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MENTAL IMAGERY: AN INSTRUCTIONAL STRATEGY TO FACILITATE MEMORY PERFORMANCE IN THE TAKING OF MULTIPLE-CHOICE TESTS

The University of Oklahoma PH.D. 1984

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THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

MENTAL IMAGERY: AN INSTRUCTIONAL STRATEGY TO FACILITATE MEMORY PERFORMANCE IN THE TAKING OF MULTIPLE-CHOICE TESTS

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

BY

ANTOINETTE FUHR HARRISON

Norman, Oklahoma

1984

MENTAL IMAGERY: AN INSTRUCTIONAL STRATEGY
TO FACILITATE MEMORY PERFORMANCE IN
THE TAKING OF MULTIPLE-CHOICE TESTS

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TABLE OF CONTENTS

	Page
LIST OF TABLES	ii
ACKNOWLEDGMENTS	iii
ABSTRACT	2
CHAPTER	
I. Introduction	3
Statement of the Problem	7
Hypotheses	7
Definition of Terms	8
Overview of Chapters	9
II. Review of Literature	11
The Nature of Memory	10
Conceptualization of Mental Imagery	23
Mental Imagery as a Memory Strategy	28
III. Methodology	34
Method	36
IV. Results	44
Discussion and Conclusions	49
REFERENCES	59
APPENDIX A	67
APPENDIX B	77

LIST OF TABLES

		Page
1.	Summary Table: Analysis of Variance (ANOVA)	68
2.	Means and Standard Deviations	69
3.	Means and Mean Differences: Mental Imagery Instruction Strategy	70
4.	Means and Mean Differences: Repetition Instruction Strategy	71
5.	Means and Mean Differences: Control Instruction Strategy	72
6.	Means and Mean Differences: Familiar Incorrect Option	73
7.	Means and Mean Differences: Unfamiliar Incorrect Option	74
8.	Means and Mean Differences: Completion	75

FIGURE

1.	Mean Performance Score for Test Form on Instruction Memory Strategies Consisting of Mental Imagery (MI), Repetition (R), and Control (C)	76

Acknowledgements

I express appreciation to my major professor, Jay C. Smith, for his interest and guidance in my graduate studies. My appreciation is also extended to the members of my dissertation committee.

I am indebted to Dr. Robert Smallwood, a colleague at Northeastern State University, (NSU), Tahlequah, Oklahoma, whose assistance was invaluable in the preparation of this study. I am also grateful to Dr. Polly Clark, Ms. Luana Lair and their students in the Library Media Department and Dr. A. C. Nunley and his mathematics students at NSU who made my data collection possible.

I am further indebted to Frankie Robertson Easter, a childhood friend who was always there with many kind words and encouragement and to Jocelyn Lee Payne who spent hours tracing the elusive "string" in this study.

My deepest gratitude is expressed to the memory of my parents, Antoine and Riva Abram Fuhr, whose love for and dedication to education continue to sustain me and to my family, who have always supported and encouraged my endeavors. They have provided me with the loving concern needed to fulfill my goals.

This dissertation is lovingly dedicated to my husband, Floyd and our children, Theodore, Michael-Antoine, and Amanda, whose love, devotion, assistance and support made the completion of this study and my educational goals possible.

Mental Imagery: An Instructional Strategy to Facilitate Memory Performance in the Taking of Multiple-choice Tests

Antoinette Fuhr Harrison

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Abstract

This study was designed to analyze the capacity of mental imagery to reduce frequency interference which can negatively influence student performance during multiple-choice tests requiring recognition memory. The analysis involved 69 subjects enrolled in the undergraduate divisions of Library Media and Mathematics at Northeastern State University, Tahlequah, Oklahoma. A two factor analysis of variance (ANOVA) with repeated measures over one factor, test form, was performed to test eight hypotheses which include: (1) multiple-choice test performance is improved by a mental imagery strategy over that of either repetition or no direct instruction (control group); (2) the effects of frequency interference are inhibited by a mental imagery strategy during a multiple-choice test where the choices include familiar options as distractors; (3) during multiple-choice testing, frequency interference is not increased when the test includes unfamiliar options as distractors; and (4) the negative influence of frequency interference is not increased during a recall completion test. A statistically significant interaction, ($F(4114=15.92$; p .05), was obtained between Instruction Memory Strategy (Factor A) and Test Forms (Factor B). The data support the thesis that mental imagery, as an instructional strategy, facilitates memory while failing to support the ability of mental imagery to significantly inhibit frequency interference when familiar options are used as distractors. The possibility exists, however, that teachers may overcome students' learning obstacles by teaching them the skill of mental imaging.

MENTAL IMAGERY: AN INSTRUCTIONAL STRATEGY TO FACILITATE MEMORY PERFORMANCE IN THE TAKING OF MULTIPLE-CHOICE TESTS

CHAPTER I

INTRODUCTION

The academic performance of students in public schools and in post-secondary classrooms concerns teachers, students, administrators, and the tax-paying public. The concern for academic performance at the public school level is evident from the public outrage generated by increasingly low college entrance examination scores.

Parental response has taken the form of increased enrollment of children in private and parochial schools. Some parents have chosen to set up tutorial programs at home where they become their child's primary teacher.

Action at the post-secondary level has resulted in increasingly rigorous standards for Education majors. An example is Oklahoma House Bill 1706 which established "qualifications for teachers and administrators in the accredited schools of Oklahoma through licensing and certification requirements to ensure that the education of the children of Oklahoma will be provided by teachers and administrators of demonstrated ability."

Clearly the inability of our children to test well has been blamed on their teachers. The idea seemed to be that students could neither read nor write

effectively because their teachers could not do so at a level acceptable to the educational community. Classroom instruction may be impoverished, however, researchers, parents, teachers, and students must investigate methods useful in overcoming deficiencies in instruction and in retention of educational information. In many educational situations, learner evaluation includes measuring student performance with standardized and teacher-constructed tests.

Standardized and teacher-constructed tests tend to utilize multiple-choice tests (tests in which the student is required to choose one alternative from among a set of possible responses), thus, it is appropriate to examine which variables may affect student performance. One variable which has consistently been shown to improve learning and memory performance is the use of mental imagery instruction (Levin, Ghatala, Wilder & Inger, 1973); that is, memory performance has significantly improved when students were instructed to utilize mental imagery in their learning.

Another variable, one which has been shown to decrease effective learning and memory performance, is termed frequency interference. (Underwood, 1968). Originally, Ekstrand, Wallace, and Underwood (1966) postulated frequency theory to account for adult learning in tasks requiring verbal discrimination.

Underwood (1971) asserted that evidence of frequency interference is most visible in the multiple-choice type of recognition memory test. Frequency theory states, generally, that the ability of a person to discriminate differences among words is based on the frequency with which the words have been exposed to the subject.

Frequency theory suggests that when subjects are presented with information which they are required to remember, a frequency point (FP) of one (1) is attached to each noun in the information. An additional frequency of one (1 FP) is attached to each noun in the information with each successive presentation. When the information is accurately retrieved, that correct answer receives an additional one FP. According to frequency theory, the correct information should receive more FPs than does the incorrect information.

An example is explained with the following sentence: "From his prison the prisoner told how he looked at the seal". Each noun in the sentence will receive one FP each time the sentence is presented aurally and another one when the presentation is visual. The individuals in this study will be placed in one of three study groups: (1) Repetiition, in which subjects will repeat assigned sentences three times orally while simultaneously reading the material, (2) Mental Imagery, in which subjects will make images of the material in the same sentences, and (3) Control, in which subjects will be left to individual strategies.

The test quetion is: At what did the prisoner look?

a. the seal

b. the prison

c. the palace

When the subject views the nouns, prison, seal, and palace, the presumption is that the following transaction might take place: The noun, palace, would be eliminated as a correct answer because it can only receive one FP (Too low to be considered a choice). Now the subject is free to discriminate between the nouns, prison and seal. Based on the subject's ability

to retrieve the information in the study sentences, the subject theoretically grants an additional FP to the noun, seal, as the correct answer. Thus "prison" has seven more FPs than "palace" but one less than "seal".

How Frequency Points Accrue

Noun	No. FPs for each noun	Hearing	Seeing	Correct Answer	Total
Seal	1	4	4	1	9
Prison	1	4	4	0	8
Palace	0	0	1	0	1

In the testing situation, the subject would need to retrieve, at least, the portion of the study sentence which would indicate the correct answer, which is in this case, seal. Based on the discriminative attribute of the frequency theory, a difference of 8 FPs between the nouns, seal and palace: the subject is less likely to choose the unfamiliar distractor, palace. The narrow difference (1 FP) between "seal" and "prison" suggests the possibility that the subject might confuse the two nouns. Frequency interference, then, is the case where desired learning is blocked by the equal frequency or small frequency difference of an incorrect term.

The accumulated evidence presented here suggests that frequency interference is most likely to occur when memory performance is assessed by multiple-choice tests. Two of the implications are that: (1) We in Education need to take note of our own procedures for improving multiple-choice test construction, while questioning the form and substance of these tests, and (2) we need to continue to investigate the use of mental imagery while employing it as an instructional strategy and as a learning technique.

The promise of mental imagery as an instructional strategy is that teachers can teach the skill of mental imaging to their students without a threat to their own competence and students are free to use the skill without regard to their own academic record. (Dwyer & DeMelo, 1983)

Statement of the Problem

The present study was designed to determine the empirical validity of the assumption that providing students with the instructional strategy of mental imagery will decrease the influence of frequency interference as an element which increases errors in recognition memory performance on multiple-choice tests. This study will add to the growing body of knowledge about utilizing mental imagery as an instructional strategy. If mental imagery is either a signigficant instructional strategy or will decrease the error producing effects of frequency interference, then as students learn to utilize this strategy, performance on multiple-choice tests should improve.

Hypotheses

The following hypotheses represent the primary questions under investigation in this study:

1. Mental imagery is an effective instructional strategy in improving multiple-choice test performance.
2. The improvement of test performance will exceed performance where no direct instruction (Control group) or a repetition strategy is used.

The ancillary hypotheses are:

3. Mental imagery will influence the effects of frequency interference during multiple-choice testing.

4. The effect of the frequency differential will not be present in a recall type test such as a completion test where there are not competing options, either familiar or unfamiliar.

Briefly stated, employing a mental imagery strategy during a multiple-choice test will: (1) reduce errors assumed to be due to frequency interference, and (2) improve subsequent test performance.

Definition of Terms as Used in This Study

Research in memory process has often been conducted from a psychological viewpoint. The present study is viewed from an educational orientation. For that reason, although the following terms are based on psychological terminology, they are defined as they apply in this investigation to an educational process.

Frequency Theory: The theory states that subjects have the capability to discriminate differences in the number of times an individual has been exposed to a particular stimulus. On each exposure, the particular stimulus gains one frequency point (FP). The basic postulate of the theory is that the stimulus considered to be the correct response in a testing situation will gain more FPs than the stimulus considered not to be the correct option. Clearly, the more FPs accruing to the correct stimulus and the fewer to the incorrect option, the less difficulty in choosing the correct response.

Frequency Interference: A theorized phenomenon which occurs when the FPs of the reaponses are too close for accurate discrimination and an incorrect choice is made.

Memory: The mental faculty of retaining and recalling a past experience.

Mental Imagery: The result of the mind forming images or symbols; the ability of the mind to categorize, storing and retrieving them as images and symbols on demand.

Recognition Test: A class of tests in which the subject is required to select the correct answer to each question from among a number of options. Examples: multiple-choice and matching items tests.

Multiple-choice Test: A specific type of recognition test in which the subject is required to select the correct answer from a list of at least three options.

Recall Test: A test in which the subject is required to supply missing items of information, usually words, number, or phrases, in order to complete the answer.

Completion Test: A recall type test requiring the subject to supply the missing material to complete the answer.

