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EFFECTIVENESS OF EXPERIMENTER-SUPPLIED AND SUBJECT-ORIGINATED FIRST LETTER AND DESCRIPTIVE SENTENCE MNEMONICS IN LEARNING WORD PAIRS

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Abstract

The purpose of this experiment was to compare the effectiveness of E-supplied and S-originated first letter and descriptive sentence mnemonics to a simple repetition condition. The Ss using E-supplied schemes suffered no losses in recall of 10 word pairs over 6-weeks, while Ss in the other three conditions showed significant retention losses at 2-day and 6-week intervals. The E-supplied schemes were significantly superior to S-originated schemes which in turn excelled the simple repetition condition. There were no differences in recall between the two E-supplied groups or between the two S-originated conditions. It was concluded that the source of the mnemonic was the crucial variable affecting recall.

According to Hall (1971), within "...the present state of psychology of verbal learning and retention...four major types of learning situations have been considered: (1) serial, (2) paired-associate, (3) free-recall, and (4) extended serial or contextual. [p. v]." It is becoming evident from

recent research that college students employ learning strategies or mnemonic devices as an aid in their efforts to learn verbal material of the first three varieties.

The effectiveness or type of mnemonic device used in free-recall situations has been documented by Eagle (1967), Roberts (1968), Boltwood and Blick (1970), and Blick and Waite (1971). Eagle (1967), studying the relationship between learning strategies and recall, found that Ss using associative organization recalled significantly more words than Ss using a straight rehearsal method. Boltwood and Blick (1970) allowed college students to choose their own mnemonic device to aid in learning 19 English nouns. From survey data, the authors delineated the first letter (FL), clustering (C), and descriptive story (DS) techniques. The FL device involves any manipulation of the first letters of the words in order to facilitate learning; however, usually the device is one in which the first letters of several words are arranged to spell a word. In contrast, the DS technique designates the arrangement of words into narrative forms with the words being used to form a story or sentence. The clustering of words into meaningful conceptual categories is termed the C scheme. In a second experiment (Boltwood and Blick, 1970), Ss applied the previously detailed devices and recall was compared to a simple repetition (SR) control condition, which is not generally considered a mnemonic technique and refers to simple rote memorization of the words. No significant differences were found in an immediate recall test; but the DS and C aids

produced significantly higher levels of recall one week later. At eight weeks, only the DS technique yielded a significantly higher level of recall. Blick and Waite (1971), without presenting actual words, asked Ss what mnemonic devices they would use in a free-recall situation and found Ss reported the following devices: FL, SR, other, C, personal experience, and DS. In the "other" category were grouped reports of idiosyncratic learning systems and unexplained association systems. The classification of personal experience referred to memory aids relating the words to S's personal experiences. In conclusion, the authors stated, "...first letter is reported significantly more than the other four mnemonic systems ...The most popular mnemonic that Ss invent is the first letter technique.../p. 787."

The effect of mnemonics in serial learning has been investigated by Bower and Clark (1969), and the types of mnemonics employed in serial learning have been surveyed by Blick, Buonassissi, and Boltwood (1972). In the Bower and Clark (1969) study, Ss had to learn 12 serial lists of 10 nouns by either normal study and rehearsal or narrative chaining (another term for the DS technique). The Ss using the narrative chaining mnemonic recalled 93% of the material as compared to 13% recalled by the control group. The authors concluded that the use of the mnemonic demonstrated the role of organization in increasing learning, decreasing interlist interference, and aiding reconstructive recall. Blick et al. (1972), using the hypothetical word-list method of Blick and

Waite (1971), reported eight types of memory aids in a serial learning task. The FL and SR devices accounted for 48% of all aids, while 52% were evenly divided among imagery, DS, mediation (Med), other, phonetic clustering, and semantic clustering. Briefly, imagery referred to techniques that involved using visual images of the words; Med accounted for techniques where extra-list words were related to the words in the list; phonetic clustering incorporated grouping words according to similarity in sounds; and semantic clustering designated words grouped on the basis of meaning. The authors conclude, "...For the serial task, the present survey showed the first letter technique was also the predominant mnemonic [p. 986]."

The types of mnemonic aids in paired-associate tasks have been surveyed by Blick and Boltwood (1972), and the effectiveness of mnemonics in this learning situation has been documented by Underwood and Schulz (1960, p. 296-300); Clark, Lansford, and Dallenbach (1960); Bugelski (1962); Martin, Boersma, and Cox (1965); Montague, Adams, and Kiess (1966); Montague and Wearing (1967); and Olton (1969). Underwood and Schulz (1960, p. 296-300), using trigrams, established that by far the most popular association (62% of all cases) was use of a single letter of the stimulus term to mediate the association. Clark et al. (1960) listed a number of idiosyncratic devices; some simple and spontaneous, other elaborate and bizarre. Above all, they reported that a "vast majority" of the paired-associates were learned by mnemonic devices

i.e., indirect association (A → C → B). Another study (Bugelski, 1962), with Ss learning pairs of nonsense syllables, revealed that in 67% of the total possible learning units, Ss made use of the Med mnemonic device. Those pairs that lent themselves most readily to translation into two meaningful words or could be combined into one word or initiate some imagery were most easily learned. Martin et al. (1965), after Ss reported how they attempted to form associations between paired-associates, found an increasing relationship between the complexity of the associative strategy and correct performance on individual items. Utilizing 95 CVC pairs and investigating the use of natural language mediators (NLMs), Montague et al. (1966) showed that the NLMs enhanced retention. The Es defined a NLM as any kind of association that S brings to bear on his verbal learning task. NLMs could take the form of a one-word association between the stimulus and response pairs, one or more sentences, or similarity of sounds. Finding that items for which NLMs were retained were recalled more than 70% of the time, the authors stated "...we conclude that NLMs are a very positive factor in the retention of paired-associates [p. 832]." In another experiment (Montague and Wearing, 1967), a simple paired-associate recall test was used, and Es concluded that ease of learning was a function of the complexity of the associative strategy used in learning. They found a decrease in errors with the use of more complex mediational strategies. Also, Olton (1969), using pairs of nouns and the DS mnemonic, found that the use

of the mnemonic significantly increased the rate of learning compared with a no-mnemonic control group. Blick and Boltwood (1972) conducted the first comprehensive survey of mnemonic devices used by college students in paired-associate learning. Again, using the hypothetical word-list method, their Ss were asked to describe what memory aids they would employ in learning a long list of pairs of words in a relatively short period of time. Nine categories were identified and divided into two major classifications; with the primary aids accounting for 59% of the memory aids reported and evenly distributed among FL, imagery, phonetic clustering, and SR. The remaining 41% (secondary aids) were evenly distributed among semantic clustering, other, DS, Med, and personal experience. In closing, the authors concluded "...there was apparently no single dominant mnemonic aid in the paired-associate situation, since Ss reported a variety of primary strategies. The three primary mnemonic aids Ss would employ most often were first letter, imagery, and phonetic clustering, followed by four secondary types [p. 462]."

