Summer 1966

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THE EFFECT OF VISUAL AND VERBAL MNEMONIC DEVICES ON THE PAIRED ASSOCIATE LEARNING OF AN AGED POPULATION

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A THESIS
SUBMITTED TO THE GRADUATE FACULTY
OF THE UNIVERSITY OF RICHMOND
IN CANDIDACY
FOR THE DEGREE OF
MASTER OF ARTS IN PSYCHOLOGY

AUGUST 1966

PREFACE

The author would like to take this opportunity to thank all those people whose cooperation and contributions made this study possible.

I would like to thank Dr. Neil Coppinger and the staff of the Research Unit on Aging at the Hampton Veterans Administration Hospital for so graciously presenting me the opportunity, facilities, time, and helpful advice in conducting the study. I am grateful to Mrs. Doris Shuford and Mrs. Mary Jones for checking my statistical calculations and for typing the final draft.

I am especially indebted to Dr. Robert E. Canestrari who gave unstintingly of his time, advice, and encouragement from the formulation of the problem to the final typing of the results. His patience in answering a multitude of questions, and his constructive criticism at every stage of the study will long be remembered and deeply appreciated.

I am also grateful to Dr. Austin E. Grigg for his advice and guidance regarding the design of the study and to Dr. William Leftwich for his suggestions and help in the statistical analysis of the data.

Last but by no means least I would like to thank my wife, Jean. While she was not directly involved with the mechanics of the study, she was a constant source of encouragement throughout the whole endeavor.

F. P. K., Jr.

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Chapter I

INTRODUCTION

The literature on aging is abundant with studies using a variety of tasks indicating that there is a decline in learning with increasing age. Ruch (1934), Gilbert (1941), and Pacaud (1955) along with others have demonstrated this deficit in paired associate learning.

In attempting to determine the nature of this deficit, Canestrari (1963) has shown that it would appear to be due in part to the paced conditions under which this task is usually run. A group of elderly adults and young adults were used as subjects in this study. These subjects were presented with paired associate lists of equal levels of difficulty under three different pacing schedules - $1\frac{1}{2}$ sec., 3 sec., and self-paced. The measure of learning was the number of errors made in reaching the criterion

of one perfect recitation. These errors were further broken down into those of omission and those of commission.

Canestrari found that subjects under the self-paced condition had a marked decrease in omission errors (non-responses) and very little change in errors of commission. Similar results were obtained in a study in serial learning by Eisdorfer, Axelrod and Wilkie (1963).

Canestrari's initial interpretation of these results was to attribute the improvement to the increased time available for responding. However, he later pointed out (1965) that an additional effect of the self-paced schedule was to increase the time interval between presentations of the stimuli. This fact leads to an alternative explanation of the data based on Welford's (1958) conception of the learning process. He postulates a number of stages which are essential to the learning process. First, the material has to be perceived and comprehended. After being perceived, the material must be held by some short-term storage mechanism that can store rapidly, but impermanently. This storage is broken down by neuronal activity resulting from fresh stimulus input. Welford suggests that the short-term storage mechanism of the older

person may not be able to maintain an ongoing pattern in the face of fresh stimulus input. Canestrari suggested that the lengthened time interval on the self-paced schedule allows the older person to transfer the material from the relatively impermanent storage to a more permanent one before the disrupting effects of further stimulus input.

In a study directly related to this proposal, Arenberg (1965) had young and elderly subjects learn paired associates under two conditions - long or short anticipation intervals. Interspersed through acquisition trials were self-paced trials in which the subjects had unlimited time to respond. The reasoning is such that if response time is the important variable then varying the anticipation interval should have no effect on the scores on these self-paced trials. The results indicated that irrespective of the amount of time allowed for responding, the subjects under the longer anticipation interval had fewer errors.

Canestrari is currently conducting a study to determine whether shorter intervals between the presentation of paired associate material is more disruptive for the older subject. The results to date indicate that the older subject shows a greater deficit when

the interval is short even though his performance is tested under self-paced conditions.

If we assume that this short-term storage mechanism explanation of the observed deficit has some validity, the next step is to attempt to ascertain the reason why older subjects need more time to transfer information. A possible explanation may be derived from studies investigating the role of mnemonic devices in a paired-associate learning task.

These devices appear to be employed extensively in paired associate tasks. Woodworth and Schlosberg (1954) refer to this tactic but treat it as an annoyance that contaminates the results. On the other hand, Miller, Galanter, and Pribram (1960) view the process as important in its own right. They conclude that to ignore what subjects do in the way of devising strategies for remembering is not scientific even though such processes present problems to the experimenter. Underwood and Schulz (1960) also discuss the process and report a study with young subjects that attests to its pervasiveness in a paired associate task. In this study there were 280 possible pairings of words. Subjects reported no associations used in only 27% of these.

There are several studies with young subjects which demonstrate the effectiveness of the use of such tactics in a paired associate task. Wallace, Turner, and Perkins (1957) instructed subjects to "form a mental picture" connecting each pair of words to be learned. They found that subjects were able to remember 99% of the word pairs presented with lists up to 500 items and 95% of a 700 pair list, although each pair was presented only once. Other studies (Gruber, Kulkin, and Schwartz, 1965; Paivio, 1964-65; Runquist and Farley, 1965; and the Underwood study mentioned above) have also demonstrated that mnemonic devices have a facilitating effect in paired associate learning tasks.

The use of mnemonic devices by aged subjects has not received a great deal of attention in the past. There is some indirect evidence that older subjects might encounter some difficulty in forming mental pictures or connections. This evidence comes from studies in memory and creativity in aging. Jones (1959) comments that there is a reduction in the ability of older subjects to form and integrate new connections. Several studies using a variety of approaches (Bromley, 1956; Prados and Fried, 1947; Chesrow, Wosika, and Reivitz, 1949) report an "associative impoverishment" among older persons.

In a more direct investigation, Hulicka (1965) found that elderly subjects reported using mediators less often than young subjects in a paired associate task. In a subsequent study (1966 b) she found that older subjects reported 20% of the pairs were too odd to form a connection while the young subjects rarely complained of this difficulty.

Riegal's (1965) work with word associations offers further evidence along these lines. He found that association latencies were greater for elderly subjects as compared with those of young subjects. In addition, his data indicate that older subjects have more difficulty and require more time to make associations when redundancy between stimulus and response words is small. This is exactly the situation they face in a paired associate task where the linkage between stimulus and response words is deliberately made obscure.

However, even though old subjects have difficulty in developing mediators, Hulicka (1965) found that instructing them to do so resulted in improved performance. Also, a pilot study by this author indicated that aged subjects could develop connections to some degree and that this ability was positively related to paired associate performance.

Returning to Welford's stages of learning, it is quite possible that in the initial stage of learning subjects are organizing the material and attempting to develop mediators. Since the previously cited evidence suggests that older subjects have difficulty and require more time in developing such mediators, the lengthened time interval may possibly enhance their performance by allowing them more time to develop these mediators before fresh stimuli disrupt the process.