Overview of Chapters

Chapter II points out and discusses the topic of memory and its relationship to frequency theory and frequency interference. The Frequency Theory of recognition memory will then be explained followed by an analysis of the role of mental imagery in affecting learning and memory performance.

Chapter III presents the design and results of the study.

Chapter IV discusses the results of this investigation and contains conclusions based on those results.

CHAPTER II

REVIEW OF THE LITERATURE

The Nature of Memory

Memory is said to be the result of experiencing an event, concrete or imagined, which usually leaves in the mind some relatively permanent representation (Underwood & Freund, 1970a p. 117). Early investigations of memory appear to have most often been studies of interference-produced forgetting. Underwood (1969) suggests that although a performance test indicates a loss of memory for a specific event, it does not necessarily mean that the memory for that event no longer exists. The meaning could only be that the subject did not perform, in that specific instance, in such a way as to exhibit memory. Logic would suggest that other types of tests might produce evidence indicating some aspect of memory retention. Experimental findings show that recognition scores give evidence of memory when recall scores will not. Those findings also suggest that interference influences test performances said to be measuring memory (Underwood, 1971, p. 313). In an earlier paper, Underwood (1969) viewed memory as consisting of an ensemble of attributes which represent various kinds of information stores when learning occurs. He later noted that:

> The way subjects process events determines the nature of the ensemble; such processing often being called encoding. With the young

adult subject . . . some encoding appears to occur spontaneously (without intent to learn), although the nature of the ensemble may differ somewhat following incidental vs. intentional instructional conditions. (Underwood, 1971, p. 315)

Eight attributes of memory have been identified and labeled by Underwood (1971). They are:

1. Temporal: Whenever an event is experienced it is experienced at a given point in time and may be associated with contiguous events.
2. Spatial: Certain memories have a three-dimensional quality.
3. Frequency: All events occur at least once; others more than once. Memory may involve the number of times a specified phenomenon occurs.
4. Sensory Modality: Some memories are associated with one sense more than another.
5. Orthographic: A word has a limited number of letters arranged in a given sequence.
6. Acoustic: When pronounced, a word has a certain sound spectrum. It may produce an image or an affective response.
7. Verbal Associates: When a word occurs in a learning task other similar words are likely to be elicited.
8. Class: Memory carries information concerning the set or group of events involved.

When memory tests are given, Underwood (1971) hypothesized that these attributes function on two levels, discrimination and retrieval. In the discrimination process the requirement is to distinguish one target memory for an item from another memory. During retrieval, the requirement is to produce

or recall a targeted item such as a specific word. Some combination of the attributes listed above seemingly function so that one word can be distinguished from another. The generalization is that this discrimination among words represents the essence of recognition memory (Underwood, 1971). He further assumed that these attributes vary in their functional ability depending on the demands of the memory test. Retrieval attributes rise to the top of the hierarchy in a recall test; discriminative attributes rise in the case of a recognition test.

The probability is that the frequency attribute is primarily a discriminative attribute and is preeminent in the hierachy in recognition tests of memory. Within the frequency attribute, Underwood (1971), identified what he termed event frequency as a combination of background and situational frequency. (p. 316)

Background Frequency

Background frequency involves the frequency information which a student assimilates throughout the course of his life and brings to the instructional situation, either experimental or educational. A number of studies have investigated the capacity of letters, singly and in syllabic units, words, phrases, and sentences to carry frequency information. There appears to be considerable evidence to show that some frequency information is assimilated in the occurrence of verbal units as minute as a two-letter fragment and as large as sentences with appreciable integrity (Attneave, 1953; Shapiro, 1969; Underwood & Shultz, 1960).

Underwood (1971) observed that background frequency information is accrued incidentally and is abstracted from a larger context producing a lifetime of experienced memories.

Situational frequency tends to occur either in an experimental laboratory or instructional situation when assimilation of word frequency has been manipulated. In such instances, subjects are required to select the most frequently viewed word (s) or phrase (s) or sentence (s) from among similar units. Situational frequency occurs because the units may include some of the same letters or words but not be identical to the target unit. Studies (Hintzman, 1969; Underwood, 1969; Underwood, 1971) have shown, however, that as frequency increases, frequency judgements increase; and as frequency differences between two words increases, the probability of selecting the most frequent word increases. Underwood (1971) noted, nevertheless, that recognition memory based on frequency as the dominant attribute was a theory waiting definitive empirical resolution.

Results of studies by McNulty (1965) and Postman (1950) indicated that recognition performance between lengthy correct integrated (e.g., highchair) and incorrect nonintegrated units (e.g., AHRICGHIH) is inversely related to the degree of similarity between the units presented for learning and the distractors added for testing purposes. High similarity incorrect units serving as distractors may include in different order exactly the same letters as stored for a correct unit (e.g., AHRICGHIH; highchair). This is less likely to happen if the distractors are dissimilar to the correct units (e.g., upstairs vs. highchair).

Some evidence points to human maturation as a valid influence on how people hear and listen. Young children seem to be more influenced by the similarity of sound between study and distractor words than are adults (Bach & Underwood, 1970; Davis, 1967; Underwood & Freund, 1968). Others suggest that these findings are not always consistent (Buschke & Lenon, 1969).

The Associative Attribute

When words are used in recognition performance the associative attribute appears to be critical. Underwood (1971) assumed the process by which the associative attribute influences recognition to be related to frequency theory. He suggested two other assumptions which relate to frequency theory. One is that the act of perceiving a word is a representational response (RR) and that the frequency unit is this RR. The other is that when a word is presented for learning, certain implicit associative responses (IARs) occur. These assumptions are explained in this manner:

> As a rough index of these IARs, word-association tables are normally used. The IAR occurs to the RR of the word presented, and when the IAR is a single word, it may be assumed to have a frequency of one in that situation. One may proceed to predictions concerning recognition performance by treating the IAR as if it were a word actually presented to subjects. Because not all subjects make the same IAR to a given word, and because the data in word-association tables may not represent the frequencies of IARs which occur in any particular learning situation, the predictions must be of a gross nature. (Underwood, 1971, p. 328)

The supposition is that the judgement of situational frequency for words not actually presented as implicit associative responses (IARs), but assumed to have been presented, ought to be higher than judgements for words which were not presented as either study information or IARs to any of the words presented. (Underwood, 1971)

Low- and High-Frequency Words

Mandler, Pearlstone, and Koopman (1969), in an experiment employing synonyms, noted that the IARs and the words producing them can be

synonymous but that it need not be error producing. Underwood (1971) held that the evidence did not support this contention. In an earlier study, Rowe (1972) presented subjects one of two passages: in one, associations among words in the sentences were weak and in the other, associations were strong. The critical words were then removed from the passage, mixed with distractors, and a recognition test given. The results showed that recognition for the strongly associated words was better than for the weakly associated ones. There was greater probability that subjects would have an IAR for words of high frequency than of low frequency. In another word frequency study using high- and low-frequency words, Gorman (1961) found that recognition performance is greater for low frequency words than for high.

Frequency Theory of Recognition Memory

Frequency theory states generally that the ability of a person to discriminate differences among units (words, phrases, or sentences) is based on the frequency with which the units have been exposed to the subject. In a study, in which Ekstrand, Wallace, and Underwood, (1966) experimented with pairs of words, the frequency of a unit was regarded as its acquired familiarity (i.e., the number of times the subject was exposed to the unit.) The essential element of the theory is that the correct item in each set of units (i.e., items in a multiple choice test) acquires more frequency points on each exposure of the unit than does the incorrect item. The postulated build-up of the frequency differential favoring the correct item in each unit proceeds along the following lines. First, a subject is presented with a set of units to study. One frequency point for each member of the set is accumulated during this exposure since the subject is presumed to perceive or make some sort of response to each unit presented. (Ghatala & Levin, 1976; Underwood, 1971) Second, because the

experimenter indicates the correct member of the set during a feedback interval, the subject is again presumed to attend to and possibly rehearse the correct member of the unit. In that way, the correct member of the unit will receive at least one additional frequency point. The result of this procedure is that frequency points will accrue faster to the correct alternative than to the incorrect ones.

Research studies have indicated that subjects possess a well-developed skill allowing a detection of differences in frequency. Learning may occur, then, if the learning task is such that the detection of frequency differences will allow acquisition and application of the skill. Ekstrand, Wallace, and Underwood (1969) formulated this theory of verbal discrimination (V-D) learning based on the assumption that subjects choose alternatives by discriminating differences in situational frequency. They also discovered that background frequency did not confound situational frequency. Subsequently, frequency as a theory has been extended to account for a variety of experimental memory tasks in which frequency interference has been a variable (Ghatala & Levin, 1976; Ghatala, Levin, & Truman, 1978; Levin et al., 1973; Underwood & Freund, 1970a; Underwood, Zimmerman & Freund, 1973).

Frequency Interference

According to frequency theory, subjects perform successfully when presented with a pair of words to study because they will select the member of the pair they perceive as having the higher frequency value or the most frequency points. During the course of investigations dealing with frequency theory, evidence began to suggest an unusual phenomenon: the frequency which accrued to correct options could also accrue to incorrect options through contiguity (Levin et al., 1973).

Indications were that frequency acquisition of incorrect options through contiguity was a fundamental element in frequency theory. This phenomenon was termed "frequency interference" (Ghatala et al., 1978; Ghatala & Levin, 1976; Levin et al., 1973). The general view is that evidence of frequency interference was most visible in the multiple-choice type of recognition memory test. It is this aspect of the frequency theory and its appearance in multiple-choice tests that is the impetus for the problem addressed in this particular paper.

When Ghatala et al. (1978) and Levin et al. (1973) sought evidence to support the theory that frequency interference caused elementary school children to perform poorly on multiple-choice tests, the investigators used mental imagery and repetition as experimental controls to isolate the frequency differential. They found that students who used mental imagery as a strategy to facilitate memory performance made fewer errors than did students who used repetition as a memory strategy.

Frequency Theory and Recongnition Memory Tasks

The focus of research led by Ghatala and Levin (1976) was whether children can and do utilize their ability to assimilate and discriminate situational frequency in performance recognition tasks. Utilization of recognition memory as a variable in discrimination tasks has been central to investigations of frequency interference. (Ghatala et al., 1978; Levin et al., 1973)

The very nature of research theories allows for confirmation and contradictions. Underwood (1971) came to view frequency theory as it was then formulated to be too restrictive. (p. 321) The decision appears to have evolved from the collaboration of Underwood and Freund (1970b) in which subjects

found it impossible to perform recognition memory tasks on the basis of a frequency discrimination. The investigators took the position, therefore, that although the frequency attribute is dominant in verbal discrimination situations, other attributes replace frequency when the frequency discrimination attribute is inadequate.

During investigations of recognition memory tasks, a subject is presented once with, for example, a number of sentences to study. This familiar information in the sentences is mixed with unfamiliar information which the subject has not seen. The subject is then required to identify the familiar study information. Frequency theory hypothesizes that the dicrimination between the familiar and unfamiliar information is made on the basis of the frequency differential. Specifically, the theory assumes that the familiar information has a frequency of one (1) and the unfamiliar information as a frequency of zero (0). The degree to which the subject can discriminate the frequency differences will determine performance on the task. If familiar information in a sentence is paired with unfamiliar, the subject may easily make a direct frequency comparison of information in the two sentences.

Underwood (1971) and Hintzman (1969) suggest that if a difference of zero versus one frequency unit is discriminable, a subject's performance on the recognition task should be perfect after a single presentation of the units. The evidence of their studies indicated that under the above circumstances, performance is often imperfect; revealing that when subjects are asked to choose the most frequent word in a pair, and when the situational frequencies are zero and one, the choice is only correct about 80 percent of the time.