Not all mnemonics are equal in their effects on retention. Studies by Rohwer (1966), Olton (1969), and Boltwood and Blick (1970) have determined the DS mnemonic to have a very powerful effect on learning and retention. In an experiment investigating the facilitation of paired-associate learning produced by imbedding each word pair in a sentence, Rohwer (1966) found that a S who heard a linking sentence such as "The COW chased the BALL." recalled the COW-BALL pair better than a

control S who simply studied the pair without a sentence context. Rohwer concluded, "The results clearly indicate that meaningfulness and syntactic structure in combination are properties of verbal storing which facilitate learning [p. 546]." Similarly, Olton (1969) reported that Ss using the DS mnemonic learned significantly more word pairs than Ss using the SR condition. In another study (Boltwood and Blick, 1970), the effectiveness of the DS, FL, and C mnemonics was compared and the authors established that the DS group had significantly better recall of words after eight weeks than the other groups. The Es came to the conclusion that "...only the DS technique was effective at the eight week retention interval. It was hypothesized that the DS technique was effective because it resulted in a meaningful syntactical arrangement of the words to be remembered... [p. 341]."

Surveys by Roberts (1968), Boltwood and Blick (1970), Blick and Waite (1971), Blick and Boltwood (1972) and Blick et al. (1972) have indicated that the FL technique is among the most popular mnemonic techniques in free-recall, paired-associate, and serial learning tasks. In the first study, Roberts (1968) reported that 60% of his Ss grouped words by their first letters. In a later study, (Boltwood and Blick, 1970) Ss were presented with a list of words to learn and then the mnemonic devices chosen were analyzed. The Es found that 38% of their Ss used the FL technique, 31% C, 22% DS, and 6% SR. Blick and Waite (1971) established that the FL device was preferred 34% of the time, the next highest being

SR at 21%. In an experiment with similar methodology, (Blick and Boltwood, 1972) 15% of Ss favored the use of the FL technique. Finally, Blick et al. (1972) stated that the FL mnemonic aid was the most popular device when Ss were asked which they would choose if they actually had to learn a list of words.

While the popularity of the FL technique seems well established, its effectiveness as an aid to recall is not. Pash and Blick (1970) reported that Ss who used the FL technique demonstrated superior retention of verbal material after 48 hours compared to a control group. In two earlier studies, (Freund and Underwood, 1969; Roberts, 1968) alphabetic cues were found to have no effect on the immediate retention of a list of nouns. In an experiment utilizing longer retention intervals, (Boltwood and Blick, 1970) the FL device was not significantly superior to the DS and C techniques or even to the SR device over retention intervals of one week and eight weeks.

The effectiveness of a mnemonic technique as an aid to free recall is greatly influenced by whether or not the mnemonic scheme is E-supplied or S-originated. Kibler and Blick (1972) offered an explanation for the differences in performance of Ss using the FL mnemonic in Pash and Blick (1970) and Boltwood and Blick (1970) in similar free-recall tasks. Pash and Blick supplied Ss with a FL mnemonic and found those who used the scheme showed significantly better retention than Ss who did not use the FL mnemonic. However, Boltwood and Blick instructed their FL group in the use of the technique

but Ss had to originate their own FL device when actually presented with words to learn. When Ss had to supply their own FL scheme, they did not differ significantly from the SR control group. Kibler and Blick (1972), deciding that the FL technique had varying effects on free-recall depending on whether the mnemonic was E-supplied or S-originated, provided one group of Ss with an E-supplied FL mnemonic and allowed the second group of Ss to devise their own FL aid. Free recall was tested immediately and at intervals of one day, one week, and four weeks. There were no differences in recall of 19 nouns at the immediate test, but Ss with the E-supplied scheme showed significantly superior recall compared to those Ss with the S-originated aid at the other retention intervals. The authors furthermore attempted to identify the reason for the better performance of the E-supplied group. They found that after four weeks, 75% of the E-supplied Ss recalled the mnemonic in its entirety compared to only 41% of the S-originated group. From this, Kibler and Blick (1972) concluded, "The existence of a strong correlation between how easily a mnemonic scheme is recalled and the over-all effectiveness of the mnemonic may be the key in answering the question concerning the efficacy of mnemonic techniques, irrespective of whether the device is E-supplied or S-originated.../p. 312/."

Kibler and Blick (1972) found that an E-supplied FL mnemonic technique excelled a S-originated FL scheme as an effective aid to free-recall. On the other hand, Lieberman, Walters, and Cox (1968), using 42 word pairs and providing

one group with a Med mnemonic while having a second group devise their own mnemonic aid; reported no difference in the number of pairs learned. In contrast, Bobrow and Bower (1969), using a paired-associate learning task and the DS mnemonic, reported the S-originated group to be superior. The Es believed that Ss who supplied their own schemes have better comprehension and hence better retention compared to Ss who were provided with descriptive sentences. These results, coupled with the findings of Lieberman et al. (1968); demonstrate that the S-originated device, supposedly the more difficult task, is not necessarily the inferior mnemonic device. Utilizing a free-recall task, Buonassissi, Blick, and Kibler (1972) reported no significant differences between E-supplied and S-originated DS schemes across five retention intervals. Their study supports the no differences found by Lieberman et al. (1968), but does not support either Kibler and Blick (1972) or Bobrow and Bower (1969).

The purpose of the present experiment was to compare the effectiveness of the FL and DS mnemonics as well as the efficacy of the E-supplied and S-originated schemes to a SR control group in a modified paired-associate verbal task. This task should not be considered a traditional paired-associate learning situation since on recall tests the entire pair (A-B) was recalled without prompting.

From previous research (Kibler and Blick, 1972; Boltwood and Blick, 1970), there should be no differences between any of the five groups at the immediate recall test, and the

E-supplied FL group will recall significantly more word pairs than the S-originated FL group at the other three retention intervals.

Like Bobrow and Bower (1969), it is hypothesized that the S-originated DS group will recall significantly more word pairs than the E-supplied DS group, but only at the six week retention test. These results would disagree with the finding of Buonassissi et al. (1972), but it is felt that in a paired-associate task, like Bobrow and Bower (1969), a S-originated sentence would add greater comprehension than E-supplied sentences and thus aid retention and recall.