Before going further it will be necessary to point out that there is a distinction to be made between verbal mediators and visual mediators. In the majority of studies where such a dichotomy has been assumed none report the criterion used to make the distinction. For the most part the instructions to form a mental picture have sufficed for an operational definition. Indeed, Jenkins poses the question as to whether or not all such mediators are not verbal. At this point it would appear that one will have to rely on a common sense approach for distinguishing between the two. For the purpose of this study verbal mediators will be defined as linkages based on the formal syntactical characteristics of the words (grammatical linkage, connecting phrases, etc.) and visual imagery

defined as those that appear to be descriptive of some picture or image. This, unfortunately, introduces an element of arbitrariness into the matter and must be kept in mind when considering the ensuing discussion.

In a study with young adults, Paivio (1965 c) found that the reaction time of verbal mediators increased with an increase in the associative variety of the words. This finding is important when it is noted that Hulicka (1965) found that aged subjects report using more verbal mediators than visual ones. Reigel (1965) has also pointed out that elderly subjects respond more with regard to grammatical form in word association tasks. These data, when related to the general assumption that the verbal repertoire of an individual increases with age, suggest that an additional explanation as to why older subjects need more time to form mediators is that they are more prone to use verbal mediators which, in view of their larger verbal repertoire, require more time to develop.

In the Hulicka study a deficit between the two groups was still observed. An obvious explanation for this deficit lies in the fact that old subjects, even after being instructed to use mediators, could not develop as many as did the young subjects. However, an

additional factor may also have been contributing to this deficit. Paivio (1965 b) found in a study using young subjects, that visual mediators were more effective than verbal ones. It has previously been noted that old subjects tend to use verbal mediators when instructed to develop mediators. It is conceivable, therefore, that these verbal mediators are not as effective as the visual ones being utilized by the young subjects.

The implications of the foregoing discussion are as follows: young subjects report using mediators more extensively than do old subjects. The literature indicates that old subjects appear to have difficulty in developing mediators. They also require more time in developing mediators, possibly because of the deliberate obscurity of the connections between pairs of words. Also, additional time may be needed by old subjects because of their tending to use verbal mediators that require more time to develop as a result of their larger verbal repertoire.

These factors may partially account for the improved scores of old subjects on self-paced schedules where there is more time to form mediators during the short term storage before the disrupting effects of new stimulus input.

When instructed to use mediators, evidence indicates that the old subject's performance shows more improvement than that of the young subject. However, there is still a deficit. Two concurrent factors may be responsible for this deficit. Old subjects still do not report the use of as many mediators as do young subjects and the ones they do report using are most often the presumably less effective verbal ones. It follows then that the deficit should be further reduced if the old subjects are aided in developing visual mediators. The most efficient way to do this would be to present them with an image along with the word pair to be learned.

The purpose of this study was to observe the effects of just such a procedure. Subjects were presented pairs of words accompanied by a black and white sketch that contained both words.

In a further attempt to study more directly the effects of visual vs. verbal mediators, a second condition was included where subjects were presented pairs of words accompanied by a phrase that contained both of the words.

The following hypotheses were postulated:

1. Performance of younger subjects will be superior to old ones over all conditions.

2. Performance will be superior for both groups in order of conditions: pairs presented with visual mediators; pairs presented with verbal mediators; and pairs presented with standard paired associate instructions.

3. Differential performance of the older group will be greater than the young group with visual mediators and possibly verbal ones.

Chapter II

METHOD

Subjects - Thirty old subjects were drawn from the domiciliary population of the Hampton Veteran's Administration Hospital. Their ages ranged from fifty to seventy-three (m=62.44).

Thirty young subjects were drawn from the population of the Southampton, Virginia Prison Farm. This institution is for young men who have been convicted of their first offense as adults. The age range of this group was from 16 to 27 (m=20.78).

The use of young subjects from such a population made it possible to obtain two groups of roughly comparable socio-economic background and educational level.

In a further attempt to equate the intellectual level of the two groups, both were given the WAIS vocabulary sub-test.

Apparatus - The words were printed in large print on 3x5 cards. A modified Wisconsin General Test Apparatus was used.

This consists of a piece of plywood separating E from the Ss with a small opening at the bottom through which a tray containing the stimulus cards and the sketches can be pushed.

List - Following Canestrari's (1963) procedure, 30 one-syllable stimulus words were chosen from the Russell & Jenkins (1954) norms and paired with a response word that occurs only once in one thousand presentations of the stimulus word. These 30 pairs were randomly divided into three lists.

Sketches - Simple sketches were made that contained both words of the pair. All, except two, were black and white with the exceptions being those accompanying the pair "loud-tie" and "red-heart". The sketch for the former was done in color to depict a loud tie and the one for the latter was also done in color to depict a red heart.

Verbal mediators - A phrase was made up that contained both of the words. These phrases were very short, sometimes resulting from merely adding the indefinite article "a" to a pair - e.g., "a short box." Some phrases were in the form of equations - e.g., "needle + nurse = hypo." In all cases except one, the words were kept in the same stimulus- response order.

The exception was with the pair "bed-twin" which was reversed to read "twin bed."

Procedure - Condition I - Each S was instructed that he would be shown a pair of words and that on subsequent trials he would be shown only the first word of the pair and asked to provide the second. He was also informed that previous studies had indicated that if a person sees a picture that contains the words it makes remembering easier. He was then instructed that such a sketch would accompany each pair and that he was to look at the pair and the picture.

Condition II - S was instructed concerning the presentation of pairs of words and was given instructions similar to those in condition I with the word "phrase" being substituted for "picture."

Condition III - S was instructed only as to the procedure of presentation of the pairs and to the recalling of the response words. No instructions were given to induce any kind of strategy.

Throughout all the conditions, on each trial subsequent to the first presentation each response word was shown again with the stimulus word regardless of the appropriateness of S's response. In conditions I and II the mediator was also shown each time with the stimulus and response words.

Trials for all Ss were presented under self-paced conditions. Ss were instructed that they could take as much time as they liked to look at the pair and to respond to the stimulus words. The time between the withdrawal of a pair together, and the presentation of the next stimulus word was approximately 5 to 10 seconds.

The dependent measure was the number of errors committed in reaching a criterion of one perfect recitation of a list. These errors were further broken down into errors of omission (no response) and commission (overt incorrect response).

Design - A latin square design was used, whereby each of the two main groups were subdivided into three groups. Each of these subgroups were exposed to each of the three lists and each of the three conditions. The order of presentation of the conditions was counter-balanced with the order of lists being disregarded. A diagram will better illustrate the design.