Integrated vs. Non-integrated Units in Recognition Memory Tasks

During the course of investigations into recognition memory performance,

results showed that testing effects (i.e., changes in behavior which were usually decremental in nature) represented interference resulting from a diminution in frequency discrimination. Experimentally, therefore, a memory theory could be evaluated by studying the effects of interference. Underwood (1971) called attention to the difference in recognition memory performance when frequency discrimination breaks down. This disruption of the frequency differential is posited to result from the presentation of a poorly-integrated unit such as "M-A-L" versus "M-A-T." A well-integrated unit is thought to elicit from the subject a response to the unit as a whole. Poorly-integrated units, from the stimulus-response view, may cause a response to only one or two letters; thereby accumulating incorrect frequency values.

Peixotto (1947) demonstrated the results of performance by subjects who poorly integrated verbal units. In his study subjects were shown 30 nonsense syllables for an average of 2 seconds each. On the recognition test, 90 additional syllables were included as new syllables. In an arrangement of five columns of 24 syllables with six correct syllables in each column, the subjects were required to identify, in order, the old syllable across the five columns. The results were 85, 70, 64, and 49 percent correct identification of old syllables. The results were interpreted to indicate that the decline in performance was due to the effect of the new or distractor syllables.

As stated earlier, Underwood (1971) noted that when non-integrated units are presented as the subject views each successive syllable during the testing, there is an increase in the frequency with which various single and/or two-letter combinations are experienced. The memory for a syllable or letter during testing could lead to an inability to distinguish, on the basis of the frequency differential, between familiar and unfamiliar words.

Evaluating the Frequency Theory

Psychologists hold that the critical test for a theory is the degree of correspondence between its predictions and the effects of its major independent variables on behavior for which the theory is said to be relevant (Underwood, 1971, p. 321). Investigators who have tested the frequency hypothesis have reported various results. McNulty (1965) notes that when a unit is poorly integrated, recognition memory performance may be based on less than the total unit presented. The method of unit presentation provides still another criterion by which interference could occur during testing. Dale and Baddely (1966) and Field and Lachman (1966) consistently reported that recognition performance decreases as the number of alternatives, in a multiple-choice type test increases. Underwood (1971) suggested that the hypothesis might be tested in this manner:

> An experiment may be designed so that as a test of recognition learning there are two, four, or six alternative choices for each correct, or old, unit. If these three conditions are given to different groups of Ss, or the same Ss at different times, it is clear that the testing effect must be greater the greater number of alternative choices. This must follow: as S goes through the successive sets the probability of building up interference by a buildup of the frequencies of the components of the units increases as the number of alternatives increase. (Underwood, p. 323)

Underwood also notes that Postman (1950) posits the idea that to manipulate the variable properly, subjects ought to be exposed to some items with two, four, six or more alternatives, all intermingled. In this mixed-testing condition the retention interval for all the items would be the same. The testing effect

would not be removed in this type of experiment, but it would be spread equally over all conditions. (Underwood, 1971, p. 324) Designed appropriately, it appears that the effect of the number of alternatives is negligible. Both Postman (1950) and Underwood (1971) reported evidence which indicated that the testing effect is of small magnitude when words are used in the recognition task.

As stated earlier, the theory of memory asserts that memory consists of an ensemble of attributes. Frequency attributes are assumed to be the dominant, though not exclusive, factor available to subjects when decisions on a recognition test are required.

Although there is not unanimous agreement among the results of available studies, the consensus seems to indicate that certain variables based on frequency theory do influence recognition performance, there are instances when the theory in its formulation is not applicable. Gorman (1961) has shown, for example, that recognition performance is better with concrete than with abstract words. Jenkins, Neale, and Deno (1967) conducted studies which found that pictures yield higher scores than will the words naming the pictures. In a similar study, Paivio (1969) suggested that effects noted by these studies may be in some way mediated by imagery differences which support the frequency discrimination. Using these studies, (Gorman, 1961; Jenkins et al., 1967; Paivio, 1969) as a basis, Underwood (1971) poses the possibility that discriminative and retrieval attributes differ for abstract and concrete words.

The axiom that there are two sides to every issue is nonetheless accurate for recognition performance. Evidence points to a gradual assimilation of situational frequency to background frequency with the passage of time. (Underwood & Freund, 1970c) The indication is that recognition scores will

decrease over time revealing that recognition memory over time shows evidence of forgetting. Frequency discrimination is posited as the dominant attribute in recognition memory performance. Forgetting must indicate that there is a loss of the frequency which originally produced the discrimination. Underwood (1971) suggests and other investigators (Crawford, Hunt, & Peak, 1966) concur that such a hypothesis would account for two facets in the forgetting of a discrimination. One, low-frequency letter sequences should be forgotten more rapidly than high frequency letter sequences. The other is that situational frequency as a basis for responding to an item is replaced by background frequency. Such a tendency would influence high frequency word sequences less than low frequency word sequences. The role of forgetting in recognition performance is explained by the conclusion that an accumulation of situational frequencies evolve over time into background frequencies causing the loss of identity of the situational frequencies. Why this may be so is not presently understood. (Underwood, 1971)

On the other hand, certain studies suggest that a discrimination attribute, such as represented in recognition or verbal discrimination learning, does not follow the same laws of forgetting as represented in associative learning where recall is used to measure memory. Bower and Bostrom (1968) and Underwood and Freund (1970b) noted the involvement of fundamentally different mechanisms. One of the mechanisms is thought to be the frequency attribute. Although studies report conflicting results, there appears to be no sufficient evidence indicating that the frequency attribute dominates recognition memory performance. That is not to say that recall may be a facet of recognition or that "intrusions" in recall would be sources of error in recognition if the intrusion is a distractor on the recognition test. (Underwood, 1971, p. 332)

Conceptualization of Mental Imagery

Imagery is thought to be one of several modes of thinking and remembering in which usually visual but non-verbal representations are produced and used by an individual (Wickelgren, 1970). The psychologist, Watson (1930), led an influential group of behaviorists who believed that mental imagery was too subjective an experience to qualify for scientific research. During that era, inquiry into mental imagery declined. Not until the 1960's when cognitive psychology gained recognition was interest in mental imagery revived. (Paivio, 1971)

Mental imagery literature reveals that the most often discussed issues in this area of research relate to fundamental differences in the conceptualization of the role of mental imagery in research. Current interest in the topic represents diverse views with several research trends.

Recent evidence indicates that words are thought to be the only manageable and objective unit for study and that parsimony and directness in scientific investigation of mental imagery is achieved only when the response is verbal (Paivio, 1971). Other studies suggest that there is no empirical superiority of words over images and that perceptual images are no less inferential than is the word/verbal process (Paivio & Rowe, 1970; Sachs, 1967; Yuille & Paivio, 1969). It was Paivio (1971) who noted that if empirical studies were to be the sole vehicle for mental imagery research, there was little chance for interest in imagery to survive.

Paivio and his associates at the University of Western Ontario, Canada, have conducted many studies in which the goal was to relate imagery to verbal and other learning processes. They found, for example, that an important variable in verbal learning is the imagery producing power of words. (Paivio,

Yuille, & Madigan, 1968) Concrete words such as table, chair, and girls, were learned faster than abstract words such as love, honesty, and hate. Associations between concrete words appeared to be learned faster. The suggestion is that mental imagery is a factor which helps individuals learn concrete words faster. Concrete words, therefore, evoke mental images that can function as mediators in thinking and memory.

Ghatala and Levin (1973) have focused on the role of word frequency in memory performance. They have used mental imagery as a mnemonic device toward understanding how frequency discrimination functions in recognition and recall memory.

That there are differences in an individual's memory ability has been noted. (Ebbinhaus, 1964; Hintzman, 1973) When an individual shows an exceptional ability to faithfully reproduce mental images of previous perceptions, it is referred to as a photographic or an eidetic memory. (Hintzman, 1973, p. 160) An individual's memory, however, is said to be most reliable when bizarre happenings and traumatic events are involved.

Paivio and Mental Imagery

A continued review of mental imagery literature from the early 1960s through 1975 reveals that the works of Allan Paivio have dominated the revival of interest in the mental imagery concept among cognitive psychologists. Richardson (1980) noted that Paivio set the pattern of most subsequent research on mental imagery with his early experiments. Recent publications of his are concerned with the methodological foundation of mental imagery research. (Paivio, 1971, 1975)

Prior to discussing the contemporary approaches to the study of mental imagery, it should be re-emphasized that historically, behaviorist psychologists

viewed mental imagery as a subject unsuited to scientific inquiry. Behaviorists (Watson, 1930) determined that mental images did not accurately reflect reality and could not, therefore, be studied empirically. Bartlett, (1932) another behaviorist and a contemporary of Watson's took an alternative view. He proposed, instead, that remembered events need not be faithful reproductions of reality but were partial constructions which provided needed cues for the retrieval of required information. The problem at the heart of criticism by early psychologists was, it seemed, how to discover a method to study mental imagery which would be consistent with the scientific methodology of behaviorist psychology.

Paivio and his colleagues chose this methodological problem as the basis for investigations into mental imagery. They (Paivio, 1971) viewed the problem as one in which there was a need to demonstrate to the research community that while the concept of mental imagery was admittedly subjective or mentalistic, it could be studied scientifically. Paivio's methods remained, it is noted, within a systematic associationistic framework of classical behavioristic inquiry (Neisser, 1972; Richardson, 1980), and rigorous behaviorist methodology. (Bower, 1972; Levitt, 1977) Nevertheless, some investigators determined that Paivio's conceptualization of mental imagery was a "radical departure from the theoretical tenets of his peers" (Richardson, 1980, p. 8). The suggestion is that the views of his peers caused Paivio to adopt a defensive stance concerning the appropriateness of mental imagery as a psychological concept. (Yuille & Catchpole, 1977)

Adoption of this particular position may have served as the impetus for Paivio's work, Imagery and Verbal Processes, (1971). Richardson (1974), in a review of that work, posited its goal to show that mental imagery could be

fitted into a framework which behaviorist psychologists could and would accept as a psychological theory. That position set Paivio on a course of inquiry in which mental imagery was viewed as a mentalistic concept. This concept would require a different sort of experimental treatment than that for classical cognitive psychological research. Mental imagery, asserted Paivio (1971), ought to be accorded the same status as that granted to verbal mediation in standard classical associationism.

The central problem in mental imagery research is believed to be how to formulate an objective, scientific inquiry of a private, subjective experience. Paivio (1975a) and his associates treated mental imagery as a theoretical concept which could be operationalized. Operational procedures were devised to provide a link between hypothetical subjective events and observable events which would permit investigators to make inferences about the subjective events. Paivio was breaking no new ground in this procedure; studying intervening variables and symbolic processes has been a scientific tradition for some 60 years. (Richardson, 1978)

The following three sorts of operational procedures have been suggested as the basis for mental imagery research:

1. The use of instructions and their effect on experimental subjects employing mental imagery in performing psychological tasks,
2. The measurement of the degree to which stimulus material is reported to evoke mental imagery by the experimental subjects, and
3. The degree to which their reports predict variations in performance in psychological tasks with varying samples of materials. (Paivio, 1972; 1975b)

In order to meet the requirements of testing a theory, investigators must specify various hypothetical constructs and operational procedures, and define terms used to explain these constructs and procedures. The precedures then are required to show a correlation, or a cause-effect relationship, with performance on certain experimental tasks. (Paivio, 1971, p. 6) Richardson (1978) noted that the procedures described by Paivio (1971) were used in research where subjects were given mental imagery instruction. The stimulus attributes were successfully studied although the investigation into individual differences were less successful.

Early on Garner, Hake, and Eriksen (1956) proposed that operational definitions are no guarantee that certain procedures were defining the desired theoretical construct. More recently, Richardson (1980) proposed that "the use of a single operational procedure might mean that the theoretical construct would . . . be identified with the instrument being used to measure the construct" (p. 11). For example, an intelligence test would simply measure the ability to do intelligence tests.