In comparing the effectiveness of the DS and FL techniques, it is hypothesized that both conditions of the DS scheme will recall significantly more word pairs than the S-originated FL group. But since Kibler and Blick (1972) demonstrated the effectiveness of the E-supplied FL scheme on retention, it is expected that only at the six week retention test will S-originated and E-supplied DS groups recall significantly more pairs than the E-supplied FL condition.

METHOD

Subjects

Originally, 180 University of Richmond undergraduates, both males and females, from five introductory psychology classes served as Ss. Participation in the experiment, which was conducted during class time, was a requirement of the course. Following the 6-week retention test, the scores from

34 Ss had to be discarded because 9 Ss failed to follow instructions (e.g. using a different mnemonic device other than the assigned one) and 25 Ss failed to attend each session of the experiment.

Apparatus

The verbal material to be learned by Ss consisted of 10 pairs of English nouns giving a total of 20 words, 19 of which were used in experiments by Boltwood and Blick (1970) and Kibler and Blick (1972). The word pairs, always presented in the following order, were: motorcycle-archery, dresser-volcano, petticoat-sandals, felony-lung, influenza-garlic, haddock-topaz, worsted-rafter, eternity-cobalt, kerosene-journalist, and oboe-blizzard. The words were further characterized by low frequency of occurrence (15 times or less per million words) according to the Thorndike and Lorge (1944) word-frequency tables. In order to minimize conceptual relatedness among the words, each word was selected from a different one of Cohen, Bousefield, and Whitmarsh's (1957) conceptual categories. Each of the 20 words was checked to insure it occured in only one of the 20 categories used. For example "archery" belongs to the category "A Sport," and none of the other 19 words are members of this category.

Each S received a test booklet the first day with a cover sheet of instructions explaining the use of mnemonics, specifying the mnemonic device to be used, and an example of the device; a yellow sheet with the 10 pairs of words and either the E-supplied device or space for the S-originated Ss to

devise a mnemonic; a sheet with supplementary instructions; a green sheet with 10 pairs of blank spaces for recall; and a final sheet asking Ss to detail the mnemonic used. For the two days and one week tests of retention, Ss were provided with a sheet of 10 pairs of blank spaces. For the final recall test, Ss were provided with the recall sheet and a second sheet asking Ss to detail the device used. Colored pages were used to aid Ss in following E's instructions.

Design and Procedure

The experiment was a 5x4 design with repeated measures on the second factor. The first factor was the four different mnemonic conditions: first letter E-supplied (FL-E), first letter S-originated (FL-S), descriptive sentence E-supplied (DS-E), descriptive sentence S-originated (DS-S); and the simple repetition (SR) control group. The second factor was the four retention intervals: immediate, two days, one week, and six weeks. A recall test was given to all five groups at each of the four retention intervals.

Each of the five classes were randomly assigned to one of the five conditions: SR (n=33), FL-E (n=32), FL-S (n=24), DS-E (n=27), DS-S (n=30). All Ss, after receiving a booklet, were told they would have seven minutes in which to familiarize themselves with the word pairs. At the end of that time interval, they were told they would have three minutes to learn the word pairs using the memory device provided or explained, and two minutes to recall the word pairs. The additional three minutes learning period was used in an attempt

to equate time spent across all groups in actual learning of the word pairs after mnemonic aids had been devised.

The cover page of each booklet explained the use of mnemonics and that learning pairs of words could be increased by the use of the assigned mnemonic condition. If possible, an example of the suggested mnemonic was provided. The introductory instruction for all groups was:

> This is an experiment in verbal learning. The purpose is to test whether or not you can familiarize yourself with a long list of word pairs in a relatively short period of time by using a given memory device.
>
> When I say "begin" turn to the next page and familiarize yourself with the word pairs you find there using the memory aid explained below. You will be given seven minutes in which to familiarize yourself with the word pairs.

At this point, DS-S and FL-S Ss were told: "...You will use the bottom half of the page to determine and illustrate briefly your memory aid." DS-E Ss were informed: "...A memory aid has been devised for you and is printed below the list of word pairs." FL-E Ss were told: "...A memory aid has been devised for you and is printed beneath and to the side of the word pairs." Following this, each group received separate instructions also printed on the first page detailing the mnemonic device to be used. The SR group was told that the list was best learned by simple rote memorization and repetition. The DS-E and FL-E groups were told that a descriptive sentence and first letter technique, respectively, had been devised for them by E and that the memory aid was printed below the list of words to be learned. The DS-S and FL-S

groups were informed that they would be required to devise their own descriptive sentence and first letter schemes in the space provided on the second page.

The instructions for the SR group were:

> For tasks in which long lists of word pairs are to be learned, psychologists have found the following memory trick or aid very useful. The person simply repeats the word pairs over and over until he is sufficiently familiar with them. It is easy to remember word pairs this way since you are repeating the entire word pair and not just studying fragments of the pairs which might cause interference.

Instructions to the DS-E and DS-S groups were:

> For tasks in which long lists of word pairs are to be learned, psychologists have found the following memory trick or aid very useful. The person makes up a sentence in which the word pair to be remembered is used. The word on the left is used before the word on the right in the sentence. For example, if I had to remember the word pair "cow-ball," I might remember the word pair by remembering a sentence such as "The cow chased the ball." It is easy to remember words this way for you are remembering a meaningful sentence rather than a list of unrelated words.

In addition, the DS-E group was told: "...To help you familiarize yourself with the word pairs, sentences using each pair have been written for you and are printed below the list of word pairs."

The instructions to the FL-S and FL-E groups were:

> For tasks in which long lists of words are to be learned, psychologists have found that the following memory trick or aid is very useful. The person reads the list several times in order to familiarize himself with the words but then he concentrates on familiarizing himself with the first letters of each word pair. He might learn the letters in groups of three or four letters each or learn the letters in alphabetical order or learn the letters by spelling a word out of the

> letters. When he later tries to remember the list of word pairs, he first recalls the letters and connects each first letter with the appropriate word. It is easy to remember words this way because in memorizing letters, one is learning smaller bits of information than he would be in memorizing the actual words.

Ss in the FL-E group were also told: "...The first letters of the word pairs have been grouped into words or abbreviations which are printed beside the word pairs and which you will use to help familiarize yourself with the word pairs."