	Visual	Verbal	Standard
List 1	OG 1 YG 1	OG 2 YG 2	OG 3 YG 3
List 2	OG 3 YG 3	OG 1 YG 1	OG 2 YG 2
List 3	OG 2 YG 2	OG 3 YG 3	OG 1 YG 1

OG = old group
YG = young group

Chapter III

RESULTS

Initially 30 Ss from each age group were to be used. However, in the latter stages of the study, one of the young Ss was transferred to a different location thereby necessitating the random dropping of 5 more Ss. The results, then, are based on 27 Ss in each age group.

As was stated earlier, an attempt was made to match both experimental groups on the basis of socio-economic background and intellectual ability. The elderly group scored significantly higher (t_{obs}=4.35, sig. at .01) than the younger group on the WAIS vocabulary sub-test. However, because it was not feasible at this point to expand the samples in order to match the groups, and in lieu of the results of further analysis of the data, no further attempt was made to match the groups on the basis of the vocabu-

lary scores. This point will be discussed in more detail in a later section.

Total Errors - The critical measure of learning was the number of errors committed in attaining one perfect recitation. The data were analyzed by a 3x2x2 Latin square analysis of variance with repeated measures (Weiner, 1962).

Figure 1 graphically represents the difference between the two groups in regards to total errors committed. Table I indicates that the young Ss committed significantly fewer errors than did the old ones.

The data analysis further indicates a significant age by conditions interaction. This interaction is represented graphically in Figure 2. A test for simple effects of the treatment factor with the old group and the young group is summarized in Table II. From this table and Figure 2 it is evident that the two mediators had a greater effect in reducing errors in the old group than in the young group. A further F test (F_{obs}=.16, n.s. at .01) indicated that the difference in error scores between treatments 1 and 2 in the old group was not significant.

Errors of Commission - Total errors were further broken down into errors of commission and errors of omission. Errors

Figure 1

COMPARISON OF YOUNG AND ELDERLY SUBJECTS

ON TOTAL ERRORS

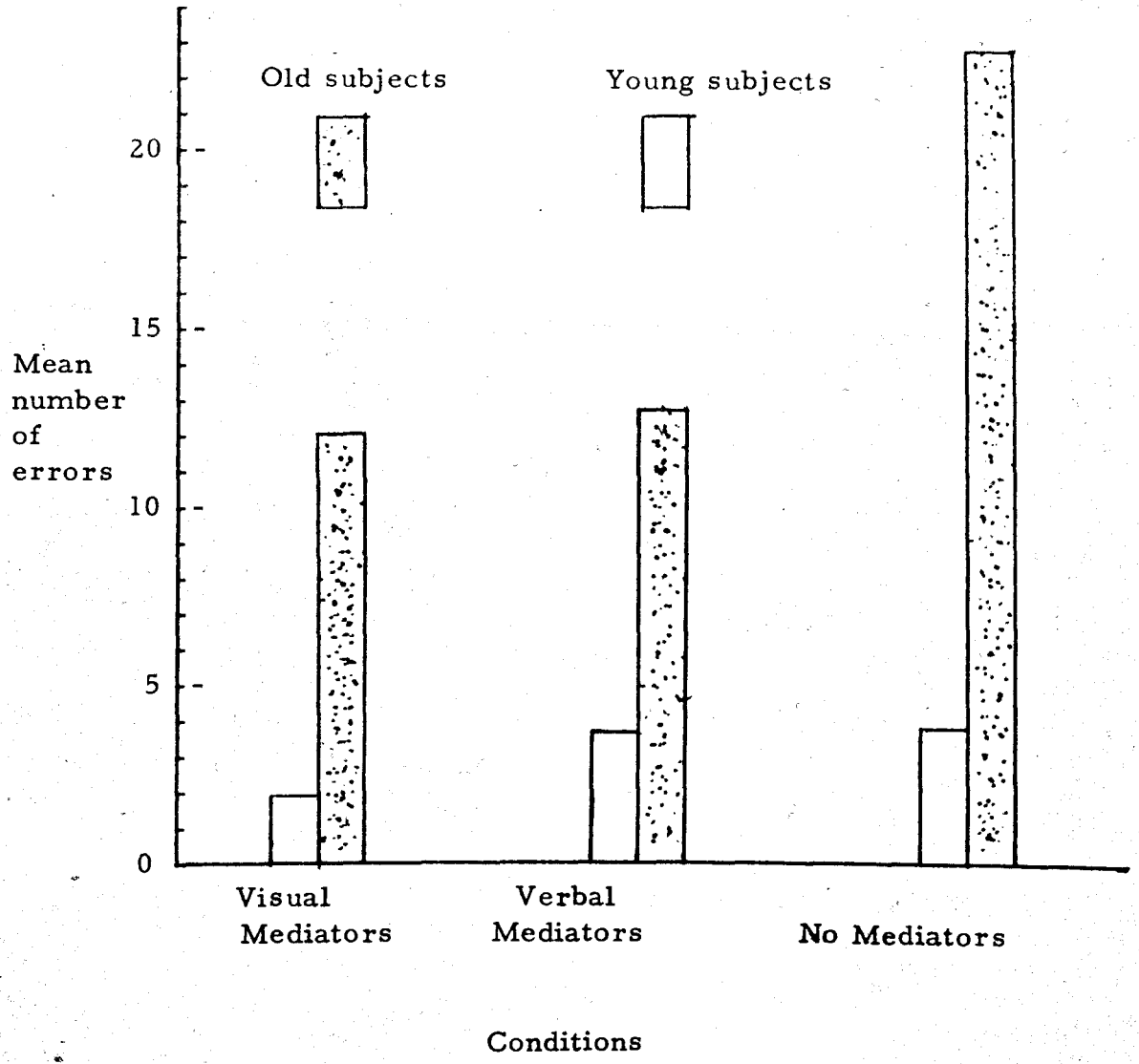

Table I

ANALYSIS OF TOTAL ERRORS

Source	SS	df	MS	F
Between Ss	22515.53	53		
C(Age)	6548.76	1	6548.76	23.66**
Rows	1398.86	2	699.43	
CX Rows	1280.06	2	640.03	
Ss within groups	13287.85	48	276.83	
Within Ss	9990.00	108		
A (Lists)	192.79	2	96.40	1.37
B (Cond.)	1404.01	2	702.01	9.95**
AC	433.98	2	216.99	3.08
BC	764.46	2	382.23	5.42**
AB'	149.43	2	74.71	
ABC'	275.40	2	137.70	
Error	6769.93	96	70.52	