In contemporary psychological investigations, however, mental imagery is defined by behavioral operations and is characterized as a theoretical covert reaction. (Richardson, 1980) Some psychologists currently accept mental imagery as an empirical phenomenon; others as a hypothetical entity. (Hayes, 1973; Janssen cited by Richardson, 1980, p. 42) The question is, then, can the same term be used to refer to a theoretical construct and to an empirical phenomenon? That scientific investigations often raise more questions than they provide answers is an accepted truism. Nevertheless, investigators have proceded by hypothesizing and building theories which operationally define the components of mental imagery.

Mental Imagery as a Memory Strategy

Hintzman (1969) has observed and Paivio (1972) concurred that mnemonic instructions may improve memory performance by using instructions as a device for organizing information to be remembered. Some investigations have compared imagery instructions and situations requiring mnemonic strategies without specifically mentioning the use of mental imagery. (Bower, 1970, 1972) Others have used prepositional phrases or pairs of nouns in meaningful phrases or sentences to improve recognition memory performance. (Anderson & Bower, 1974) Still other investigators reported empirically significant gains in learning from a mental imagery strategy in which students were instructed to generate dynamic mental images for themselves. (Ghatala & Levin, 1976; Ghatala, et al., 1978)

Evidence has suggested that in recall memory performance verbal mediators may be as effective as are instructions to employ interactive mental imagery. (Janssen, cited by Richardson, 1980, p. 45) Richardson's (1980) position included the idea that both formulation of sentences and generation of mental images were two forms of cognitive processing operations on a common representational system in memory. (p. 77)

Earlier, Bower (1970) had supposed that this representational system was influenced strictly through verbal mediators. More recent experiments caused a rejection of this inflexible position. (Bower, 1972) He, along with Paivio (1971), came to the view that the ability to generate sentences depended upon the use of mental imagery. It was found that experimental subjects reported a spontaneous imagining of a scene or an event evoked by the generation of certain sentences.

Richardson (1980) noted that Atwood (1972) conducted one of the first studies which investigated the beneficial effects of mental imagery instruction on memory retention when subjects were given spatial tasks concurrent with verbal information. Several researchers in reviewing Atwood found three main problems which cast doubt on the validity of the study. Atwood, according to Janssen (as cited by Richardson, 1980, p. 42) confounded the effect of varying the concreteness of the stimulus material with the effect of varying the mnemonic instructions. As a result, the experience provided no method for testing the hypothesis that a concurrent task would reduce the benefits of mental imagery instructions. Second, the phrases used to generate the images were of an unusual nature (i.e., a "nudist devouring a bird"). Third, and of utmost concern to researchers, were the unsuccessful attempts to replicate the experiment. (Baddely, Grant, Wright, &Thompson, cited by Richardson, 1980, p. 79; Bower, Munoz, & Arnold, cited by Anderson and Bower, 1973, p. 459; Brooks, cited by Paivio, 1971, p. 374; Quinn, cited by Baddely, 1976, p. 229)

Richarson (1980) reported that Janssen was most active in trying to bring some scientific standard to bear on the idea of spatial tasks, the effects of stimulus concreteness, and the influence of mental imagery mnemonic instructions on memory performance. The results of the studies as reported by Janssen (as cited by Richardson, 1980) suggested that concurrent visual or spatial tasks generally do not interfere with the use of mental imagery in human learning.

Paivio (1971) and Richardson (1980) found that mental imagery may lead to reliably effective improvement in memory performance. On the other hand, the value and ability to generalize memory mnemonic instructions have yet to be integrated into theories of human understanding. Richardson (1980), nevertheless concluded:

> . . . it is possible that the construction of a mental image according to an intentional description when material is presented for learning gives rise both to a proposition representational and to a pictorial presentation in long-term memory. (This) . . . applies whether the subject was deliberately constructing mental images in response to specific mnemonic instructions to do so, or whether he happened to experience mental imagery in carrying out other instructions such as generating sentences, or in learning without specific mnemonic instructions. (p. 83)

Image Coding

It appears to be accepted in research literature that mental imagery influences memory performance in a variety of recall and recognition tasks. Researchers have speculated as to the nature of the memory processes and to the relationship and differences, if any, between memory and retrieval systems used in recall and recognition tasks. The search for formulation of the appropriate questions led Paivio to ask the following:

1. Are the effects of mental imagery best explained in terms of perceptual images, verbal representations, a combination of both, or some kind of abstract semantic representation which is neither imaginal nor verbal?
2. Are the effects of mental imagery mediated by some general factor such as depth of processing as opposed to qualitatively distinct memory codes. (Paivio, 1978)

These possibilities were the basis for five theoretical approaches to imagery research evolved by Paivio (1978). They are imagery, verbal and abstract representations, dual coding and depth of processing.

An imagery theory suggests that any effects attributable to imagery variables are due to the mnemonic properties of the image code. A model for this idea would encompass a process in which both verbal and pictorial stimuli would be encoded in a pictorial form. From this form, subsequent information required for experimental tasks could be retrieved on demand. A second interpretation is that verbal processes function as mediators of mental imagery. Third, a verbal-coding hypothesis, however, has been found to be unreliable. Evidence has shown pictures to be superior to words and to have more impact than abstract words in stimulating memory performance. (Paivio & Csapo, 1969)

The fourth possibility would be a dual coding system which would take into account both the imaginal and verbal processes. The suggestion is that these processes include independent but richly interconnected systems for encoding stimulus information, storage, organization and retrieval. (Hintzman, 1973; Levin & Allen, 1976) A model of dual-coding would include an additive effect on performance as a result of the two codes. The implication is that the codes are interchangeable (i.e., names can be attached to visuals; words can evoke images) and that the interchange is a cognitive function.

Anderson and Bower (1973) wrote extensively about the fourth theoretical approach to memory coding in terms of propositions. According to their view, both non-verbal and verbal information is represented in some common abstract form such as logical propositions. These propositions serve as a functional memory code on which verbal and mental images are based. The problem with the dual coding theory appeared to lay in its inability to account for the superiority of pictures over words in either a recall or recognition memory task.

Research literature indicated that when subjects were instructed to employ imaginal or verbal encoding, those using the former scored higher than those using the later system. Paivio concluded "that pictorial/imaginal and verbal codes must have different memory properties associated with them as some point in the stream of information processing". (Paivio, 1975, p. 126) Such a conclusion lent more support to some form of a dual-coding theory.

A dual-coding system noted by Hintzman (1973) included the idea of levels of processing, the fifth of Paivio's (1975) theoretical approaches to mental imagery research. Much of the evidence to support the level of processing mode has been presented by Craik and Lockhart (1972). Their approach to this theory differs in principle from the dual coding idea in that memory performance is considered to be a function of the depth to which an item was encoded in memory without reference to structural or functional differences between memory codes at any specific level.

Yet another approach to mental imagery research involves semantic factors. Paivio (1975) and Ghatala et al. (1978) presented evidence to suggest that semantic variables were critical in the retrieval of to-be-learned information under both recall and recognition experimental conditions. Early evidence did not always support the semantic approach (Kintsch, 1970b), although more recent findings suggest a reversal of earlier studies.

Generally, the conclusions drawn from the review of the literature are that:

1. There is evidence to support the existence of a dual coding memory system;
2. Pictures are a more potent imagery stimulant than are words, although concrete words are easier to remember than abstract ones in both recall and recognition memory tasks;

3. When subjects have been instructed to employ mnemonic devices as memory strategies, the results have been significantly better than those who do not use that strategy, and
4. There is much research activity generated by investigations into the uses of mental imagery. Researchers are not certain that all the appropriate questions are being asked or theories constructed regarding memory retention in the learning process.

CHAPTER III

METHODOLOGY

Objectives

The following three objectives evolved from the aggregate information about mental imagery. The present study provided: (1) statistical data relative to mental imagery as an instructional strategy to facilitate memory assessed by multiple-choice tests, (2) current information to teachers which can be readily applied in the classroom, thereby, improving student performance on multiple-choice tests, and (3) an increase in the bank of knowledge about mental imagery and frequency theories.

Assumption

If mental imagery is an effective instructional strategy, multiple-choice test performance will be improved.

Variables

From this theoretical framework and the related literature, the following variables have been selected for this study: Three instructional memory strategies: Mental imagery, repetition, and control, and three locally produced evaluation measures, multiple-choice tests (M/CT), Forms I and II, and a completion test (CT).

Operational Definitions

1. Memory facilitation study groups are groups in which:
    a. Mental Imagery (MI) instructions are given to students randomly assigned to the mental imagery study group.

b. Repetition (R) instructions are given to students randomly assigned to the repetition study group.

c. Control (C) instructions are given to students randomly assigned to the no direct instruction study group.

2. Instruction

a. MI: 1) Students were shown a slide-tape presentation suggesting one method for generating a mental image from a series of concrete pictures with an accompanying sentence. The sentence, "A lady in a ball gown tried to climb a tree," was presented from an overhead projector simultaneously with the same sentence played from a cassesette recorder (See p. 41 for complete text and visuals used in the mental imagery exercise).

2) Students were instructed to form a mental picture of the information in each sentence as it is simultaneously presented in print and aurally.

b. R: Students were instructed to repeat each sentence three times as it is simultaneously presented in print and aurally.

c. C: Students were given no direct instructions relative to a method to employ in order to remember the information in the sentences.

3. Stimulus duration The interval during which each student in MI, R, and C was exposed to both audio and visual presentation of the sentences was set arbitrarily on cassette and was the length of time required to repeat each sentence three times, approximately 17 seconds.

4. Mental imagery strategy will be determined by the appropriate study group on each of the three tests.

5. Multiple-choice Test Form I is a recognition type test in which the correct answer is selected from choices which include familiar distractor options.

   Each distractor option is plausible. Only one response is correct, although the familiar incorrect option (distractor) appeared within the group of study sentences. Having been seen and heard previously, the distractors are familiar (accured frequency). It is predicted that the accrued frequency will increase the difficulty of discrimination (choosing the correct option).

6. Multiple-choice Test Form II is a recognition type test in which the answer is selected from choices which include unfamiliar distractor options.

   Each distractor option is plausible. One response is correct.

   Discrimination between the unfamiliar distractor options and the correct response should according to frequency theory, provide the correct response more often than would occur by chance.

   Familiar options appeared in the study sentences. Unfamiliar options did not. The distractors are familiar by virture of having been used in the study questions. It is predicted that this familiarity will increase the difficulty of discrimination.

7. Completion Test is a recall test in which students supply the correct answer.

Method

Subjects

The subjects for this study were a group of 69 male and female students enrolled in undergraduate studies at Northeastern State University (NSU),

Tahlequah, Oklahoma. The original pool of 69 students, 23 in each of the three study groups was reduced by attrition. Twenty-three students in mental imagery, 21 in repetition, and 22 in the control group, no-direct instruction, returned to take the prescribed tests. The group studied comprised a sample of opportunity. This sample was assumed to be representative of undergraduate students enrolled at NSU.

Materials

The materials were divided into two groups. One was provided for the three study groups: (1) mental imagery, (2) repetition and (3) control (No-direct instruction): the other for the same groups in the testing situation. Those materials are as follows:

A. Study Situation

1. Sixty complex sentences; each containing three nouns.
2. Three tape recorders; one for each study group.
3. Three identical cassette tapes recorded with the same sixty study sentences (same voice).
4. One set of slides for use with mental imagery study group.
5. One slide projector for use with mental imagery study group.
6. One cassette tape with recorded instructions on how to form a mental image.
7. Directions which proctors were to read to each group.
8. Rooms (See page 40)
9. Proctors (See page 40)

B. Examination Situation

1. Test Forms I, II, and Completion
2. Pencils

3. Directions proctors used
4. Identical rooms used in study situtation
5. Same proctors as used in study situation
6. Labeled manila envelopes to each proctor for returning unsigned tests: (1) Mental imagery (2) repetition (3) control

An example of the complex sentence is: In her song, the sister demonstrated how she triumphed over the trouble. In this experiment, the sentences met the following criteria; (1) each sentence was relatively concrete; and (2) two of the nouns in each sentence comprised a plausible response to a question cued by a third noun: Over what did the sister triumph? Both "the song" and "the trouble" are plausible in the absence of hearing the original sentence. However "trouble" is the correct answer to the question "over what did the sister triumph?"