After reading the cover page, all Ss turned to the word pairs on the yellow page. The SR group was provided with only the 10 word pairs previously described. The DS-S and FL-S groups were provided with the 10 word pairs and were told to devise mnemonic aids. The DS-E group was provided with the word pairs and 10 sentences, utilizing each word pair. Each word pair was typed in capital letters within the sentences. The sentences were:

> He rode a MOTORCYCLE to ARCHERY.
> The DRESSER fell into the VOLCANO.
> Under her PETTICOAT she wore SANDALS.
> His FELONY was for stabbing someone's LUNG.
> INFLUENZA can be cured with GARLIC.
> Inside the HADDOCK was a TOPAZ.
> The cloth, WORSTED, hung from the RAFTER.
> Roads to ETERNITY are paved with COBALT.
> He poured KEROSENE over the JOURNALIST.
> An OBOE sounds flat in a BLIZZARD.

Each sentence was between five and seven words in length. The sentence structure was not identical, however all word pairs were used as nouns.

The FL-E group was provided with the word pairs and the first letters of each word underlined. The word pairs were

presented in the same order as previously described, and beside and beneath the word pairs, the first letters of each word were combined in order of presentation to form the following first letter mnemonic: MAD VPS (vice-presidents) FLIGHT WRECK JOB. The mnemonic was an adaptation of the device used by Kibler and Blick (1972). The words were presented in the following manner:

MOTORCYCLE - ARCHERY	MAD
DRESSER - VOLCANO	VPS (vice-presidents)
PETTICOAT - SANDALS	
FELONY - LUNG	FLIGHT
INFLUENZA - GARLIC	
HADDOCK - TOPAZ	
WORSTED - RAFTER	WRECK
ETERNITY - COBALT	
KEROSENE - JOURNALIST	JOB
OBOE - BLIZZARD	

As previously stated, all Ss were given seven minutes to familiarize themselves with the word pairs and/or devise their mnemonic aids. At the end of this time period, all Ss turned to the third page which informed them they were to turn back to the yellow page and that they now had three minutes to learn the word pairs. All Ss would then have two minutes to recall the word pairs. The pairs did not have to be recalled in order and pair reversals (A-B recalled as B-A) were correct. Ss were also told, for attendance purposes, that they would be tested again in two days, one week, and six weeks. The

instructions to all Ss at this juncture were:

> Now you will have three minutes to learn the word pairs using the memory trick previously suggested. At the end of three minutes I will say "stop." At that time you are to turn to the green page and write down as many of the words you have just learned. You will be given two minutes to write down all the word pairs you can remember. You need not write the pairs in the order they are presented and pair reversals (A-B recalled as B-A) are correct.
>
> You will be tested again in two days on the words you learn today. Another test will be given you in one week and a final test in six weeks. Therefore it is important that you learn the pairs well.
>
> I want you to use the memory trick suggested in trying to learn the word pairs on the page. Later you will be asked to write down the memory trick you used. You must use this technique or your score on the experiment will be invalid and will have to be thrown out. It is critical to the entire experiment that you try to remember these word pairs by using the assigned technique that I have given you.

After three minutes, all Ss turned to the green page and were given two minutes to recall the word pairs.

After completing the immediate recall test, S-originated Ss were questioned whether they had enough time to devise their techniques. All Ss were asked to detail their technique and if they did not use their assigned mnemonic aid, to explain what they did use. Finally all Ss were instructed not to discuss the experiment while it was in progress and to refrain from practicing or writing down the words between sessions.

A two-minute recall test was given at two days, one week, and six weeks. At the last session, Ss were again asked to recall the mnemonic device used and whether they discussed the experiment with any of their classmates.

RESULTS

Although 146 Ss participated in the experiment, for two reasons the scores from only 80 Ss were used in the final analysis. (see Appendix A for original analysis)

From Kibler and Blick (1972) came justification for reduction of Ss. They stated, "The existence of a strong correlation between how easily a mnemonic scheme is recalled and the over-all effectiveness of the mnemonic may be the key in answering the question concerning the efficacy of mnemonic techniques.../p. 312/." For this reason, 33 Ss who on the six-week recall test could not recall one-half or more of their mnemonic devices were discarded from the analysis.

Secondly, according to Winer (1962), "If the n's do not differ markedly from each other, the harmonic mean of the n's may be used.../p. 216/." Since the n's in each of the five groups differed so markedly (16 Ss in one condition to 33 Ss in another condition), an unweighted means analysis utilizing the harmonic mean was unfeasible. With the use of a table of random numbers, Ss were eliminated to reduce the number of Ss in each group to 16.

The mean number of words recalled correctly over the immediate, two-day, one-week, and six-week retention intervals for the SR, FL-E, FL-S, DS-E, and DS-S groups are presented in Figure 1.