**$F_{.99}(1, 48)$ 7.31

$F_{.99}(2, 96)$ 4.79

Figure 2

PROFILE OF CONDITION X AGE INTERACTION

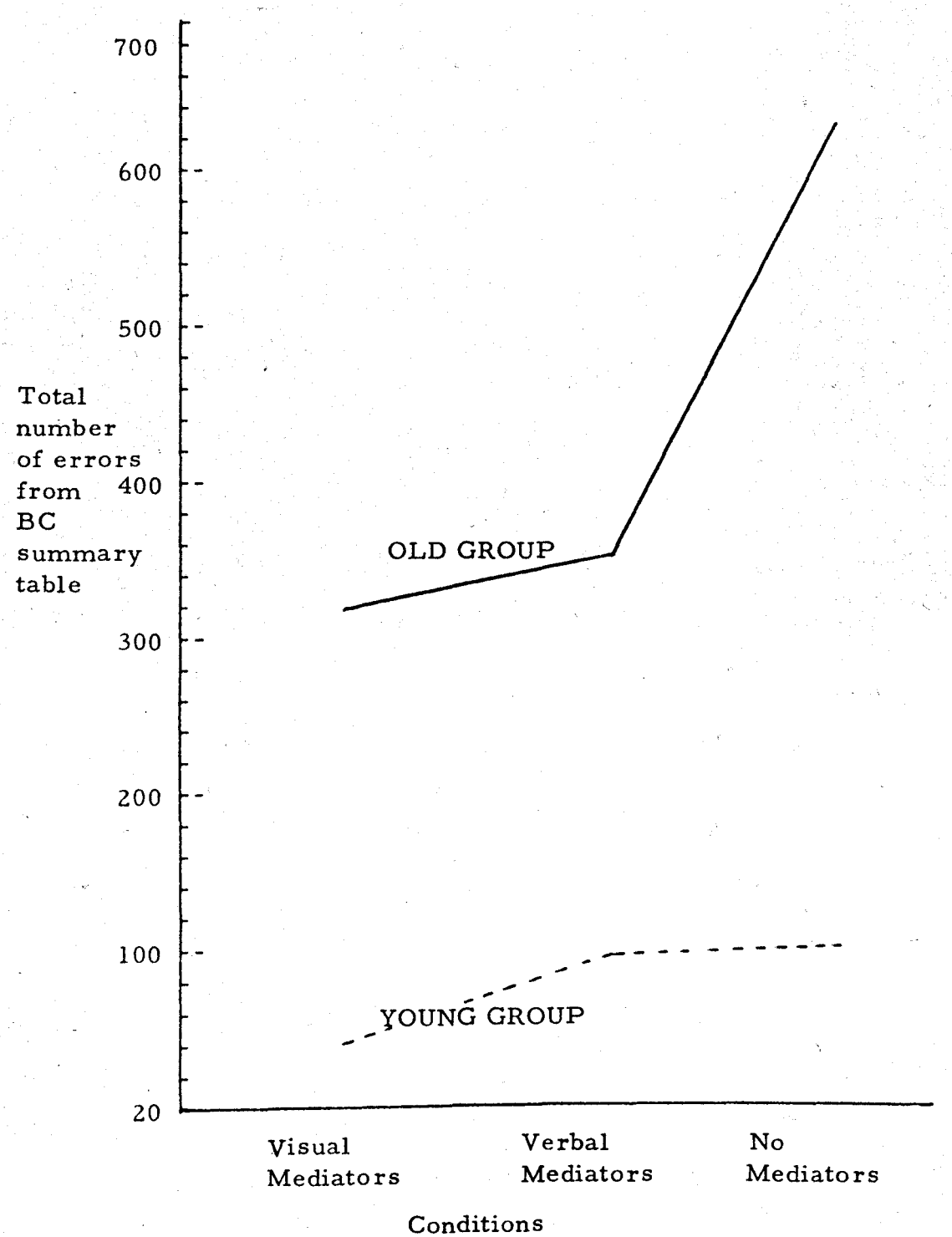

Table II

SIMPLE EFFECTS FOR INTERACTION

BETWEEN CONDITIONS AND AGE

Source	SS	df	MS	F
Conditions at level c_1 (Old Ss)	2095.28	2	1047.64	14.86**
Conditions at level c_2 (Young Ss)	73.19	2	36.60	.52
Error (within)	6769.93	96	70.52	

**$F_{.99(2,96)}=4.79$

of commission were those overt responses that were incorrect. The difference between age groups for these errors is represented in Figure 3. Table III indicates that the young Ss made significantly fewer errors of this type than did the old ones. There was also a main effect of the lists, but no significant treatment effects.

Errors of Omission - Errors of omission were those errors where the Ss gave no response at all. The differences between groups on this measure are graphically represented in Figure 4. Table IV indicates that once again the young Ss gave significantly fewer such responses than did the old Ss.

Treatment by age interaction was significant. This interaction is represented graphically in Figure 5. A test for simple effects of the treatment factor with the old and young groups is summarized in Table V. From this table and Figure 5 it is evident that the two mediators had a greater effect in reducing errors of omission in the old group than in the young group. A further F test (F_{obs}=1.84, n.s. at .01) indicated that both types of mediators were equally effective in reducing the errors of omission of the old Ss.

