
14.	I feel "high strung"	1	2	3	4
15.	I am relaxed	1	2	3	4
16.	I feel content	1	2	3	4
17.	I am worried	1	2	3	4
18.	I feel over-excited and "rattled"	1	2	3	4
19.	I feel joyful	1	2	3	4
20.	I feel pleasant	1	2	3	4

APPENDIX J

A DESCRIPTION OF THE KEYWORD METHOD

FOR TEACHERS TO USE

AN EFFECTIVE WAY TO TEACH VOCABULARY

Investigations have shown the Keyword Mnemonic Method to be a very effective way of teaching vocabulary. When middle and high school boys used the Keyword Method to study fourteen difficult vocabulary words for eight minutes they remembered 82% of the definitions while boys not using the method recalled only 21% of the meanings!

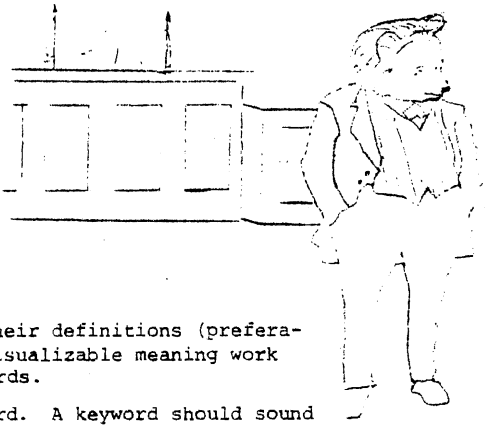
The Keyword Method is based on the principle of replacing a difficult association (between a new vocabulary word and its definition) with two easier associations. This is made possible by the use of a "keyword," a common word that sounds like part or all of the vocabulary word. Here is an example:

Vocabulary Word	Keyword	Definition
BARRISTER	BEAR	LAWYER

Acoustic Link — Imagery Link

The first easy association is a sound-alike acoustic link between the vocabulary word and the keyword. The link is based on the sound the words have in common. The second link is an imagery link. The student makes a mental picture with the keyword and the definition interacting. For example:

The student might see a funny picture of a bear in a suit acting like a lawyer. One might see the bear talking to the jury in a courtroom.



Later when the student hears or sees the vocabulary word, he/she will remember the keyword that sounds like the vocabulary word (BARRISTER-BEAR). When they remember their picture with that keyword (BEAR-LAWYER), they will then link together the word pairs and recall the definition of the vocabulary word (BARRISTER-LAWYER).

To utilize the Keyword Method in the classroom:

(a) Select a list of vocabulary words and their definitions (preferably synonyms). Words with a concrete visualizable meaning work best. A good list length is fifteen words.

(b) Choose a keyword for each vocabulary word. A keyword should sound like as much of the vocabulary word as possible. Ideally it will sound like the first syllable. It should be easy to form a memorable image connecting the keyword and the definition. Concrete nouns make good keywords since they are easy to picture.

(c) Teach your students the Keyword Method. You might call the keyword a "linking word" (like a link in a chain). Use several examples. Tell them the keywords to use and the images to see.

(d) Have the students use the Keyword Method to study the vocabulary list. Tell and show them a vocabulary word, its keyword, and the definition. Be sure they clearly see a mental picture before you move on to the next word.

(e) For your tests over the list, present each vocabulary word and ask the students to recall both the keyword and the definiton.

Furthermore, there may be many learning situations where one or more of the important processes underlying the effectiveness of the Keyword Method can be used: (a) replacing difficult associations with smaller easier ones, (b) organizing the associations in a logical order, (c) utilizing present knowledge (the keyword) in learning new material, and (d) having the students actively use mental pictures to learn verbal material.

VITA

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