Sixty sentences were constructed and reviewed by three judges who were faculty members at Northeastern State University but who taught outside the departments of Education & Psychology, or Mathematics. The words were randomly selected from the Teacher's Word Book of 30,000 Words (Thorndike & Lorge, 1944). A pool of 190 nouns and 120 verbs were chosen. From this pool, 60 sentences were constructed.

The composition of the response options following the questions were varied such that for sentences in the multiple-choices Form I, the alternatives consisted of the verbatim correct word (the trouble), and a familiar but incorrect word from the same sentence (the song), and a unfamiliar word: for the sentences in Form II, the set of alternatives consisted of the verbatim correct word plus two unfamiliar words.

In order to control for practice effect, the completion test was presented first and multiple-choice test Forms I and II were not identifiable to the students as separate tests.

The completion test consisted of 20 sentences chosen from the original pool of sentences and not included in the multiple-choice test. The sentences were of the same variety as listed above. The answer "trouble" was solicited in the following form: In her song, the sister demonstrated how she triumphed over the _____. The correct answer was supplied by the student.

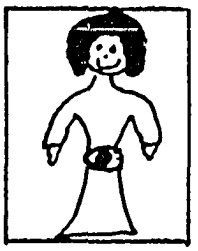
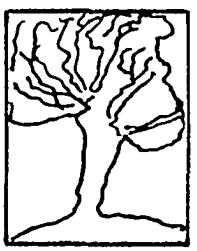
Procedure

Three NSU graduate students served as proctors. They were recommended by faculty members and were chosen for their maturity, competence with tape recorder and ability to work with people, especially students. The proctors were contacted one week prior to the experiment. They were instructed by this investigator in the use of the cassette players so that the procedures in each study groups, except for the mental imagery training session, would be consistent. Each proctor demonstrated an ability to correctly use the cassette tape recorder and the slide projector. The proctors were then instructed in the procedure to be used with the students on the first day of the experiment (See Appendix B: pp 77-102).

Immediately prior to the experiment, the subjects were divided into three groups of 23 each. The division was accomplished by separating the 69 copies of the sentences into three stacks. The stacks were labeled 1, 2, 3. The first subject was sent to group 1, the second to group 2, the third to group 3, the fourth to group 1 until all of the subjects were assigned to one of the three study groups. Each proctor was assigned by drawing numbers to one of the three study groups: Mental image, repetition, or control and to one of three

similar classrooms (i.e., seating arragement, lighting, and temperature). For this study situation, the proctors were each provided with 23 copies of the study sentences, a cassette player and tape, and copies of directions that were to be read verbatim to the subjects. A separate cassette tape, slide projector and appropriate slides with verbatim directions were provided for the mental imagery group.

The study sentences were recorded on three identical cassette tapes, and reproduced on mimeographed sheets which were distributed by the proctors to each study group. The stimulus duration was the same for each group, 17 seconds. That was the time needed to repeat the longest sentence three times. Each subject read or repeated the sentences three times while listening to the same sentences on tape. All three treatments occurred simultaneously. At the start of the study situation each study group was told that they would be tested at the end of a 48 hour period and were asked to remember the material but not to discuss the sentences with anyone. The mental imagery group was told specifically how to form a mental image. No other information was given. For the mental imagery group, the sample sentences at the beginning of the tape were supplemented by a slide-tape presentation. The tape explained to the subjects how they should generate a mental image of the sentences they were about to hear. Slide one identified the stem of the sentence as in, "The lady told how she climed the tree in a ball gown." Slide two shows what shape of tree might be imagined, one of the qualifications is that it must have the strength and conformation to support a lady (person). Slide three then shows a lady in a ballgown climbing the imagined tree. Slide four further demonstrated the kind of tree not to be imagined.

Slide		Audio
1.		The lady
2.		the tree (one that can be climed, perhaps one with a large trunk and has branches extending from it)
3.		a woman climbing the tree in a ball gown
4.		not to be considered would be a tree similar to a christmas tree, or one that has a small trunk and/or branches to small to hold on to.

On the day of the examination, the proctors were provided with copies of the test questions and pencils for each of the students in the three study groups. Each study group with their assigned proctor returned to the originally assigned

classroom. At this time, the students were given the evaluation forms. The tests for the three study groups were identical in form and content. The students completed the test at their own pace. However, no student took longer than 30 minutes to complete the entire test. At the completion of the testing situation the labeled manila envelopes were returned to the investigator. The test forms were counted. Mental imagery returned 23 test forms, repetition 21 and the control group returned 22. At that time the investigator spread out the forms and withdrew (one at a time) enough forms so that each group contained 20 forms each.

Treatment of Data

The data were analyzed by a two-way analysis of variance (ANOVA). The level of significance was set at alpha equal to .05. The following analyses were performed:

Hypothesis A: Multiple-choice test performance using a mental imagery strategy will not be superior to the performance which uses either repetition or control strategies. In this analysis, the expectation is that there will be a significant main effect for the memory strategies. Given a significant F, the Tukey a posteriori comparison will indicate where those differences lie.

Hypothesis B: Scores of Test Form 2 will not be superior to scores on Test Form 1 and Completion. Scores on Test Form 1 will not be superior to those on Test From Completion. The expectation is for a significant main effect for test forms.

Hypothesis C: A mental imagery performance will not be superior to a repetition or control strategy performances where the choices include familiar options. A mental imagery strategy is predicted not to improve performance even though the frequency differential interferes. In this analysis, a significant interaction between instructional strategies and test form is expected.

Hypothesis D: The prediction is that repetition and control performances will not be lower when familiar choices are present as options on multiple-choice tests than when they are not.

Hypothesis E: Where multiple-choice tests include unfamiliar options the frequency differential is predicted to influence test performance for either repetition, control or mental imagery strategies. If a difference does occur it is expected that mental imagery would show the highest mean.

Hypothesis F: There will be a difference in performances of repetition, mental imagery and control during the completion test. If a difference does occur it is expected that mental imagery would show the highest mean.

Hypothesis G: There will be a difference in performance of mental imagery during a multiple-cholice test where familiar or unfamiliar options are included.

The analysis of variance (ANOVA) performed in this study required cells of equal number. A minimum number of 60 subjects was set, 20 in each cell. Sixty-nine subjects, 23 in each study group, were chosen to allow for attrition. The determination was that 3 tests from each group would be extracted and discarded, leaving the required 20. Twenty-three subjects returned for the mental imagery test, 21 for the repetition, and 22 for control. Three tests were extracted from the mental imagery group, 1 from repetition, and 2 from control.

CHAPTER IV

RESULTS

The purpose of this study was to examine the potential of a mental imagery strategy to improve memory retention in multiple-choice tests under condition in which frequency interference is thought to be present and to examine the effects of repetition and control strategies under similar conditions. Another purpose was to examine the three memory strategies under conditions in which the test form, Completion, was presumed to be free of frequency interference.

The experimental design chosen to determine the effect of varying instruction strategies on test format was a two factor ANOVA design with repeated measures over one factor. As presented in Table 1, Factor A (Instruction Memory Strategy), was the between-subjects variable and Factor B (Test Forms) was the within-subject variable. (Tables and Figures Appendix A: pp. 67-76).

Insert Table 1 About Here

Statistically significant interaction was obtained between these two factors ($F(4114) = 15.94$; $p > .05$), as well as significant main effects for instruction memory strategy ($F(257) = 62.23$; $p > .05$) and Test Forms ($F(2114) = 106.87$; $p > .05$).

Table 2 contains the least squares means and standard deviations for the sample.

Insert Table 2 About Here

Mean performance scores for test form by instruction memory strategies are presented in Figure 1. Both Table 2 and Figure 1 reflect the difference between test form and each memory condition. After statistically significant interactions were observed between Factors A and B, (Table 1) the differences between group means were analyzed with Tukey a posteriori comparison for simple main effects at the .05 level of significance. These results were depicted in Tables 3 through 8.

Insert Figure 1 About Here

An examination of the means and mean differences in Table 3 show that with mental imagery instruction, performance on a multiple-choice test with familiar and unfamiliar options is superior to performance on a completion test and that when unfamiliar options are present, performance is significantly superior.

Insert Table 3 About Here

Hypothesis A stated "There will be no differences in performance of mental imagery during multiple-choice testing where familiar or unfamiliar options are included." The expectation was that there would be no significant differences between the mental imagery performance as stated in Hypothesis A. The employment of a mental imagery strategy appears to be less successful when familiar options are present than when unfamiliar options are present in multiple-choice test items. (Table 2, MI/Column II) Tables 6 and 7 indicate that the differences are indeed significant beyond .05 and that the differences indicate a rejection of Hypotheses A.

Insert Table 6 and Table 7 About Here

Hypothesis B predicted that repetition and control performances would not be lower when familiar choices are present as options on multiple-choice tests than when they are not present. Table 2 shows that the scores of R_I are lower than R_{II} and that C_I is lower than C_{II}.

Within the repetition group, Table 4, the indication is that significant differences exist between test form and instruction strategy whether options were familiar, unfamiliar or required a completing word. Table 4 verifies that the difference between R_I and R_{II} is significant at the .05 level, but that the

difference between C_I and C_{II} is not significant at the same level as indicated in Table 5.

Insert Table 4 and Table 5 About Here

Further examination reveals no significant differences between performances when subjects were required to complete a statement without a visual stimulus and the appearence of an old incorrect option.

Table 5 is another indication that when frequency interference is judged not to be present performance of the control group who did not receive specific study instruction improved. Subjects employing a spontaneous strategy, control group, showed significant differences only between the completion tests form and new incorrect option.

Hypothesis C stated that Multiple-choice test performance using a mental imagery strategy will not be superior to the performance which uses either repetition or control strategies. The expectation is for a significant main effect for memory strategies. Columns I and II, Table 2, indicated that MI strategy shows a superiority or R and C strategies. Table I indicates the presence of a significant main effect for memory strategies.

An examination of the means and mean differences in Table 3 verifies that with mental imagery instruction, performance on a multiple-choice test which either familiar or unfamiliar options is superior to performance on a completion test and unfamiliar options are significantly superior to familiar options. Therefore, Hypothesis A was predicted to be rejected and was rejected at the .05 level.

Examining across rows of Columns I and II, Table 2, the reader can observe that when unfamiliar options are included with the correct answer the means were higher for all three strategies than when familiar objects are included. Observation of the same columns also indicated that R scores, in both instances, are better than C scores.

Within the R group, Table 4, the indication is that significant differences exist between test form and instruction strategy whether options are familiar, unfamiliar or required a completing word. This information is the result of an analysis of Hypothesis D which predicts that scores of Test Form II not be superior to scores on Test Form I and Completion. Scores on Test Form I will not be superior to those on Test Form Completion. The expectation is for a significant main effect for test forms.

The significant main effect for test forms is indicated in Table 1. The expectation was that this hypothesis would be accepted at .05. Tables 6, 7, and 8 reveal that the differences between test forms is significant and that Hypothesis D is rejected.

Insert Table 8 About Here

Where multiple-choice tests include unfamiliar options the frequency differential is predicted by Hypothesis E not to influence test performance for either repetition, control or mental imagery strategies. If a difference does occur it is expected that mental imagery would show the highest mean, the reader can see (Table 2, Column II) that MI scores are higher than R or C.

Table 7 verifies that the differences are significant at the .05 level. The subjects have behaved as though frequency interference has not interferred with their performance. Therefore, the hypothesis is accepted as predicted. Mental imagery score is significantly higher than either R and C, and R is significantly higher than C.