Figure 3

COMPARISON OF YOUNG AND ELDERLY SUBJECTS

ON COMMISSION ERRORS

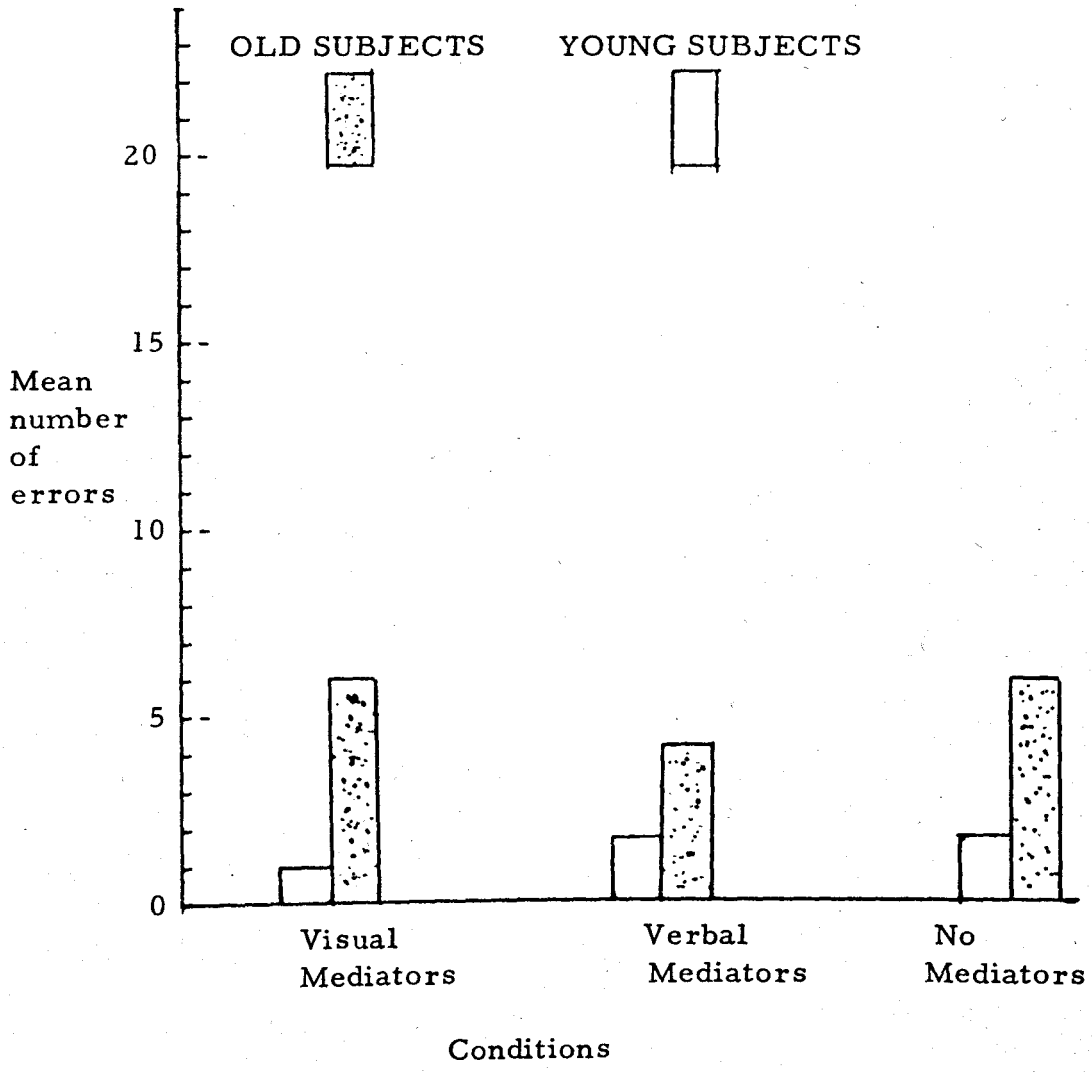

Table III

ANALYSIS OF ERRORS OF COMMISSION

Source				
Between Ss	2768.05	53		
C (Age)	640.03	1	640.03	18.90**
Rows	324.10	2	162.05	4.78
C X Rows	178.37	2	89.19	
Ss within groups	1625.55	48	33.87	
Within Ss	1376.67	108		
A (Lists)	116.76	2	58.38	5.50**
B (Cond.)	40.02	2	20.01	1.89
AC	30.97	2	15.49	1.46
BC	45.34	2	22.67	2.14
AB'	46.73	2	23.37	
ABC'	78.40	2	39.20	
Error	1018.45	96	10.61	

** $F_{.99}(1, 48)$ 7.31
$F_{.99}(2, 96)$ 4.79

Figure 4

COMPARISON OF YOUNG AND ELDERLY SUBJECTS

ON OMISSION ERRORS

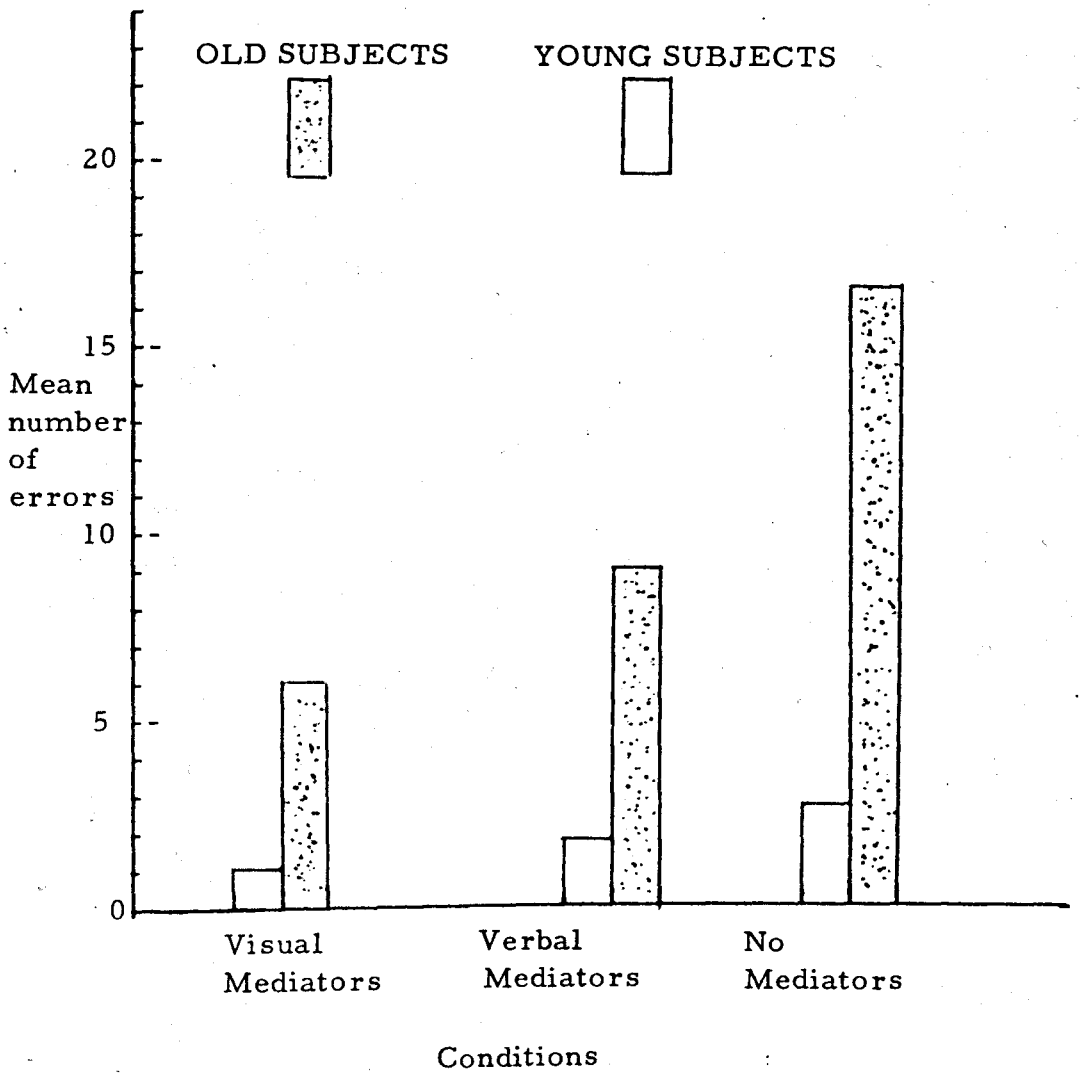

Table IV

ANALYSIS OF ERRORS OF OMISSION

Source	SS	df	MS	F
Between Ss	12701.81	53		
C (Age)	3085.49	1	3085.49	17.44**
Rows	469.68	2	234.84	
C X Rows	653.68	2	326.84	
Ss within groups	8492.96	48	176.94	
Within Ss	8476.67	108		
A (List)	113.13	2	55.57	.89
B (Cond.)	1109.28	2	554.64	8.84**
AC	324.90	2	162.45	2.59
BC	701.12	2	350.56	5.59**
AB'	52.45	2	26.23	
ABC'	154.08	2	77.04	
Error	6023.71	96	62.75	