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Insert Figure 1 about here

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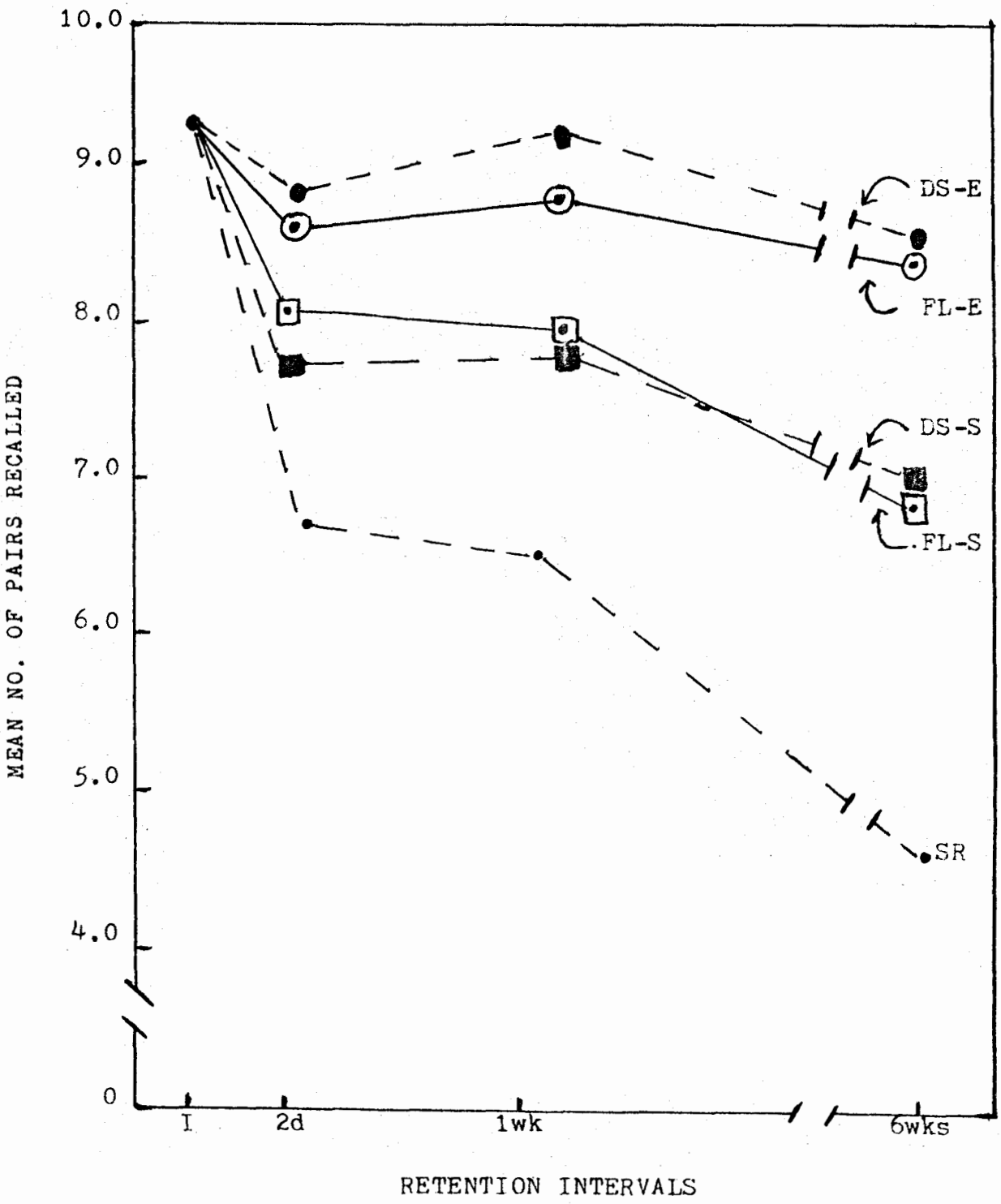

Fig. 1. Mean number of pairs correctly recalled for all five conditions following immediate, 2-day, 1-wk., and 6-wk. retention tests.

An analysis of variance (ANOV) was performed to learn if there were any significant effects of the two factors, mnemonic conditions and retention intervals, and their interaction. The overall effects of the mnemonic conditions (A) were significant, $F(4,75) = 3.28$, $p<.05$, as were the effects of retention intervals (B), $F(3,225) = 51.60$, $p<.05$ and interaction (AxB), $F(12,225) = 5.87$, $p<.05$. A summary of the ANOV is presented in Table 1.

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Insert Table 1 about here

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The significant interaction permitted the investigation of simple effects to determine whether there was a significant difference between the five groups at each retention level and across retention levels for each of the groups. The analysis of simple effects indicated that at the immediate level there were no differences between any of the groups [$F(4,300)<1$, $p>.05$]. At each of the other intervals, the differences between groups were significant with F's = 2.64, 3.41, and 9.11 (df = 4,300, $p<.05$) at the two-day, one-week, and six-week intervals, respectively. Examination of the simple effects across retention intervals for each group revealed no significant retention losses for either the FL-E [$F(3,225) = 1.11$, $p>.05$] or DS-E [$F(3,225) = 1.92$, $p>.05$] groups. However, significant losses in recall were noted for the SR, FL-S, and DS-S groups [F's (3,225) = 49.50, 11.67, 10.87, $p<.05$, respectively]. The ANOV simple effects summary table is

TABLE 1

Analysis of Variance:

Mnemonics X Retention Intervals

Source	SS	df	MS	F
Between subjects		79		
Mnemonics (A)	182.58	4	45.65	3.28*
Subj. w. groups	1042.62	75	13.90	
Within subjects		240		
Retention Intervals (B)	179.58	3	59.86	51.60*
Mnem. X RI (A X B)	81.67	12	6.81	5.87*
B X Subj. w groups	261.50	225	1.16	

$F_{.95}$ (4,75) = 2.45 $p<.05$

$F_{.95}$ (3,225) = 2.60 $p<.05$

$F_{.95}$ (12,225) = 1.75 $p<.05$

presented in Table 2.

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Insert Table 2 about here

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A Newman-Keuls test of ordered means was performed on the means of the five groups at the two-day retention interval and a summary of the results are shown in Table 3. All

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Insert Table 3 about here

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four mnemonic conditions recalled significantly more word pairs than the SR group at the two-day level. Also, the two E-supplied groups (FL-E and DS-E) recalled significantly more pairs than the DS-S group.

The Newman-Keuls test on the means at the one-week interval again showed all mnemonic conditions having significantly better recall than the SR group. The DS-E group furthermore recalled significantly more pairs than both S-originated conditions (FL-S and DS-S). The data are presented in Table 4.

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Insert Table 4 about here

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A final Newman-Keuls at the six-week interval, presented in Table 5, again demonstrated that all four mnemonic conditions recalled significantly more word pairs than the SR group. Also, at this longest retention interval, the E-supplied groups each recalled significantly more pairs than

TABLE 2

Analysis of Variance:

Simple Effects of Significant Interactions

Source	SS	df	MS	F
Mnem. at I	0.58	4	0.15	0.03
Mnem. at 2 days	45.95	4	11.49	2.64*
Mnem. at 1 week	59.30	4	14.83	3.41*
Mnem. at 6 weeks	158.43	4	39.61	9.11*
Pooled error	1304.12	300	4.35	
Ret. Int. at SR	172.25	3	57.42	49.50*
Ret. Int. at FL-E	3.88	3	1.29	1.11
Ret. Int. at FL-S	40.63	3	13.54	11.67*
Ret. Int. at DS-E	6.69	3	2.23	1.92
Ret. Int. at DS-S	37.82	3	12.61	10.87*
B X Subj. w groups	261.50	225	1.16	

$F_{.95}$ (4,300) = 2.37 $p<.05$

$F_{.95}$ (3,225) = 2.60 $p<.05$

TABLE 3

Newman-Keuls Test of Differences Between Means of Mnemonics at Two-Days

Treatments		1	2	3	4	5
	Means	6.75	7.75	8.13	8.69	8.88
SR	6.75		1.00	1.38	1.94	2.13
DS-S	7.75			0.38	0.94	1.13
FL-S	8.13				0.56	0.75
FL-E	8.69					0.19
DS-E	8.88					
	K		2	3	4	5
	q.95 (K,300)		2.77	3.31	3.63	3.86
	$s_{\bar{X}}$ q.95 (K,300)		0.72	0.86	0.94	1.00