According to Hypothesis F, there will be no difference in performances of repetition, mental imagery and control during the Completion test. If a difference does occur it is expected that mental imagery would show the highest mean, indicates that on examination of the Completition Test (Table 2) the means of MI are significantly higher than R or C, thus, rejecting the hypothesis as expected. However, an anomaly occured in that the pattern observed in Column I and II, Table 2, is reversed in this test: C means are higher than those of R. Table 8 verifies significant differences among these three groups.

The final prediction is in Hypothesis G which states that a mental imagery performance will not be superior to a repetition or control strategy performance where the choices include familiar options. A mental imagery strategy is predicted to improve performance even though the frequency differential interferes. A significant interaction between strategy and test forms is expected. Figure 1 and Table 1 provide the information that MI strategy is superior to R and C under conditions of frequency interference, therefore, rejecting the null hypothesis as expected.

Discussion and Conclusions

Frequency theory states, generally, that the ability of a person to discriminate differences among words, phrases or sentences is based on the frequency with which information has been exposed to the subject. The

assumtion is that the correct item acquires more frequency points on each exposure than does the incorrect item.

The need is to continue to gather evidence to support the proposal that the frequency which accrued to correct options could also accrue to incorrect options because of the contiguity of the information, i.e., frequency interference.

The general view is that evidence of frequency interference is most apparent in the performance of students on multiple-choice tests. Results from this present study suggest that learning was blocked in those individuals who performed poorly on multiple-choice tests. This was especially so where the options included incorrect but familiar choices. The degree, then, to which the subject can discriminate the frequency difference will determine performance on the task.

If familiar information in a sentence is paired with unfamiliar, a direct frequency comparison is easily achieved. When the frequencies are narrow, (e.g., zero and one), the choice is correct only about 80 percent of the time. (Underwood, 1971) Evidence was sought by this present study to indicate that the use of mental imagery, more than repetition or the control group strategies, would increase the number of times the correct option was chosen. The prediction was that the error producing effects of frequency interference would not intervene even though familiar options were included as distractors.

The general conclusion was that the discriminative ability of the subjects in this study, on average, was improved when they employed mental imagery as an instructional strategy. Nevertheless, when the frequency differential was assumed to be an interfering presence, student performance decreased.

Specifically, a mental imagery instructional strategy appears to be significantly superior to a repetition instructional strategy when new options are included in multiple-choice test items. When mental imagery is involved in recalling information where options are not visibly available, the mean scores appear to increase significantly over that of repetition or control group strategies.

The results of this study clearly support the proposition that employing mental imagery as an instructional strategy facilitates memory. This facilitation of memory, it appears, lead to improved performance of the MI group on multiple-choice and completion tests.

Education is under extreme pressure from public and governmental sectors to prepare students who score high on standardized tests. However, these agencies, in this era of conservative fiscal policies, provide minimun funds to accomplish their demands.

This investigation was predicated on Ghatala's (Ghatala, et al., 1978) and Levin's (Levin et al., 1978) theory that a frequency differential interferred with the retrieval (recognition) of information during a multiple-choice test, especially one in which familiar items were included as options in the answers. They further predicted that using mental imagery as a memory device would significantly deter the negative effects of the frequency differential under the conditions stated in the previous sentence. The indication would appear to be that performance would be high or higher when mental imagery was employed in instances where either familiar or unfamiliar options were included on multiple-choice tests.

These studies would have been supported if there had been no significant difference in performance between unfamiliar options and familiar options in a

multiple-choice test following mental imagery training (thus offsetting frequency interference effects).

An interaction among mental imagery, repetition, and control strategies was expected. The level of the interaction among the instructional memory strategies was not predicted.

A statistically significant interaction was predicted between training strategies and test form. The hypotheses would have been supported if there had been no significant difference in performance between unfamiliar and familiar options in a multiple-choice test following mental imagery training (again offsetting frequency interference effects).

A review of the precedures for collecting the data indicates that students retained information acquired from the study sentences for a 48-hour period of time. Studies conducted by Ghatala et al. (1978) and Levin et al. (1978) chose a 24-hour retention interval. Retention intervals seem to be arbitrarily determined, apparently based on investigators' access to subjects.

Availability of students in the present study was limited to a 48-hour period. Classes at many colleges and universities occur on a Monday, Wednesday, Friday (MWF) or a Tuesday, Thursday schedule. Students who participated in this investigation were scheduled for classes on MWF; thus, the 48-hour retention interval.

Public school students attend classes on a daily, Monday through Friday schedule. It is probable that daily reinforcement of material would enhance memory retention. The evidence in this study suggests that students can be successfully trained in mental imagery which can serve as retrieval cues or stimuli to facilitate memory retention. The same evidence also directs attention to the retention interval. In this investigation the effects of imagery

training of a few minutes was observed after a longer period of time (i.e., 48 hours) than the 24 hour interval used in other imagery experiments (Ghatala et al, 1978). Therefore, even longer intervals between training and evaluation may be required to fully test the efficiency of imagery strategies.

Investigations into subjective processes such as mental imagery have often been difficult and not always fruitful (Paivio, 1971). Divining inferences from studies which are not empirical carries with it some risks, and cause and effect variables are not always directly observed or easily supported by scientific evidence.

However, based on the works of Ghatala et al. (1978) and Levin et al. (1973) which reported findings to support the inference that a frequency interference differential inhibits multiple-choice test performance, this study sought evidence to support two ideas. One was that mental imagery could be successfully used as an instructional strategy. The other, was that as an instructional strategy mental imagery would substantially inhibit the effects of frequency interference during a multiple-choice test where the items included either familiar or unfamiliar distractor options.

According to Levin et al. (1978), the frequency differential operated in multiple-choice tests where either familiar or unfamiliar options were present. The logic of this present study is that, in a test situation not including multiple-choice items, frequency interference would not serve as an inhibiting factor. Evidence to support that thesis would require that mean scores of the completion test among mental imagery, repetition, and control group subjects would not significantly differ. The expectation was that the mental imagery mean scores would be higher because of the training session experienced by the subjects immediately prior to presentation of the study sentences. As stated

earlier, the mental imagery group was exposed to a slide presentation in which they were instructed in a method of constructing a picture in their minds (i.e., a mental image of the information contained in each sentence). This mental imagery process was predicated in Levin and Allen's (1976) study in which they asked their subjects to "think-up" vivid pictures to word pairs, as in "dog-stairs".

The slide-tape presentation was based on the assumption that aural experience combined with a visual experience would enhance the mental imagery process (Norman, 1968). Thinking up pictures, during the interval after listening to and visually seeing words which provide the stimuli for the mental images, would deepen the memory trace; thereby facilitating memory at the instance of retrieval of the stored mental image. (Levin & Allen, 1976).

The risk was that the process of visually reading the sentences while listening to them on tape might equally enhance the retention of both repetition and control groups. However, there was no evidence that repetition improved performance.

Employing Tukey's specific comparison, the mental imagery groups performance was significantly different from either the repetition or control group on the completion test. The possibility is that even when the frequency differential is assumed not to be present, subjects exposed to the mental image process would be able to retain and retrieve information more efficiently than either repetition or control.

Information for the completion test was required without the stimulating influence of suggestive options as were present in multiple-choice tests. The retention effects of a mental imagery strategy appear to have remained

operative during the total testing process. Subjects were able to retrieve the necessary information to provide the correct answer when that answer was required. Even though frequency interference might not have been an inhibiting factor during the completion test, the mental imagery process must have been a faciliating one.

Analysis revealed that an interaction exists among the mean scores in mental imagery, repetition and control strategies on the multiple-choice test form.

The characteristics of the interaction are such that when MI is used as the instruction strategy and unfamiliar options are present in multiple-choice test items, the means are significant highest among MI, R and C. (Table 3) This observation appears to be valid even when the means for MI, R and C where familiar objects are present are added to the calculation.

Although R means are significantly lower than MI in Column II (Table 4), they (R) are higher than C (Column II). MI means (Column I/II) indicate that MI II was significantly higher than MI_I thus disputing Ghatala and Levin's claim that MI would significantly negate the effects of the frequency differential. Repetition means were lower when the frequency differential was thought to be present (familiar options Column I) and higher when frequency was thought to be less active (unfamiliar options Column II).

However, R performed better under both conditions of Columns I and II, than did C whose means were lowest of all three groups and were not significantly differents then each other. Although the means were lower under Column I (familiar options-frequency interfered) and were higher in Column II with unfamiliar options (frequency interference less active).

Imagery appears to be encoded at a level which leaves a deeper memory trace than does repetition. Repetition of an item encoded at the sensory level, according to Moray (1959; 1970) and Norman (1968), from an aural and visual perspective does not lead to an improvement in memory performance. Is this why students who often learn information by rote (repetition) and remember that information only through the presentation of it? Students who used repetition performed significantly lower on the completion test than either mental imagery or control groups. Without the visual stimulus of the correct answer (even among distractors), subjects may have had only a transitory memory system from which to retrieve the needed information (Craik & Lockhart, 1972). Therefore, since the retention interval between study and evaluation was longer (48 vs 24 hours) than some memory investigations, (Ghatala et al., 1978) deterioration of the temporary memory trace after 24 hours may have begun. It is difficult to interpret this finding. When students are requested to use a repetition strategy does it not only leave a transitory memory trace, but does repetition inhibit subjects who might have naturally employed mental imagery? What can account for the performance of the control group on the completion test? There is a possibility that some control subjects may have spontaneously employed a mental imagery strategy. This would appear to account for the significantly higher mean scores for the control group on the completion test. Indications are that instructing students in a memory strategy could be a successful technique.

Investigating a process such as mental imaging often proposes more questions than solutions. Any one of the following questions could form the nuclious of future research: Can repetition inhibit? Is there reason to believe that repetition would inhibit the functions of imagery? Under what

conditions? Does imaging become less or more efficient over time? Do some students unconsciously or spontaneously employ mental imagery as a strategy to retrieve information when they use their own choice of memory strategy? Are the effects of repetition such that the memory trace established during the study process is transitory to the extent that the required memory is not efficient during a test in which subjects must supply the correct answer from memory rather than from stimulus options? Perhaps a memory test based on repetition or contrasted with imagery?

Additional questions relate to a mental imagery training session. How sophisticated should the slide/tape presentation be? How long should the presentation last? What is the maximum length of time and most efficient method for presenting the slide/tape presentation? Ought the slide presentation be in color or is black and white equally effective or perhaps superior? If the slide presentation is in color, do subjects image in color? Or black and white? If the presentation is in black and white do students image in black and white or do they supply their own color based on their own experiences?

The purpose of this study was to seek evidence to support the proposition that employing mental imagery as an instructional strategy facilitates memory. This facilitation of memory, supported by the findings of this study, will lead to improved performance of students on multiple-choice tests. There is supporting evidence to suggest that the benefits of a mental imagery strategy include improved performance on frequency interference-free tests (i.e., completion tests). This evidence could be put to immediate use in the classrooms.

The results of this study suggested that there was a phenomenon which influenced the selection of incorrect options when familiar information appears

as distractors. There is support for Ghatala's (Ghatala et al., 1978) and Levin's (Levin et al., 1978) theory that that phenomenon was frequency inferference. Additionally, mental imagery was shown to be more effective in improving test performance, even with the error producing effects of frequency interference, than either repetition or the control group.

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APPENDIX A

TABLE 1

ANOVA

of Test for Memory of Words for

Memory Strategies & Test Form

Source	df	SS	MS	F
Between-Subjects	59	1167.87	-----	
Instructional Memory Strategy (A)	2	1167.60	583.30	62.23*
Error: Between-Subjects	57	526.27	9.23	
Within-Subjects	120	1697.33	-----	
Test Form (B)	2	926.63	463.32	106.87*
Strategy X Form	4	276.47	69.12	15.94*
Error: Within-Subjects	114	494.23	4.34	
Total	179	3391.2		

*p .05

TABLE 2

Means and Standard Deviations

of

Test for Memory of Word

Scores by Test Form

Instructional Memory Strategy		F I Familiar Incorrect Option	F II Unfamiliar Incorrect Option	F Completion Completion
MI	M	13.10	16.35	11.25
	SD	2.34	2.41	1.41
R	M	11.25	13.70	4.65
	SD	2.84	3.13	2.23
C	M	7.35	8.60	6.15
	SD	2.30	2.28	2.66

N = 60

TABLE 3

Means and Mean Differences:

Mental Imagery Instruction Strategy

	Completion	Familiar Incorrect Option	Unfamiliar Incorrect Option
Completion	11.25	1.85*	5.10*
Familiar Incorrect Option		13.10	3.25*
Unfamiliar Incorrect Option			16.35

*p >.05

Note: The Means are on the diagonal and the differences between paired means are in the off diagonal positions.