**$F_{.99}(1, 48)$ 7.31
$F_{.99}(2, 96)$ 4.79

Figure 5

PROFILE OF CONDITION X AGE INTERACTION

FOR ERRORS OF OMISSION

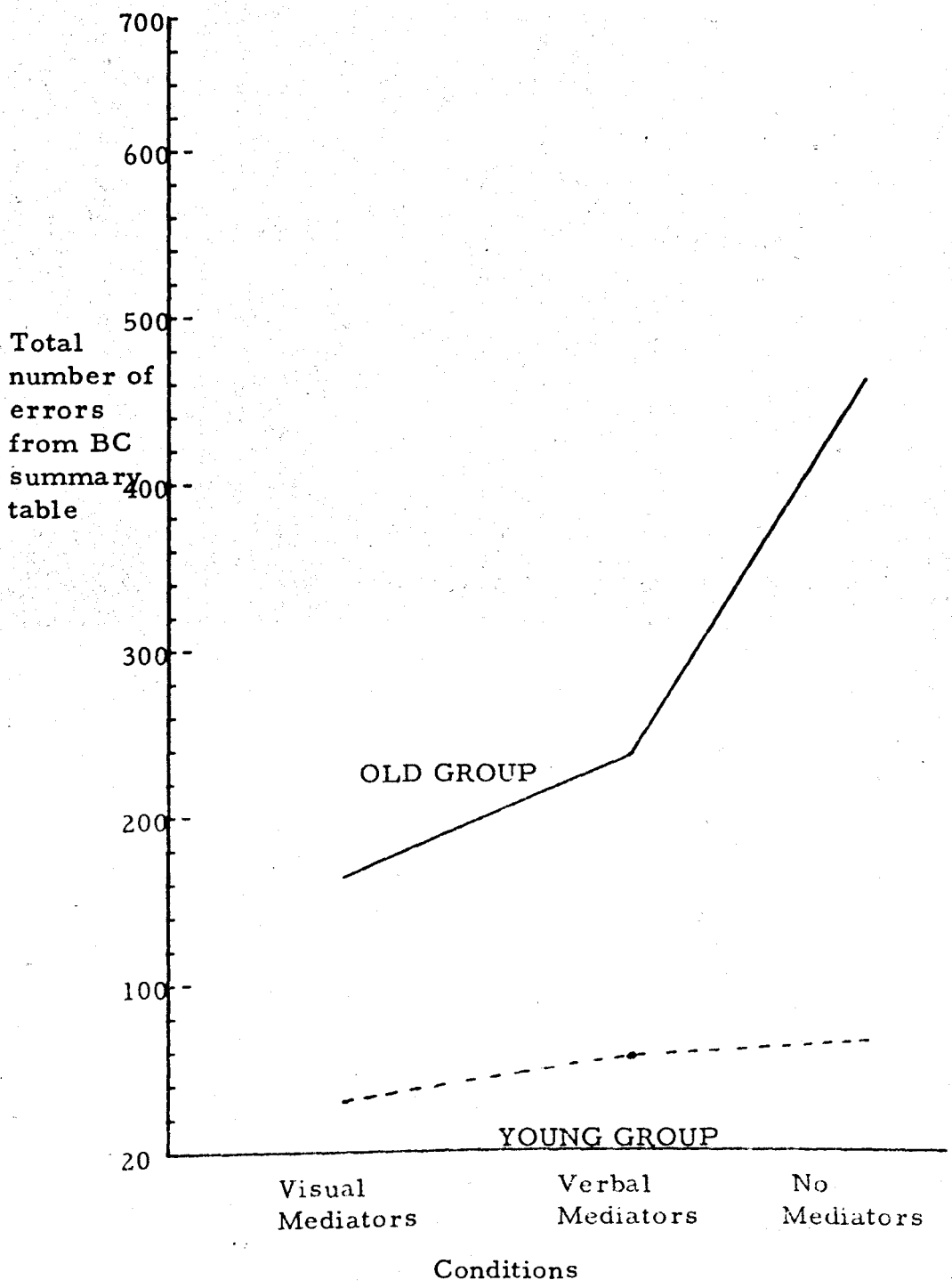

Table V

SIMPLE EFFECTS FOR INTERACTION BETWEEN CONDITIONS AND AGE ERRORS OF OMISSION

Source	SS	df	MS	F
Conditions at level c_1 (Old Ss)	1778.30	2	889.20	14.17**
Conditions at level c_2 (Young Ss)	32.10	2	16.05	.26
Error (within)	6023.71	96	62.75	

**$F_{.99}(2, 96)=4.79$

Chapter IV

DISCUSSION

The results of this study indicate an age related difference in the performance of both groups. The young subjects' performance on the task was superior to the elderly ones regardless of the condition. This finding supports the first hypothesis and is in agreement with previous studies.

It is interesting to note that this result was obtained even though the old groups scored much higher on the WAIS vocabulary subtest.

The data further indicate that providing subjects with mediators resulted in a differentially greater improvement of performance by the elderly subjects. This confirms the third hypothesis.

The results obtained did not confirm the second hypothesis relative to the prediction that visual mediators would improve the performance of all subjects more than verbal mediators.

This prediction was based on Paivio's study (1965 b) with young subjects in which he found visual mediators more effective than verbal ones. A closer look at his procedure provides a possible explanation for the disparity between the present results and Paivio's.

In the Paivio study, each word of the pairs was rated before the experiment on the basis of ease of eliciting imagery. The words were paired to obtain combinations of high and low ratings. After the task, subjects were given a questionnaire with the pairs listed and asked to mark whether they used visual, verbal, or no mediators. It is obvious, as Paivio himself points out, that the subjects might not have been reporting what actually happened during acquisition. Instead, they might have been responding to the high imagery of the words listed on the check sheet.

The design of the present study partially eliminates this source of contamination by providing the subjects with ready made mediators.

Another explanation of the noted discrepancy in results is suggested by an examination of the performance of the young subjects in the present study. The data indicate that neither of

the mediating conditions resulted in a significant improvement in the performance of the young subjects. This is not in keeping with previously cited evidence. It is possible that the lists in the present study were not difficult enough, resulting in a ceiling effect with the young group. If the lists had been more difficult the results might have more closely paralleled those of Paivio in regards to the effectiveness of the two types of mediators. Indeed, it is possible that the differential effect obtained would have been reduced or completely erased.

While the possibility of such a ceiling effect casts some doubt on the validity of the results of the young groups' performance, and the differential effect between the two experimental groups, no such ceiling effect was observed with the old group. It is therefore possible that old subjects can use both types of mediators equally as well.