	SR	DS-S	FL-S	FL-E	DS-E
SR		*	*	*	*
DS-S				*	*
FL-S					
FL-E					
DS-E					

$p < .05$

TABLE 4

Newman-Keuls Test of Differences Between Means of Mnemonics at One-Week

Treatments	Means	1 6.63	2 7.88	3 8.00	4 8.75	5 9.13
SR	6.63		1.25	1.37	2.12	2.50
DS-S	7.88			0.12	0.87	1.25
FL-S	8.00				0.75	1.13
FL-E	8.75					0.38
DS-E	9.13					
K			2	3	4	5
q.95 (K,300)			2.77	3.31	3.63	3.86
$s_{\bar{x}}$ q.95 (K,300)			0.72	0.86	0.94	1.00

	SR	DS-S	FL-S	FL-E	DS-E
SR		*	*	*	*
DS-S					*
FL-S					*
FL-E					
DS-E					

$p < .05$

either S-originated group.

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Insert Table 5 about here

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The findings of the Newman-Keuls tests on differences across retention intervals disclosed that the SR, DS-S, and FL-S groups all suffered significant losses in recall between the immediate and other three retention intervals. A significant recall loss was also found for the same three groups between the two-day and six-week intervals and between the one-week and six-week intervals. However, there were no significant losses in recall between the two-day and one-week intervals for the three groups. These results are presented in Tables 6, 7, and 8.

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Insert Table 6 about here

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Insert Table 7 about here

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Insert Table 8 about here

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Finally, of interesting note is the fact that in spite of directions telling Ss that the word pairs did not have to be learned or recalled in the order of presentation, the pairs were generally recalled in their presentation order. A plot

TABLE 5

Newman-Keuls Test of Differences Between Means of Mnemonics at Six-Weeks

Treatments	Means	1 4.63	2 6.94	3 7.06	4 8.44	5 8.50
SR	4.63		2.31	2.43	3.81	3.87
FL-S	6.94			0.12	1.50	1.56
DS-S	7.06				1.38	1.44
FL-E	8.44					0.06
DS-E	8.50					
K			2	3	4	5
q.95 (K,300)			2.77	3.31	3.63	3.86
$s_{\bar{x}}$ q.95 (K,300)			0.72	0.86	0.94	1.00

	SR	FL-S	DS-S	FL-E	DS-E
SR		*	*	*	*
FL-S				*	*
DS-S				*	*
FL-E					
DS-E					

$p < .05$

TABLE 6

Newman-Keuls Test of Differences Between Means of Retention Intervals at SR

Intervals		1	2	3	4
	Means	4.63	6.63	6 75	9.25
6-wks.	4.63		2.00	2.12	4.62
1-wk.	6.63			0.12	2.62
2-days	6.75				2.50
I	9.25				
	K		2	3	4
	q.95 (K,225)		2.77	3.31	3.63
	$s_{\bar{x}}$ q.95 (K,225)		0.28	0.33	0.36

	6-wks	1-wk.	2-days	I
6-wks.		*	*	*
1-wk.				*
2-days				*
I				

$p < .05$

TABLE 7

Newman-Keuls Test of Differences Between Means of Retention Intervals at DS-S

Interval:		1	2	3	4
	Means	7.06	7.75	7.88	9.19
6-wks.	7.06		0.69	0.82	2.13
2-days	7.75			0.10	1.44
1-wk.	7.88				1.31
I	9.19				
	K		2	3	4
	q.95 (K,225)		2.77	3.31	3.63
	$s_{\bar{x}}$ q.95 (K,225)		0.28	0.33	0.36

	6-wks.	2-days	1-wk.	I
6-wks.		*	*	*
2-days				*
1-wk.				*
I				

p<.05

TABLE 8

Newman-Keuls Test of Differences Between Means of Retention Intervals at FL-S

Intervals		1	2	3	4
	Means	6.94	8.00	8.13	9.19
6-wks.	6.94		1.06	1.19	2.25
1-wk.	8.00			0.13	1.13
2-day	8.13				1.06
I	9.19				
	K		2	3	4
	q.95 (K,225)		2.77	3.31	3.63
	$s_{\bar{x}}$ q.95 (K,225)		0.28	0.33	0.36

	6-wks.	1-wk.	2-days	I
6-wks.		*	*	*
1-wk.				*
2-days				*
I				

$p < .05$

of the total number of times each word pair was missed revealed an approximation of the serial position curve; with the pairs occurring first and last in the list being recalled better (fewer misses) than pairs in the middle of the list. Visual inspection of Figure 2 revealed that the first three word pairs and the last two pairs were the lowest points on the curve. This effect is depicted in Figure 2.

- - - - - - - - - - - - - - - - -

Insert Figure 2 about here

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A total of misses and reversals for each of the 10 pairs of words for every group is presented in Table 9 in the appendix. These data, however, were not used in the reported analyses since no other trends were readily discernable.

DISCUSSION

From the results it appeared that E-supplied mnemonic aids are more effective for recall than either S-originated devices or a SR condition. The fact that neither the FL-E or DS-E conditions suffered significant retention losses over any of the retention intervals established the superiority of an E-supplied device. Like some complex perceptual motor skills that are relatively impervious to the effects of time, interference, and forgetting; the E-supplied devices served to establish practically a non-forgetting curve for a verbal task. While Kibler and Blick (1972) in a free-recall task found their FL-E group to be superior to a FL-S condition, their FL-E