TABLE 4

Means and Mean Differences:

Repetition Instruction Strategy

	Completion	Familiar Incorrect Option	Unfamiliar Incorrect Option
Completion	4.65	6.6*	9.05*
Familiar Incorrect		11.25	2.45*
Unfamiliar Incorrect			13.70

*p > .05

Note: The Means are on the diagonal and the differences between paired means are in the off diagonal positions.

TABLE 5

Means and Mean Differences:

Control

	Completion	Familiar Incorrect Option	Unfamiliar Incorrect Option
Completion	6.15	1.20	2.45*
Familiar Incorrect Option		7.35	1.25
Unfamiliar Incorrect Option			8.60

*p > .05

Note: The Means are on the diagonal and the differences between paired means are in the off diagonal positions.

TABLE 6

Means and Mean Differences:

Familiar Incorrect Option

	Control	Repetition	Mental Imagery
Control	7.35	3.90*	5.75*
Repetition		11.25	1.85*
Mental Imagery			13.10

*p > .05

Note: The Means are on the diagonal and the differences between paired means are in the off diagonal positions.

TABLE 7

Means and Mean Differences:

Unfamiliar Incorrect Option

	Control	Repetition	Mental Imagery
Control	8.60	5.10*	7.75*
Repetition		13.70	2.65*
Mental Imagery			16.35

*p >.05

Note: The Means are on the diagonal and the differences between paired means are in the off diagonal positions.

TABLE 8

Means and Mean Differences:

Completion

	Repetition	Control	Mental Imagery
Repetition	4.65	1.50	6.61*
Control		6.15	5.10*
Mental Imagery			11.25

*p > .05

Note: The Means are on the diagonal and the differences between paired means are in the off diagonal positions.

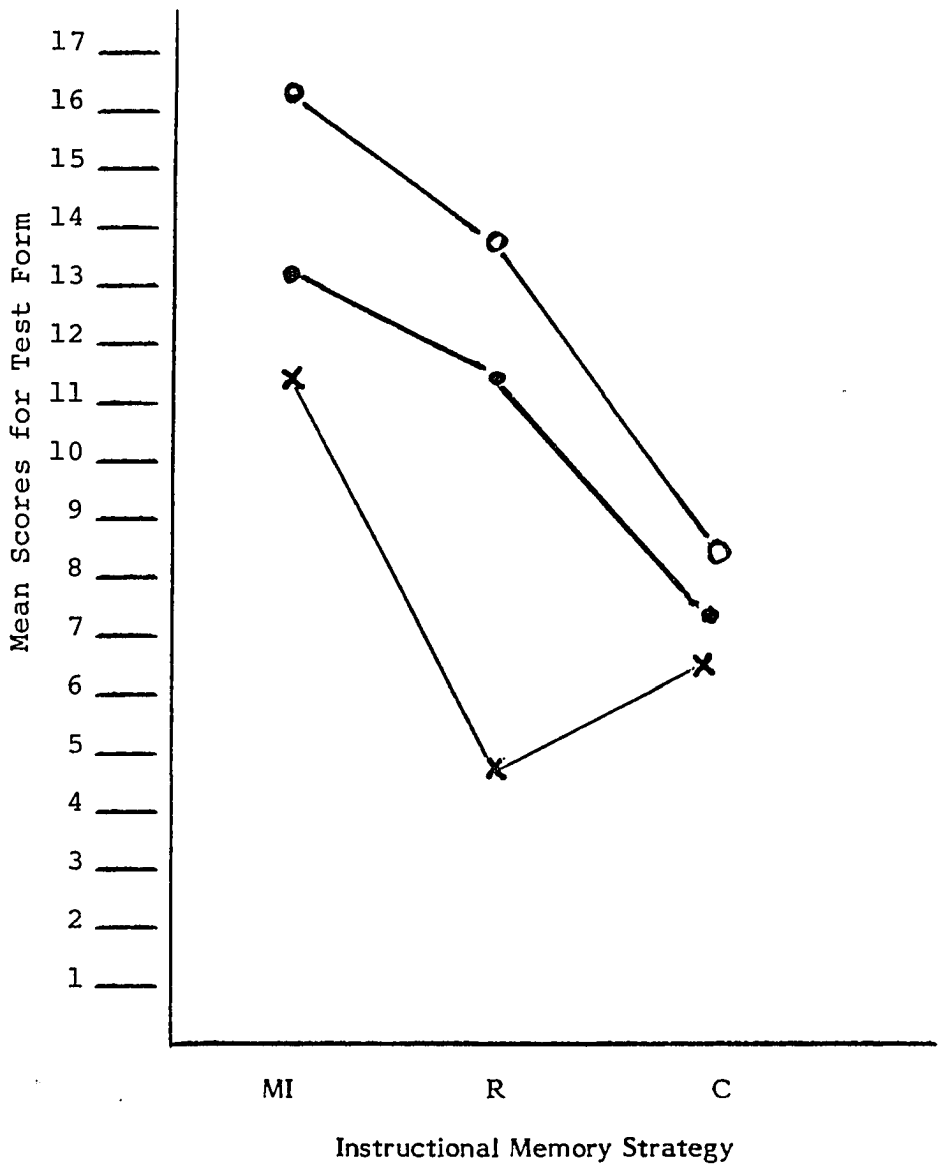
Figure 1. Mean Performance Score for Test Form on Instructional Memory Strategies Consisting of Mental Imagery (MI), Repetition (R), and Control (C)

Legend:

Familiar Incorrect Options = ●

Unfamiliar Incorrect Option = O

Completion = X



APPENDIX B

STUDY SENTENCES

DIRECTIONS FOR STUDY GROUPS

I REPETITION

II MENTAL IMAGERY

III CONTROL

MULTIPLE-CHOICE TEST FORM I

MULTIPLE-CHOICE TEST FORM II

COMPLETION TEST

COMBINED MULTIPLE-CHOICE TEST

(Form I and Form II)

CORRESPONDENCE:

MULTIPLE-CHOICE TEST

CONSTRUCTION COMMITTEE

STUDENT RELEASE FORM

STUDY STENTENCES

1. In his room the sailor told how he ran to the railroad.
2. In the class the student told how she watched the jack.
3. In the bay the model told how she recited the poem.
4. In the shop the lady told how she dropped the lamp.
5. At the fire the firefighter told how he covered the produce.
6. In the Atlantic the ship demonstrated how it rushed toward the shore.
7. As the thief saw the boulder he told how he pushed the bird.
8. In the race the queen told how she shot the shoe.
9. At the players demand the guard told how he contacted the government.
10. In the newspaper the heroes told how they surprised the nurse.
11. Since the accountant instructs the course he told how he explained the taxes.
12. In her song the sister demonstrated how she triumphed over the trouble.
13. In his study the star reported how he sang in the snow.
14. After the author left the hall he told how he saw the committee.
15. In the letter the lie was written to simulate the truth.
16. Under the glass the egg rolled until it hit the wool.
17. In the journal the man told how the dollars increased the business.
18. As the mother called her son she waved away her daughter.
19. At the school the pupil reported how he whistled at the sky.
20. In the play the people told how they shouted at the wind.
21. From his prison the prisoner told how he looked at the seal.
22. While he was living in town the prince traveled through the state.

23. When the team won the contract they gained the yacht.
24. In her search the woman told how she circled around the wolf.
25. In his teaching Washington stated how he worshiped with a Christian.
26. Before the tribe saw the city they told how they swam the river.
27. In his sleep the slave told how he struggled to stay silent.
28. In her ear the editor told how he whispered to the gaint.
29. Because the witness saw the picture he told how he retracted his statement.
30. In his will William stated how he lost his wealth.
31. From the south the Spanish spoke of how they walked to the west.
32. On the wall Virginia wrote how she looked at the university.
33. After the professor gave the answer he told how he scoffed at the evidence.
34. From the tower the farmer told how he fell into the river.
35. Due to the law the maid told how she spoke to the major.
36. In the museum the dog remembered how he drove the sheep.
37. Because the banker lends money he told how he loves people.
38. To his wife the senator stated that he wanted to vote.
39. In the sun the woman told how they dried in the winter.
40. In the summer the artist shows how he draws trees.
41. While the musicians played the bagpipe they reported how they laughed at the drums.
42. After he greeted his father the brother told how he called his fiance.
43. After the water destroyed the store it flooded the valley.
44. As the housewife made the pie she told how she enjoyed the story.
45. In the store the temperature was seen to drop before the storm.

46. When the troops attacked the fortress they told how they blocked the defense.
47. After the stranger found the temple he related how he buried the coin.
48. When the uncle painted the cottage he told how he camouflaged the yard.
49. After the monks worked the garden they told how they sprayed the chapel.
50. As the baby held the bottle he screamed at the toys.
51. Before the speech the mob mocked the crowd.
52. Among the shelves the clerk described how she stacked the patterns.
53. After the officer served the coffee she told how she kicked at the sugar.
54. While the teacher held the book she told how she grabbed at the apple.
55. In the oasis the leader told how he called to the night.
56. In the bank the teller told how he trained the fellow.
57. Wherever the disease strikes the cattle it diminishes the dollar.
58. At the church the youth told how he played in the band.
59. In the ballpark the coach told how he coached the game.
60. After the doctor bandaged the arm he repeated how he examined the blood.

DIRECTIONS FOR STUDY GROUPS

I Repetition

PROCTOR: (Say these words to the student:) "Please pay close attention to the sentences you are going to hear, because later you will be asked questions about them. To help you remember, after you listen to each sentence, I want you to repeat it three times to me exactly the same way you heard it. Listen to a sample sentence and repeat it to me three times exactly the same way you hear it." (Start the tape and let the student listen to the sample sentence. At the completion of the sentence, stop the tape.)

"Now repeat the sentence three times." (Wait) "If you don't have any questions, let's begin." (If there is a question answer it briefly. Start the tape. After the student has repeated the sentence three times, stop the tape.)

"Remember not to discuss this with anyone and thank you."

(Rewind the tape.)

II Mental Imagery

PROCTOR: (Say these words to the student:) "Please pay close attention to the sentences you are going to hear, because later on you will be asked questions about them. To help you remember, after you

listen to each sentence, I want you to get a good picture in your mind of what happened in the sentence. Listen to a sample sentence and get a good picture in your mind of what happened." (Start the tape and let the student listen to the sample sentence. At the completion of the sentence, stop the tape.)

"Did you get a good picture in your mind of what happened?" (wait for an answer. If yes, say, "Let's begin." If no, say, "Try to get a good picture in your mind." Pause, then say, "Let's begin." After the sentence give the student time to imagine the last sentence before you speak. But stop the tape immediately after the sentence.) "Remember not to discuss this with anyone and thank you."

(Rewind the tape.)

III Control

PROCTOR: (Say these words to the student:) "Please pay close attention to the sentences you are going to hear, because later you will be asked questions about each one. Listen to a sample sentence so you will understand the type of sentences you are going to hear." (Start the tape and let the student listen to the sample sentence. Stop the tape immediately the sentence is completed).

Ask: Are there any questions? (Pause) Then say: Let's begin." (After the sentence, there will be a pause. Then the voice will say: This is the end. Thank you." Stop the tape).