As was pointed out earlier in the study, elderly subjects verbalize a preference for verbal mediators and they respond more with regard to grammatical form in word association tasks (Hulicka, 1965; Riegal, 1965). It is possible that old subjects, having over the years developed their vocabularies and having

become accustomed to responding to various situations with stereotyped verbal responses, transfer this tendency to the paired associate task. However, the results of this study indicate that when the mediators are provided they are able to use visual and verbal mediators equally as well.

The analysis of the breakdown of total errors committed into those of commission and omission indicate that the elderly subjects committed more errors of commission, but the mediators had no effect on this type of error. In contrast, the elderly subjects also committed more errors of omission than the young subjects, but the mediator conditions sharply reduced the number of this type error for the elderly.

There are at least two interpretations of the latter results. First, with the mediators provided, it helps the old subjects to develop associative traces necessary for storing the pair in a manner which makes them more available for recall.

The second interpretation is based on Korchin and Basowitz's (1957) hypothesis that elderly subjects are more cautious and will not make a response unless they are confident of its correctness.

Providing elderly subjects with the mediators could have resulted in raising their confidence. Either or both of these explanations could account for the reduction in omission errors.

The results of this study combined with other evidence cited tend to support the basic argument developed in the introduction. Restated, this argument is: the observed performance deficit of aged subjects is reduced when the interval between presentations of stimuli is lengthened. It has been suggested that the short term storage mechanism of the elderly subject needs more time to transfer material to be learned before the disrupting effects of fresh incoming stimuli.

One activity that may take place in this short term storage is the development of mediators between items in a pair. The evidence on hand indicates that old subjects have more difficulty and need more time in developing mediators. Therefore they require extra time at this stage of acquisition.

Other evidence suggests that even though they are allowed more time to develop mediators, the elderly subjects still do not develop as many as the young subjects. This suggestion is based on the fact that further reduction in the deficit is observed when old

subjects are instructed to develop mediators under self-paced conditions. However, even under these conditions they still report having more difficulty in forming connections and still develop fewer than do young subjects.

Based on the evidence cited above, it was suggested that directly aiding elderly subjects to develop mediators would reduce the deficit even further. The results of the present study support the validity of this suggestion.

An important question which remains unanswered is why the elderly subject's ability to develop mediators is lost or impaired in the first place. There are two possible explanations for this impairment.

First, it might be due to experential factors. The technique of developing mediators is most likely to reach its peak of efficiency during those years when an individual is engaged in formal education. Consequently, the older subjects' inability to develop such mediators might be the result of disuse or less frequent practice. This is opposed to the situation of younger subjects who generally tend to be either actively engaged in, or at least chronologically closer to academic exercises. A study by Sorenson (1930)

provides some indirect support for this notion. In this study he correlated the achievement scores of a class of adults in an education course with the length of time that they had been out of school. The only reliable negative correlations he obtained were those with the group whose members had been out of school longer.

The second explanation is that the elderly subjects lose this ability through physiological changes in the central nervous system. Several studies (Kety, 1956; Andrews, 1956; and Sokoloff, 1959) indicate a general decline in cerebral blood flow, oxygen consumption, and cell loss and deterioration. Studies with electroencephalograms (Obrist, 1954; Silverman, Busse, & Barnes, 1955) reveal a decreasing number of normal EEG's with increasing age including a lowering of alpha rhythm and increased temporal lobe abnormality. With regard to one of these findings, Hulicka (1966 a) points out that one effect of oxygen deprivation on young subjects is to reduce their ability to remember and perform other cognitive tasks. These studies strongly suggest that the elderly persons cognitive functioning (which is inextricably related to his ability to abstract and develop mediators) may be impaired by these physiological changes.

At the present time it is difficult to determine which of these two alternatives is the more correct one. Indeed, they may interact.

One further comment is necessary at this point. It has been shown that by manipulating the temporal conditions of the task and by strengthening the mediational techniques of elderly subjects the observed learning deficit can be reduced. However, a deficit still remains suggesting that there are other variables involved in producing it.

Chapter V

SUMMARY

The purpose of this study was to determine if providing elderly subjects with visual and verbal mediators would reduce their learning deficit on a paired associate task. The elderly group consisted of 27 men from the domiciliary population of a Veterans Administration hospital. The young group consisted of 27 men from the population of a state prison for first offenders. The young subjects were drawn from such an institution in an attempt to control for socio-economic background. All subjects were given the WAIS vocabulary subtest. Each subject was shown three different lists of 10 pairs under three different conditions: 1. pairs accompanied by visual mediators, 2. pairs accompanied by verbal mediators, and 3. standard instructions. The order of conditions was counterbalanced and the task was conducted under self-paced conditions.

Three hypotheses were tested: 1. young subjects' performance would be superior over all conditions, 2. all subjects' performance would be superior in order of conditions - visual mediators, verbal mediators, and standard instructions, and 3. there would be a differentially greater improvement in the performance of the elderly group in conditions with visual mediators and possibly verbal mediators. Results confirmed hypothesis 1 and 3 but not 2. Visual and verbal mediators were found to be equally as effective.

The results were interpreted as supporting the notion that old subjects have difficulty in developing mediators thereby requiring more time during the short-term storage stage in acquisition. Two possible explanations for this loss in ability were offered. The loss might be due to experential factors such as long disuse or less frequent practice with such techniques, or it might be due to physiological changes in the central nervous system. Indeed, it may be an interaction between the two.

APPENDICES

INSTRUCTIONS

Condition I (visual) and Condition II (verbal)

Do you see the tray in front of you? I will pull it back to my side of the board. When it goes back to you there will be a card on the left hand side with a word printed on it. Then I will draw the tray back to my side of the board. When it comes back to you the word on the left will reappear but there will be another word next to it. Your job is to learn that the second word goes with the first so that when you see the first word alone you will be able to tell me the second word. Furthermore, we have found that if we give you a (picture/phrase) that contains both of the words it makes it easier for you to remember the second word. So when the tray comes back to you, you will see the first word, the second word, and a (picture/phrase) that contains both of the words. Let me give you an example. (Give example) Now I am going to ask you to do this with a number of such pairs. I want you to learn which word goes with the word which first appears alone so that when you see the first word you will be able to tell me the word that goes with it. The first time you go through the list you will not be able to tell me any of them but as you go

through it a number of times, you will be able to tell me the second word of each pair whenever you see the first word. There is no time limit. You may take as long as you wish. Don't forget to use the (pictures/phrases) to help you. Are there any questions?

(Condition III's instructions were the same except all references to the pictures and phrases were deleted.)