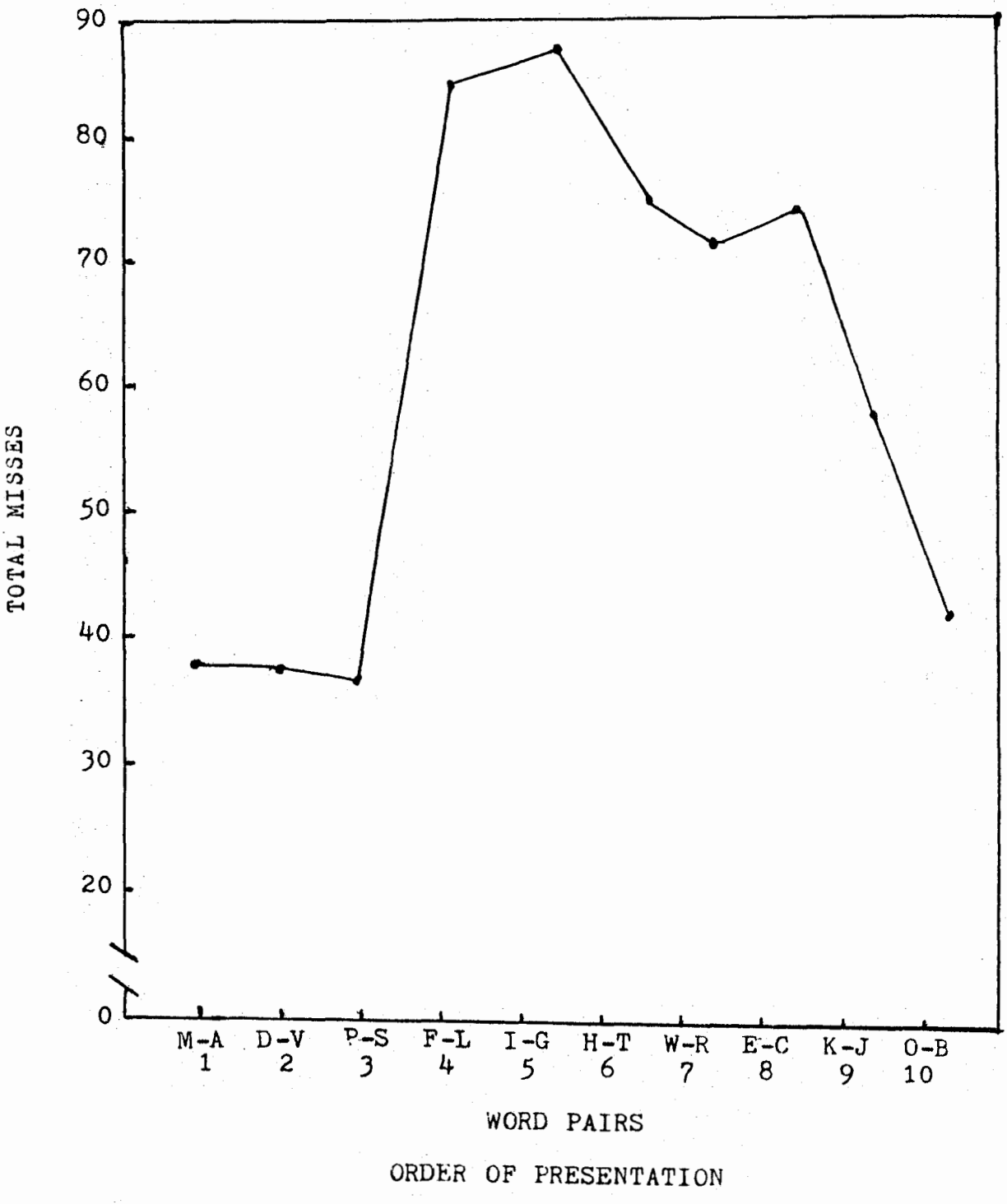

Fig. 2. Number of word pairs missed as a function of order of presentation.

group did suffer a significant retention loss between the immediate and one-day retention intervals. The fact that no significant losses in retention were found for the E-supplied conditions set forth the proposition that the E-supplied schemes provided superior encoding of verbal material which in turn served to stabilize the retention level.

Of important note is the fact that previous studies (Boltwood and Blick, 1970; Waite, Blick, and Boltwood, 1971; Roberts, 1968; Freund and Underwood, 1969) have reported the FL device to be an inferior mnemonic when compared to other devices. For the first time, the results indicated that the FL device can be as effective as the DS aid (considered to be the most effective) over long retention intervals when it is E-supplied. Since there were no differences in recall between the FL-E and DS-E groups, it appeared that the source of the mnemonic, not the specific device itself, became the crucial variable on retention tests beyond the immediate level.

In the present study, at every retention level save the immediate, the E-supplied groups recalled significantly more word pairs than the other three conditions. The retention losses for the SR, FL-S and DS-S groups, after the immediate level, came as no surprise since the retention functions reflected the findings of similar studies (Boltwood and Blick, 1970; Waite et al., 1971; Kibler and Blick, 1972).

While the S-originated devices were inferior when compared to the E-supplied schemes, they were nevertheless superior to the SR condition. At every retention level, except

the immediate, the FL-S and DS-S conditions recalled significantly more word pairs than the SR group. From the results it seemed clear that even S-originated mnemonics, relatively ineffective compared to E-supplied, are better than no mnemonics at all (the SR group). Furthermore, it appeared that the type of mnemonic used was not the significant variable when examining the effects of the FL-S and DS-S conditions. The results indicated two salient findings: (1) mnemonics, regardless of source, are superior to a SR condition and (2) the source of the mnemonic is critical for the maximum enhancement of retention and recall.

Previous research examining the effects of E-supplied and S-originated groups using the DS device in a free-recall task (Buonassissi et al., 1972) and the paired-associate task (Bobrow and Bower, 1969) have yielded conflicting results. Buonassissi et al., (1972) found no differences existed between DS-S and DS-E Ss. Bobrow and Bower (1969) and Lieberman et al., (1968) demonstrated that the S-originated device, supposedly the more difficult task, was not necessarily the inferior mnemonic technique. It must be noted that in the latter two studies Es used words of relative high frequency of occurrence and results were not compared to a SR group. In fact, the DS-E group in the Bobrow and Bower (1969) study greatly resembled a SR condition. Also, the task was so disguised as to have had possible effects on the outcome of the experiment. The DS-E group was told to repeat a sentence three times, as rapidly as they could, and Ss were led to

believe that their response times were being recorded. It appears that these questionable methods weaken the claims made by the authors.

The present study demonstrated the superior performance of the DS-E group compared to the DS-S condition. The explanation, however, is not clearly understood. It would seem logical that S-originated sentences should bring greater comprehension to their respective Ss than would E-supplied sentences. Rohwer (1966) concluded that the exposure to E-supplied sentences was an effective aid to recall because "... meaningfulness and syntactic structure in combination are properties of verbal strings which facilitate learning... [p. 546]." The E-supplied sentences in the present study were constructed to have similar syntax to aid comprehension. A cursory visual examination of the DS-S schemes revealed inconsistent sentence syntax ranging from complex sentences to fragmented phrases. It is doubtful whether comprehension could have been aided in such a diversity of syntax in S-originated sentences.

The results of the present experiment further substantiated the findings of Kibler and Blick (1972) in a free-recall task in which a FL-E group recalled significantly more words than a FL-S group. Here, with a different verbal learning task, similar results were found. Also, the finding that Ss using the SR condition can learn and recall word pairs at the immediate level just as well as Ss with mnemonic devices supported Boltwood and Blick (1970). The fact that the SR condition suffered significant losses at longer time intervals

offered further confirmation to Boltwood and Blick (1970).