(Rewind the tape)

EXERCISE: EXAMINATION

THIS EXCERISE IS DIVIDED INTO TWO (2) PARTS. PART I IS COMPLETION. PART II IS MULTIPLE-CHOICE.

PART I: COMPLETION:

DIRECTIONS: WRITE IN THE CORRECT WORD ON THE BLANK PROVIDED.

PART II: MULTIPLE-CHOICE:

DIRECTIONS: CHOOSE THE CORRECT ANSWER AND MARK THE LETTER ON THE ANSWER SHEET SIDE I.

MULTIPLE CHOICE TEST FORM I: The verbatim correct word, a familiar incorrect word from the same sentence, and an unfamiliar word.

1. From his prison, the prisoner told how he looked at the seal.

   1. At what did the prisoner look?

      a. the seal

      b. the prison

      c. the palace

2. In the play, the people told how they shouted at the wind.

   2. At what did the people shout?

      a. the play

      b. the parent

      c. the wind

3. At the school, the pupil reported how he whistled at the sky.

   3. At what did the pupil whistle?

      a. the sign

      b. the sky

      c. the school

4. In his study, the star reported how he sang in the snow.

   4. Where did the star sing?

      a. in his study

      b. in the theater

      c. in the snow

5. In her song the sister demonstrated how she triumphed over the trouble.

   5. Over what did the sister triumph?

      a. the song

b. the trouble

c. the union

6. In the Atlantic, the ship demonstrated how it rushed toward the shore?

6. Toward what did the ship rush?

a. the shore

b. the Atlantic

c. the sound

7. In his room, the sailor told how he ran to the railroad.

7. Where did the sailor run?

a. to his room

b. to the railroad

c. to the wheel

8. In his sleep, the slave told how he struggled to stay silent.

8. For what did the slave struggle?

a. to stay sleep

b. to stay awake

c. to stay silent

9. In her search, the woman told how she circled around the wolf.

9. What did the woman circle?

a. the search

b. the wolf

c. the treasure

10. In his teaching, Washington stated how he worshiped with a christian.

10. How did Washington worship?

a. with his teaching

b. with a soul

c. with a christian

11. In his will, William stated how he lost his wealth.

11. What did William lose?

a. his purse

b. his will

c. his wealth

12. From the south, the Spanish spoke of how they walked to the west.

12. Where did the Spanish travel?

a. to the east

b. to the south

c. to the west

13. On the wall, Virginia wrote how she looked at the university.

13. At what did Virginia look?

a. the map

b. the university

c. the wall

14. From the tower, the farmer told how he fell into the river.

14. Where did the farmer fall?

a. into the feed

b. into the river

c. into the tower

15. To his wife, the senator stated that he wanted to vote.

15. What did the senator want?

a. to fence

b. to vote

c. his wife

16. After he greeted his father, the brother told how he called his fiance.

16. Who did the brother call?

a. his father

b. his fiance

c. his board

17. When the uncle painted the cottage, he told how he camouflaged the yard.

17. What did the uncle camouflage?

a. the branch

b. the yard

c. the cottage

18. After the monks worked the garden, they told how they sprayed the chapel.

18. What did the monks spray?

a. the block

b. the garden

c. the chapel

19. In the oasis, the leader told how he called to the night.

19. To what did the leader call?

a. to the oasis

b. to the caravan

c. to the night

20. As the housewife made the pie, she told how she enjoyed the story.

20. What did the housewife enjoy?

a. the nod

b. the pie.

c. the story

MULTIPLE CHOICE TEST FORM II: The verbatim correct word and two unfamiliar words.

21. While the musicians played the bagpipe, they reported how they laughed at the drums.

21. At what did the musicians laugh?

a. the promise

b. the drums

c. the group

22. When the troops attacked the fortress they told how they blocked the defense.

22. At what did the troops strike?

a. the danger

b. the defense

c. the buildings

23. While the teacher held the book, she told how she grabbed at the apple.

23. At what did the teacher grab?

a. the apple

b. the desert

c. the diamond

24. As the baby held the bottle, he screamed at the toys.

24. At what did the baby scream?

a. the desk

b. the toys

c. the shadow

25. After the stranger found the temple, he related how he buried the coin.

25. What did the stranger bury?

a. the coin

b. the gold

c. the table

26. After the officer served the coffee, she told how she kicked at the sugar.

26. At what did the officer kick?

a. the teeth

b. the sugar

c. the tea

27. After the water destroyed the store, it flooded the valley.

27. What did the water flood?

a. the valley

b. the tent

c. the earth

28. Because the banker lends money, he told how he loves people.

28. What does the banker love?

a. people

b. cars

c. checks

29. After the professor gave the answer, he reported how he scoffed at the evidence.

29. At what did the professor scoff?

a. the effort

b. the evidence

c. the move

30. After the doctor bandaged the arm, he repeated how he examined the blood.

30. What did the doctor examine?

a. the blood

b. the grave

c. the horse

31. Because the witness saw the picture, he told how he retracted his statement.

31. What did the witness retract?

a. the hollow

b. the statement

c. the grain

32. Before the tribe saw the city, they told how they swam the river.

32. What did the tribe see?

a. the horn

b. the city

c. the hospital

33. When the team won the contract, they gained the yacht.

33. What did the team win?

a. the honor

b. the contract

c. the hunt

34. While he was living in town, the prince traveled through the state.

34. Where did the prince live?

    a. in the county

    b. in the country

    c. in the town

35. As the mother called her son, she waved away her daughter.

    35. Who did the mother call?

        a. the son

        b. the meeting

        c. the merchant

36. After the author left the hall, he told how he saw the committee.

    36. What did the author see?

        a. the number

        b. the committee

        c. the objection

37. Since the accountant instructed the course, he told how he explained the taxes.

    37. What did the accountant explain?

        a. the taxes

        b. the nut

        c. the note

38. As the thief saw the boulder, he told how he pushed the bird.

    38. What did the thief push?

        a. the post

        b. the boulder

        c. the press

39. At the fire, the firefighter told how he covered the produce.

39. What did the firefighter cover?

    a. the principal

    b. the smoke

    c. the produce

40. In the class, the student told how she watched the jack.

    40. What did the student watch?

        a. the jack

        b. the job

        c. the production

This exercise is divided into two (2) parts. Part I is Completion. Part II is Multiple Choice.

PART I: COMPLETION

DIRECTIONS: WRITE THE CORRECT WORD IN THE BLANK PROVIDED.

1. Before the speech the mob shouted at the _____.
2. Among the shelves the clerk described how she stacked the _____.
3. In the bank the teller told how he trained the _____.
4. Wherever disease strikes the cattle it diminished the _____.
5. At the church the youth told how he marched in the _____.
6. In the store the temperature was seen to drop before the _____.
7. In the summer the artist shows how he draws _____.
8. In the sun the women told how they dried in the _____.
9. In the journal the man told how the dollars increased the _____.
10. In the ballpark the coach told how he coached the _____.
11. In the museum the dog remembered how he drove the _____.
12. Due to the law the maid told how she spoke to the _____.
13. In her ear the editor told how he whispered to the _____.
14. Under the glass the egg rolled until it hit the _____.
15. In the letter the lie was written to simulate the _____.
16. In the newspaper the heroes told how they surprised the _____.
17. At the players demand the guard told how he contacted the _____.
18. In the race the queen told how she shot the _____.
19. In the shop the lady told how she dropped the _____.
20. In the bay the model told how she recited the _____.

MULTIPLE CHOICE: CHOOSE THE CORRECT ANSWER AND MARK THE LETTER ON THE ANSWER SHEET SIDE 1.

DIRECTIONS: THE INSTRUCTIONS ARE ON SIDE 2 OF THE ANSWER SHEET. OMIT THE LOWER LEFT HAND SECTION AND NAME ON SIDE 1.

1. At what did the prisoner look?
   a the seal
   b. the prison
   c. the palace
2. At what did the people shout?
   a. the play
   b. the parent
   c. the wind
3. At what did the musician laugh?
   a. the promise
   b. the drums
   c. the group
4. What did the troops strike?
   a. the danger
   b. the defense
   c. the buildings
5. At what did the pupil whistle?
   a. the sign
   b. the sky
   c. the school

6. Where did the star sing?
   a. in his study
   b. in the theater
   c. in the snow
7. At what did the teacher grab?
   a. the apple
   b. the desert
   c. the diamond
8. At what did the baby scream?
   a. the desk
   b. the toy
   c. the shadow
9. Over what did the sister triumph?
   a. the song
   b. the trouble
   c. the union
10. Toward what did the ship rush?
   a. the shore
   b. the Atlantic
   c. the wake
11. What did the stranger bury?
   a. the coin
   b. the gold
   c. the table
12. At what did the officer kick?
   a. the teeth

b. the sugar

c. the tea

13. What did the water flood?

a. the valley

b. the tent

c. the earth

14. Where did the sailor run?

a. to his room

b. to the railroad

c. to the wheel

15. For what did the slave struggle?

a. to stay sleep

b. to stay awake

c. to stay silent

16. What does the banker love?

a. people

b. cars

c. checks

17. At what did the professor scoff?

a. the effort

b. the evidence

c. the move

18. What did the woman circle?

a. the search

b. the wolf

c. the treasure

19. How did Washington worship?

    a. with his teaching

    b. with a soul

    c. with a Christian

20. What did the doctor examine?

    a. the blood

    b. the grave

    c. the horse

21. What did the witness retract?

    a. the hollow

    b. the statement

    c. the grain

22. What did William lose?

    a. his person

    b. his will

    c. his wealth

23. Where did the Spanish travel?

    a. to the east

    b. to the south

    c. to the west

24. What did the tribe see?

    a. the horn

    b. the city

    c. the hospital

25. What did the team win?

    a. the honor

b. the contract

c. the hunt

26. At what did Virginia look?

a. the map

b. the university

c. the wall

27. Where did the farmer fall?

a. into the feed

b. into the river

c. from the tower

28. Where did the prince live?

a. in the county

b. in the country

c. in the town

29. Whom did the mother call?

a. the son

b. the meeting

d. the merchant

30. What did the senator want?

a. to party

b. to vote

c. his wife

31. Who did the brother call?

a. his father

b. his fiance

c. his board

32. What did the author see?

    a. the number

    b. the committee

    c. the object

33. What did the accountant explain?

    a. the taxes

    b. the nut

    c. the note

34. What did the uncle camouflage?

    a. the branch

    b. the yard

    c. the cottage

35. What did the monks spray

    a. the block

    b. the garden

    c. the chapel

36. What did the thief push?

    a. the post

    b. the bird

    c. the press

37. What did the firefighter cover?

    a. the principal

    b. the smoke

    c. the produce

38. To what did the leader call?

    a. the oasis

b. the caravan

c. the night

39. What did the student guard?

a. the jack

b. the shop

c. the class

40. What did the wife enjoy?

a. the nod

b. the pie

c. the story

CORRESPONDENCE SENT TO "MULTIPLE CHOICE TEST CONSTRUCTION" COMMITTEE

August 5, 1979

Dear Colleague:

RE: Study/Multiple Choice Test Questions Conversation

The design for my dissertation requires, as you know, a committee to construct sixty study questions to present to the students participating in the "Mental Imagery" experiment.

Thank you for consenting to be one of the committee members who will construct the study sentences and the subsequent test. To help clarify how the sentences are to be formulated, you've agreed to meet at 2:00 p.m. on Wednesday, August , in the Counseling Test Room.

I hope the study sentences and the test can be completed so that the test can be administered early in the semester before the students are exposed to my rather visually laden instruction methods.

Thanks again, Yours,

Antoinette Fuhr Harrison

STUDENT RELEASE FORM

I hereby give my permission to be tested in Library Media 3443.

I understand that the results of this testing will not be made available to me except by written request and that the information provided will be screened by a qualified faculty member whose decision on what information to be devulged will be final.

Participation is entirely voluntary and knowledge of this participation will be made available to any person I so indicate.

Signature of Examinee: _____

Signature of Examiner: _____

Date: _____