Appendix B

LISTS AND MEDIATORS

List I

Pairs	Verbal Mediators	Description of Picture
Soft-Couch	A soft couch	Small boy sitting on large, overstuffed couch
Anger-Fist	Anger = Fist	Clenched fist strik- lat surface
Bread-Pan	Brean pan	Loaf of bread in a bread pan
Foot-Mule	A foot mule	Mule with one leg ending in a human foot
Short-Box	A short box	Man standing on box trying to reach shelf- box is obviously too short
Heavy-Logs	The heavy logs	Man carrying large pieces of logs
High-Ball	A highball	Glass with bubbly liquid and stirrer to depict mixed drink
Moon-Kiss	Moon missed, no kiss	Silhouette of man & woman kissing against backdrop of the moon

Pairs	Verbal Mediators	Description of Picture
Rough-Gang	A rough gang	Toughs loitering on corner around street light
Hand-Art	Hand makes art	A hand holding artist's paint brush
	List II	
Needle-Hypo	Needle + Nurse = Hypo	Hypodermic needle
Smooth-Shave	A smooth shave	Man shaving
House-Block	House sits on block	House made with children's "ABC" blocks
Music-Ear	Music pleases the ear	An ear with music entering it-music depicted by waving staff lines and notes
Dream-Snakes	I dream of snakes	Man in bed with cartoon type balloon above head representing dream filled with snakes
Slow-Bear	A slow bear	Large bear with sign behind saying "Slow"
Man-Race	Man does race	Man running a foot race
Red-Heart	Red=Blood=Heart	a red heart

Pairs	Verbal Mediators	Description of Picture
Eagle-Fish	An eagle eats fish	Large fish with eagle in its mouth
Dark-Owl	A dark owl	A black owl on tree branch
	List III	
Cold-Drip	Bad cold- nose drip	Block of ice that is melting
Deep-Cavern	A deep cavern	Deep hole in the ground
Chair-Hat	Chair on hat= squashed hat	Straight back chair with man's straw hat hanging on back
Bed-Twin	Twin bed	Twin beds
Woman-Flirt	Woman + wink = flirt	Coy woman dropping handkerchief
Hard-Brick	A hard brick	A brick
Fruit-Weed	Fruit is not a weed	Fruit tree with many weeds around the bottom
Loud-Tie	A loud tie	Wide red tie with yellow polka dots
Baby-Big	That baby is big	Baby elephant with diapers and nursing bottle
Sleep-Dog	A sleeping dog	Dog curled up on rug asleep

I: WAIS VOCABULARY SCORES, ORDER OF CONDITIONS, LEARNING SCORES FOR EACH CONDITION FOR ELDERLY GROUP

			Learning Scores								
		Order of	Cond. 1			Cond. 2			Cond. 3		
Subjects	WAIS	Conditions	EC	EO	TE	EC	EO	TE	EC	EO	TE
1	44	2 3 1	1	16	17	2	26	28	2	33	35
2	23	2 3 1	0	4	4	5	1	6	17	5	22
3	35	3 1 2	0	0	0	6	1	7	0	8	8
4	50	2 3 1	3	6	9	0	3	3	0	7	7
5	16	1 2 3	21	11	32	10	3	13	25	1	26
6	70	1 2 3	16	5	21	3	14	17	6	25	31
7	25	3 1 2	2	11	13	3	10	13	2	30	32
8	28	1 2 3	15	2	17	5	13	18	4	21	25
9	59	2 3 1	1	6	7	4	10	14	0	1	1
10	26	3 1 2	5	1	6	1	3	4	2	3	5
11	60	2 3 1	5	8	13	5	8	13	3	4	7
12	55	1 2 3	6	4	10	3	10	13	6	22	28
13	59	2 3 1	0	2	2	2	4	6	0	11	11
14	19	1 2 3	9	5	14	2	7	9	3	6	9
15	46	1 2 3	11	2	13	4	12	16	13	10	23
16	49	1 2 3	3	8	11	7	12	19	22	30	52
17	41	1 2 3	24	24	48	6	17	23	11	46	57
18	63	1 2 3	3	1	4	0	7	7	1	66	67
19	50	3 1 2	0	0	0	0	3	3	0	2	2
20	62	3 1 2	1	0	1	2	1	3	8	5	13
21	41	3 1 2	3	4	7	3	7	10	4	2	6
22	36	3 1 2	2	6	8	8	14	22	9	0	9
23	46	3 1 2	1	0	1	3	4	7	2	1	3
24	48	3 1 2	3	4	7	14	18	32	7	16	23
25	12	2 3 1	26	34	60	10	22	32	14	97	111
26	51	2 3 1	1	3	4	0	3	3	2	12	14
27	68	2 3 1	0	0	0	0	13	13	3	2	5
X	43.78		6.00	6.20	12.20	4.00	9.11	13.11	6.15	17.26	23.41
S.D.	16.30		8.57	7.62	13.93	3.43	8.21	10.02	6.69	22.05	24.13

II: WAIS VOCABULARY SCORES, ORDER OF CONDITIONS, LEARNING SCORES FOR EACH CONDITION FOR YOUNG GROUPS

			Learning Scores								
		Order of	Cond. 1			Cond. 2			Cond. 3		
Subjects	WAIS	Conditions	EC	EO	TE	EC	EO	TE	EC	EO	TE
1	24	3 1 2	0	0	0	1	5	6	4	6	10
2	24	3 1 2	2	2	4	5	4	9	3	4	7
3	17	3 1 2	0	4	4	0	0	0	3	0	3
4	32	3 1 2	0	0	0	0	3	3	0	2	2
5	39	3 1 2	0	0	0	0	1	1	0	4	4
6	40	3 1 2	1	1	2	0	2	2	2	6	8
7	16	3 1 2	2	0	2	1	1	2	5	6	11
8	26	3 1 2	0	0	0	0	1	1	2	9	11
9	33	3 1 2	0	2	2	0	1	1	0	6	6
10	18	1 2 3	1	0	1	1	0	1	3	0	3
11	22	1 2 3	1	3	4	5	11	16	2	3	5
12	16	1 2 3	1	7	8	1	1	2	1	2	3
13	16	1 2 3	2	0	2	0	0	0	1	2	3
14	20	1 2 3	7	2	9	5	2	7	11	1	12
15	18	1 2 3	2	4	6	0	5	5	0	3	3
16	60	1 2 3	0	0	0	0	1	1	2	0	2
17	22	1 2 3	0	0	0	0	2	2	1	1	2
18	47	1 2 3	3	4	7	0	2	2	2	3	5
19	28	2 3 1	1	0	1	0	4	4	1	2	3
20	15	2 3 1	0	1	1	10	1	11	0	1	1
21	17	2 3 1	1	0	1	4	2	6	1	1	2
22	42	2 3 1	0	0	0	0	0	0	0	0	0
23	16	2 3 1	0	2	2	3	7	10	0	2	2
24	14	2 3 1	1	0	1	1	1	2	2	0	2
25	37	2 3 1	0	2	2	0	0	0	0	2	2
26	32	2 3 1	1	0	1	1	3	4	0	10	10
27	37	2 3 1	1	0	1	2	1	3	1	0	1
$\bar{X}$	26.96		1	1.26	2.26	1.51	2.26	3.74	1.74	2.81	4.55
S.D.	11.75		1.47	1.77	2.52	2.34	2.44	3.88	2.25	2.70	3.47

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