Future research in mnemonics may be directed along the following lines:

1. Further investigation into the conflict between the effectiveness of the DS-E and DS-S conditions. Future Es should focus more effort and consistency in producing meaningful descriptive sentences high in imagery content, since the degree of imagery might well be an important variable effecting retention and recall.

2. Examination of the meaningfulness and syntactical factors in relation to both the DS and FL mnemonics. For example, DS with high meaningfulness and varying syntax could be compared to the reverse condition. The same could be done with the FL device.

3. Examination of E-supplied and S-originated schemes using different devices besides DS and FL. Other possibilities could be Med or C or other secondary devices delineated in previous surveys (Boltwood and Blick, 1970; Blick and Boltwood, 1972; and Blick et al., 1972).

4. Use of varying hourly recall tests to pinpoint and graph the retention losses over a 48 to 72 hour time period. Similar devices as used in the present study could be examined, and the results could be applied to the field of education. An obvious example of such application concerns the efficacy of "cramming" for exams.

It seems that research in mnemonics and the present study in particular can be best applied to the area of education.

Mnemonics, in effect, are organizational aids used to increase learning of verbal material. In the field of education, where vocabulary lists, terms, names, dates, places, etc. are found; organizational aids might seem to be of benefit. The present study has demonstrated that aids devised by E or teachers (in the classroom) would be superior to any aids devised by students themselves which in turn would be superior to rote memorization of the material. It appears that only if the student wished to begin his preparation some time before an exam would the devices prove effective. Last minute "cramming" by simple memorization would immediately be effective but the student who simply "crammed" for a test would likely suffer significant retention losses after a short time or following exam time.

It is hoped that educators in other areas will follow the results of the present study and previous ones, and begin to accept the fact that organizational aids or mnemonics can markedly increase learning and retention of verbal material.

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APPENDIX A

Presented in the following two tables are data analyses for the 146 Ss using the harmonic mean. The group sizes ranged from a high of 33 to a low of 24 and the $\tilde{n}$=29.41. The ANOV yielded a significant interaction term which permitted the investigation of simple effects. A summary of the ANOV is presented in Table A.

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Insert Table A about here

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The simple effects ANOV, presented in Table B, showed a significant difference between the five groups at the immediate retention test, although the means of the five groups were: SR=9.27, FL-E=9.59, FL-S=8.58, DS-E=8.89 and DS-S=9.13. Apparently the harmonic mean was not representative of the widely different sample sizes. A significant difference at the immediate level invalidated further analyses since the

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Insert Table B about here

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groups must start out with an equal retention score at the immediate level.

These unusual effects with the use of the harmonic mean led to additional voiding of Ss which is explained in the results. At this juncture the two criteria mentioned in the results were applied to the data.

TABLE A

Analysis of Variance:

Mnemonics X Retention Intervals

Source	SS	df	MS	F
Between subjects		145		
Mnemonics (A)	178.81	4	44.70	2.44
Subj. w. groups	2581.95	141	18.31	
Within subjects		438		
Retention Intervals (B)	598.79	3	199.60	103.92*
Mnem. X RI (A X B)	58.82	12	4.90	2.55*
B X Subj. w groups	814.18	423	1.92	

$F_{.99}$ (3,∝) = 3.78 p<.01

$F_{.99}$ (12,∝) = 2.18 p<.01

$F_{.99}$ (4,200) = 3.41 p>.01

TABLE B

Analysis of Variance:

Simple Effects of Significant Interactions

Source	SS	df	MS	F
Mnem. at I	168.40	4	42.10	6.99*
Mnem. at 2 days	98.43	4	24.61	4.09*
Mnem. at 1 week	108.51	4	27.13	4.51*
Mnem. at 6 weeks	151.18	4	37.80	6.28*
Pooled error	3396.13	564	6.02	
Ret. Int. at SR	242.70	3	80.90	42.14*
Ret. Int. at FL-E	78.77	3	26.26	13.68*
Ret. Int. at FL-S	100.12	3	33.37	17.38*
Ret. Int. at DS-E	26.14	3	8.71	4.54*
Ret. Int. at DS-S	194.84	3	64.95	33.83*
B X Subj. w groups	814.18	423	1.92	

$F_{.99}\ (4,\infty) = 3.32 \quad p<.01$

$F_{.99}\ (3,\infty) = 3.78 \quad p<.01$

APPENDIX B

TABLE 9

Total of Items Missed and Reversed

	M-A	D-V	P-S	F-L	I-G	H-T	W-R	E-C	K-J	O-B
SR	15 1R	18 4R	14 4R	26 3R	23 1R	20 4R	27 1R	26 5R	19 2R	14 2R
FL-E	7	5	7	8	10	5	10	7	6 1R	9 1R
FL-S	6	6 4R	8 1R	14 1R	22 3R	16 2R	10 2R	18	12 4R	11 2R
DS-E	3 1R	3	5 2R	19 2R	11	4 3R	7 1R	10 4R	4 5R	1 3R
DS-S	7 3R	6 7R	2 7R	16 3R	19 4R	20 5R	19 1R	23 4R	18 5R	17 1R
Tot.	38 5R	38 15R	36 14R	83 9R	85 8R	75 14R	73 5R	74 13R	59 16R	42 9R

VITA

Michael Bruce Pines was born on August 14, 1948 in Baltimore, Maryland. He grew up and attended public schools in Baltimore and was graduated from Baltimore City College High School in 1966.

From 1966 until 1970, Mr. Pines attended Clark University in Worcester, Massachusetts. He was graduated from that institution in June, 1970 with a Bachelor of Arts degree in Psychology. While at Clark University, Mr. Pines was active in Kappa Phi Fraternity and both intercollegiate and intramural sports.

From June, 1970 until September, 1971, Mr. Pines served as a student co-ordinator in the re-election campaign of former Maryland Senator Joseph Tydings, as a army medic at Fort Polk, Louisiana and Fort Sam Houston, Texas, and as an assistant ward charge at Seton Psychiatric Institute in Baltimore, Maryland.

Mr. Pines studied at University of Richmond in Richmond, Virginia from 1971 until 1973 and expects to receive his Masters of Arts degree in Psychology from that institution in May, 1973. While there, he was honored with membership in Psi Chi National Psychology Fraternity.

Upon completion of his studies at University of Richmond, Mr. Pines plans to enroll in a doctoral program in either clinical or counseling psychology.